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A Green Core for the Maroon and Gold: Creating a Sustainable Campus Expansion at the University of Minnesota

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A GREEN CORE FOR THE MAROON AND GOLD: CREATING A SUSTAINABLE CAMPUS EXPANSION AT THE UNIVERSITY OF MINNESOTA

A Thesis Presented

by

FRANK J. VARRO

Submitted to the Graduate School of the University of Massachusetts Amherst in partial fulfillment of the requirements for the degree of

MASTER OF LANDSCAPE ARCHITECTURE

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Master of Landscape Architecture
A GREEN CORE FOR THE MAROON AND GOLD: CREATING A SUSTAINABLE CAMPUS EXPANSION AT THE UNIVERSITY OF MINNESOTA

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DEDICATION

To Amy, for helping me stay sane during this process, giving me inspiration, and helping me finish this project
I would like to thank my committee members Mark Lindhult and Jack Ahern for guiding me through this process. Thank you to Brother Alphonsus Martel, who helped me to see my love of landscape architecture. Thank you to my family for supporting me throughout my education with cookies, e-mails, and persistent phone calls to motivate/harass me into finishing this project. And thanks to Amy Verel for helping me at every turn of this project and helping me to make the decisions I needed to make when I didn’t want to.

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ABSTRACT

The sustainable design movement has been one of the most influential trends seen in the last 10 years. This movement is still seen by the public at large as something that is difficult, ugly, and rural. Creating a showpiece project in an urban area allows these myths to be dispelled through education. This project focuses on a proposed design for an 80 acre campus expansion of the University of Minnesota, Twin Cities. This site has many advantages including a location in an urban core, a Big Ten football stadium that would attract national attention, and a local population made up of many impressionable students. By creating a design that fits in with the existing campus, but also treats stormwater, creates a regional transportation node, collects solar power for use on site, and creates areas of habitat including a greenway, the project would show any visitors that sustainability can be beautiful, functional, and located in urban areas.

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CONTENTS

ACKNOWLEDGEMENTS ........................................................................................................ vii

ABSTRACT .......................................................................................................................... ix

CHAPTER

I. INTRODUCTION ........................................................................................................... 1
   A. Focus Issues ............................................................................................................. 2
   B. Site Selection .......................................................................................................... 3
   C. Goals and Objectives ........................................................................................... 6

II. RESEARCH
   A. Campus Planning ................................................................................................. 13
   B. Urban Sustainability ............................................................................................. 15
   C. Stormwater Best Management Practices ......................................................... 16
   D. Greenways .......................................................................................................... 19
   E. Case Study: Westergasfabriek ......................................................................... 20
   F. Site Visits ............................................................................................................ 23

III. METHODOLOGY ....................................................................................................... 26

IV. APPLICATION
   A. Analysis ................................................................................................................ 33
   B. Design .................................................................................................................. 42

V. CONCLUSION ........................................................................................................... 84

BIBLIOGRAPHY ............................................................................................................ 92
I. Introduction

The most influential design movement in the last ten years is the sustainability movement. It is being seen worldwide on projects of all scales, from private gardens to the Olympic Stadium Proposed by Chicago for the 2016 games. Part of the new strength of the movement comes from the perceived threat of global warming, but it also is gaining a foothold because, even if global warming is ignored, cleaner air, water, soil, and food are gaining importance in our society, and people are starting to see the effect that a single person can have on the ecological problems faced today.

In urban areas, the design movement has been most strongly embraced overseas, especially in Europe, where some cities are doing tests on sustainable design alternatives for their infrastructure, and large companies are having urban headquarters built with sustainability in mind, such as Daimler did at Potzdamerplatz in Berlin. In the US, most sustainable landscapes are being designed in suburban areas, or at the least outside of the urban core. Part of this is due to the fact that, in areas with new development, sustainability seems to many as being as easy as marking an area of nature, not touching it, and letting it be. In contrast, in urban areas it seems impossible to many to create a natural area in a sea of asphalt and concrete. In the US it is also seen as a cost issue. With our abundance of open land outside of urban areas, it as seen as inefficient to try to force “natural” areas into already developed urban cores, when it could be placed a few miles away with little work and cost.

The other issue is that many Americans still are unfamiliar with the wild look of natural areas, and do not appreciate the aesthetics of it, where those who live in the suburbs moved to a place that looks, at least in theory, natural, so they have more of an appreciation for the appearance of things like prairie grasses. Both these issues can be helped by creating a new sustainable development in an urban core. By creating a new project as an example of sustainable, beautiful, urban design, people would learn both to appreciate the aesthetics of sustainability more, and also that sustainability can be achieved in a dense urban area.
In designing a showpiece project for urban sustainability, there are three main issues that must be addressed, as they will be seen in the majority of similar projects. They are the multiple aspects of urban sustainability, urban greenways, and public education about the project and sustainability. If all these aspects can be addressed by this example project, any future practitioners will have a place to work from, instead of starting from scratch.

Focus Issues

Urban Sustainability
The first main issue to address, and the core issue for this project, is urban sustainability. There are several definitions for sustainability, and all of them involve wide ranging subjects. Regardless of the definition used, most landscape projects that strive for sustainability will try to address stormwater quality, biodiversity, reduced landscape maintenance, and transportation networks. In addition, issues such as alternate energy sources, and use of local materials can be addressed, and will be addressed in this project.

Urban Greenways
One of the main ways to improve urban biodiversity is by increasing connectivity to natural areas. This is often done by creating “green fingers”, or greenways, that reach from large natural habitats into the urban core, allowing a passageway for animals to move into and out of the urban natural area. The other advantage to greenways is they create opportunities for people to move from the urban core out into the natural habitat, experiencing nature while remaining closer to home. The increased interaction this recreational corridor adds increases awareness of natural processes, and many think is also an increase to quality of life.

Education
Increasing awareness is only one of the educational goals a sustainable showpiece project should strive for. A sustainable project should also balance low maintenance, ecologically functional plantings and design with aesthetically pleasing design. Showing the public that sustainable design can also be beautiful design is one essential to making
it something people want built in their own yards. Another important method of educating is by making ecological processes visible to the public. This both serves to inform people how the landscape works, and along with native plantings, also gives sustainable design part of its style. The final method of education is through signage. While not always the preferred method, as it pulls the public out of the experience of the landscape, and demands their full attention, it is sometimes necessary to pass along detailed information. For instance, while people will learn some simply by seeing bioswales, if you want people to learn how to create their own rainwater garden, signage is needed to explain the vital components.

Site Selection

As mentioned earlier, one of the advantages to creating sustainable projects in urban areas is the increased traffic to the project, increasing the number of people who can learn from it. Choosing the right site in an urban area is also important, as some sites (building plazas, courtyards) will only be seen by a select few, even though they are in urban areas. For a showpiece project, a high visibility site, with varying visitors, would be the preference. A public building with a plaza would work well, as would a stadium, or some sort of community gathering space.

One such place would be a University. It both serves a large number of people, but has the added advantage that, as an institution for learning, people are more willing to look at a university site and see it as something they can and should learn from. Colleges and universities have been seen as the core of our worlds knowledge, especially in the hard sciences. At times, they have been places where new design ideas can take center stage, as seen at Illinois Institute of Technology in Chicago, and the Weisman Art Museum at the University of Minnesota, among others. An urban university campus fills the site needs for a showpiece project perfectly.
The issues faced when designing for a university are not terribly different from those faced when working in any community. You are dealing with a community with an established sense of place, and a design character. You must balance the new sustainable design trends with the existing design themes in order to create a place that both belongs with the rest of the University, but also stands apart and has its own character. You do, however, gain the benefit of having your showpiece site at a university, where impressionable students who are open to learning can appreciate the site, but also visitors and community members often visit and can experience the design as well. You also have a community more willing and able to maintain and monitor the project over time. The trick is finding an urban university with enough open real estate that it could be developed to a noticeable scale. One school in just such a situation is the University of Minnesota- Twin Cities.
Sitting on either side of the Mississippi, just a mile east of downtown Minneapolis, the East and West Bank Campuses are the epitome of an urban campus. Located on the main arterial road that connects the downtowns of the two Twin Cities, they will soon have a light rail line crossing them, and passing through the site, and the site sits near two interstate highways, creating one of the largest potential traffic nodes in the metropolitan area. The East Bank campus also happens to have just completed a new 50,000 seat football stadium on campus. Surrounding this stadium is a planned 80 acre campus expansion. Given the surrounding urban fabric, the proximity to the Mississippi River, the large proposed development, and the increased traffic and attention that the area will be getting as the home for a Big Ten football program, this site would be ideal for a showpiece project.
Goals and Objectives

This project has three primary goals:
1. *Create a Site Design Anchored in Sustainability*
2. *Create a Site That Teaches About Sustainability*
3. *Create an Area That Functions as Part of the Campus*

By fulfilling these goals, this project will be a Successful design. It will be an example of sustainability in an urban area that fits into its surroundings and teaches the public about what it adds to its surroundings due to its improvements to the environment. For each goal, there are the following objectives, and design guidelines:
1. Create a Site Design Anchored in Sustainability

- *Create an effective transportation node.* One of the fundamentals of sustainability is reducing energy and fossil fuel use. One of the ways to promote public transportation is by creating places that make either moving from private transportation to public transportation or moving from one type of public transport (bus) to another (lightrail) easier. If a node can be created that unifies all available transportation means, it should increase the use of alternative modes of transportation. This can be accomplished through the following design guidelines:
  
  - *Concentrate nodes for all transportation methods (car, bus, lightrail, bike, pedestrian) in one area to allow ease of cross-use.*

  - *Create amenities needed to facilitate movement between nodes*

- *Use Sustainable Energy Sources.* By using alternative energy sources on the site, two things are accomplished. First, traditional energy use is, of course, lowered. This saves the University money, and it saves on non-renewable resources that are currently used for the majority of power generation in the Twin Cities area. The second thing that will happen is that it will serve as an example to the public that alternative energy is a viable option on a small scale.

  - *Use Solar Panels to Power Pedestrian Lighting and “Unnecessary” Landscape Features like Fountains*

- *Reduce Heat Island Effect.* The urban heat island effect is a localized climate change seen in all major urban areas. It has the effect of both raising temperatures in the day, and lowering temperatures at night. It also creates a heat bubble that surrounds cities, effecting precipitation patterns in the local area, and at times holding polluted air in the city, where it can have negative effects on the population. There are a few well-established means of fighting the heat island effect on a site scale.
- Utilize Green Roofs to Mimic Forest Canopy
- Use Light Colored Pavement Materials Where Possible
- Parking Ramps Paved With Light Material
- Surface Lots Paved With Light Material or Turf
- Increase Tree Canopy

- Change the Hydraulic Curve of The Site to Come Closer to Pre-Settlement. Urban areas have a problem with Stormwater, as it runs through pipes to bodies of water nearly instantly instead of infiltrating and moving as ground water. This causes problems with increased pollution, increased water temperatures, and higher flooding risk with lower normal water levels. If stormwater can be controlled in a means that is more similar to natural processes water quality levels increase dramatically.
  - Minimize and Delay Runoff from Roofs Using Green Roofs
  - Minimize and Delay Runoff from Paving Areas Using Porous Paving
  - Clean and Delay Runoff by Moving it Through a Series of Stormwater Best Management Practices (Bioswales, Infiltration Basins)

- Increase Biodiversity and External Ecological Links. One of the most important things to create true sustainability is to increase biodiversity. With increased Biodiversity there are more animals and plants available to fill any niches that become vacant. It also allows for outside animals and seeds to come into the site to supplement falling populations, and add genetic variation to formerly isolated communities.
  - Create a Greenway Connecting the Site to the Mississippi River and the Minnesota River National Wildlife Refuge
  - Create Wetland and Forest Habitats Similar to Those Found Natively in the Region
2. Create a Site That Teaches About Sustainability

- Make Landscape Processes Visible Through Design. The first methods for educating is by doing it through the design itself. This is often very effective as one does not need to go to the effort, or even have the conscious interest, of reading a sign post. Simply by walking through the site and experiencing it certain things should become apparent- That wetland is always full after a storm; This planted area reminds me of the edge of the lake up north; etc. This first step is vital both in increasing awareness, but also in increasing the desire for some to actively do further research.

- Bring Water Movement to the Surface
- Pedestrian Flow to Follow and Cross Water Flow
- Multiple Wetland Areas
- Visible Green Roofs and Solar Panels

- Have Multiple ways to Address Sustainability in All Design Elements. By using multiple elements that contribute to sustainability in any given design element, a few goals are served. First, the obvious features of sustainability will catch visitors attention, and makes many members of the public to wonder what else in the area might be sustainable. It is when they take a closer look that things like weirs, permeable pavement, and local materials become more evident. Second, the more methods of sustainable design used in any given area mean more redundancy and an increased level of sustainability.

- Native Plants When Possible
- Maximize Use of Porous Pavements
- Native/Local Materials
- Visible Transportation Network Interaction
- Combine Green Roofs and Solar Roofs
- Stormwater Best Management Practices
- Signage to re-Emphasize Sustainability Lessons and Outline Methods. Once people realize a site is sustainable, they may want to get more information about what functions a certain area performs, or if it is something that could be done at their house with similar effectiveness. This is where signage is effective.

- Signs to Inform on Effectiveness of Best Management Practices
- Water Quality Testing Stations
- Explain Functional Roles of Greenway and Greenroofs
- Show Energy Derived from Solar

- Design to Evoke Thoughts of Sustainability and Natives While Maintaining Aesthetic Appeal. One of the main things that needs to be brought to the attention of many in the public is that things can be sustainable and beautiful at the same time. Not only can they be beautiful, but sustainability can be far more beautiful than traditional design means at times.

- Use Plants That Provide Mental Link (Cattails), and Also Plants that Provide Commonly Seen Year Round Aesthetic Interest (Big Blue Stem)
- Fountains Use Stormwater and Function Year Round
- Hide Parking Under Turf Camouflage to Show Functionality and Form at the Same Time

- Use the National Attention That a Big Ten Football Stadium Draws. As the Site of a Big Ten Football team, national camera crews are on site for 3-6 weekends a year, every year. This is an opportunity, as before the game, and coming back from most commercial breaks it is standard practice to show shots from around campus, and around town. That means that along with the 50,000 people that file into the stadium those 6 weeks a year, you have the potential to have your design showcased on national television for millions of viewers. Taking advantage of this possibility is a must.
- Create Design that Highlights Sustainability in an Attractive, Innovative Way That Bega TV Cameras to Shoot Video
- Create a Design so Filled with Sustainability That It is Impossible to Miss
- Fill Gateways with Sustainable Design to Grab Attention of Visitors to the Site

3. Create an Area That Functions as Part of the Campus
   - Maintain a Similar Sense of Place to the Existing East Bank Campus. The East Bank Campus of the University has an undeniably strong sense of place. While the West Bank Campus and St. Paul Campus’s both have unique feels to them, they are not dissimilar to the feeling you get in the East bank. In order for the expansion campus to feel like it is part of the University, a certain amount of that sense of place must be present. And as it is directly adjacent to the East Bank, it will likely need to be more similar in feel then either of the other campuses. There are a few simple ways to start down the right path.
   - Maintain Use Of Materials and General Architectural Elements
   - Similar Figure Ground Layout and Building Massing
   - Create Areas That Are Similar in Feel to Established Iconic Campus Areas

   - Create a Functionally Effective Campus. As a campus area that in summer will serve mostly commuters as a park-n-ride, during school as a home, workplace, and educational facility, and on Saturdays as the center of University life, the campus expansion will have to be designed in a way that it can thrive in all of these diverse use conditions.
     - Create an Area That Functions on Game Day, School Days, and In Summer
     - Create Effective Pedestrian and Vehicular Traffic Patterns
- **Connect to the East Bank, Dinkytown, Stadium Village, St. Paul Campus, and Both Cities.** To ensure that the site is used by a variety of users, connections to all of the local area attractions is important, as people will be coming to the site and from the site non-stop both on school days and game days. By insuring that you can get from the site to anywhere without trouble you greatly increase the chances of people seeing it as a viable core of activity.
- **Create Gateway Areas to East Bank, St. Paul Shuttle Route, University Ave., and Stadium Village**
- **Create a Greenway that Extends Through Dinkytown and Towards Minneapolis**
II. Research

Campus Planning

I started my research by looking into campus planning. The article that most influenced my decisions was “Some Thoughts on History and Campus Planning” by Paul Turner in Planning for Higher Education. Throughout his article Turner uses many examples to point to one simple fact: the quickest way to make a failure of a campus expansion plan is to ignore, or be in someway ignorant of, the original campus masterplan and its intentions. While you don’t need to follow the campus master plan blindly, you need to stay conscious of the original idea, and the existing campus, and work to ensure that the new area maintains the spirit of place that the original campus. Doing this will ensure that people feel comfortable in both areas, and students have one more stress removed when moving between areas.

Educating By Design: Creating Campus Environments That Work by C. Carney Strange and James H. Banning was useful in providing insight into some of the key factors to keep in mind in creating a campus that is highly functional. First there is the fact that the physical environment can communicate non-verbally far stronger than any person can communicate verbally. The example Strange and Banning use is of a family attending a commencement ceremony that is being held in a sports arena. While the students and attendees have been told to be respectful, the physical clues of the building that it is a place for rowdy and loud crowds (scoreboards, logos, etc.) override the instructions they receive. This idea is very important to keep in mind for this project because the East Bank campus currently is designed in such a way that it has physical clues of a classic university. Maintaining some of these clues will be key to maintaining that educational spirit of place.

Another point Strange and Banning make is that a perception of pedestrian safety is a requirement. There are a few aspects to this that effect campus planning; because it is important to minimize areas where there is what Strange and Banning call “low prospect,
high refuge, or poor escape”. Low prospect areas are places where pedestrians have low visibility, often due to darkness (or conversely, glare), elevation changes, blind corners, or eye-level vegetation. High refuge areas are places where potential assailants can easily hide, whether it be behind corners or in tall, dense brush. Lastly, poor escape areas are places where if someone is in a situation where they are trying to get away from a pursuer, they do not have multiple possible routes to take, increasing the risk of being cornered. By keeping these threats in mind a safer, more friendly campus can be created, and crime can be reduced.

The final safety aspect goes hand in hand with another point they made – direct walking access between buildings. If people feel like they have to go out of their way to get between two places, they will make it known, often by creating their own direct path. These “cow paths” then serve to signal other students that the University A) doesn’t care enough about their campus to take care of it or B) doesn’t care enough about its students to value their time. Neither is a positive outcome.

Blake Gumprecht, in his article “The Campus as a Public Space in the American College Town” in the Journal of Historical Geography, speaks about many aspects of the historical role the university/college plays in a rural area, with the University of Oklahoma serving as his prime example. One of the roles the college campus plays in a rural area is as a cultural center for a small town. Often a college or university will have the monetary resources, as well as facilities necessary, to attract outside groups from musical acts to plays and art exhibits. While this is often true of schools in small towns, Gumprecht states that it is not as important for these functions in a metropolitan area, as these areas have many cultural resources already. One of the ways the University of Minnesota stays influential culturally in the Twin Cities is through their sports programs, which are centered in the area of the new campus expansion. That injects this new campus area with a lot of local cultural importance before it is even built. I wanted to think of another way I could keep the area impactful to the local area, especially during the summer, when classes are out of session, and sports are on a break, but the outdoor areas of the site are best suited for use in the Minnesota climate. This is one of the
reasons I thought to create a transportation hub on the site. It both will serve a sustainability function, but also a function of further bringing the University as a whole into play as a cultural resource to the local area.

**Urban Sustainability**

Charles Eason, Surya Pandey, Clare Feeney, Marjorie can Roon, and Jenny Davis give a general overview of the current issues and knowledge on the subject of urban sustainability in their paper *Low Impact Urban Design and Development: Making it Mainstream*. Much of the paper gives and overview of the popular best management practices (BMPs) in sustainable design projects, and talk about some of the studies that have tested these BMPs’ effectiveness. The paper specifically addresses Low-Impact Urban Design and Development (LIUDD), similar to Low-Impact Development (LID) that is commonly mentioned in the US. The main difference appears to be that LIUDD has more of an emphasis on development patterns and overall planning than LID traditionally does. This served as a very good overview of urban sustainability, although its title was a little deceiving, as it has little to do with making urban sustainability something that the public both understood and desired, one of the main goals of my project.

One interesting test project I found data for was written up by Edgar Villarreal and Annette Semadeni-Davies Lars Bengtsson in “Inner City Stormwater Control Using a Combination of Best Management Practices”, published in *Ecological Engineering*. An area of Augustenborg, a suburb of Malmö Sweden was fitted with green infrastructure BMPs, such as greenroofs, vegetative swales, and detention basins. The designers were concerned with possible water damage from infiltration, so all BMPs were underlined with geotextile fabric that prevented infiltration. Thus the only water that left the site in ways other than through a pipe left through evapo-transpiration. The other twist to this project is that water quality was not a concern, only water volume and hydraulic time of concentration. The project mainly showed that a combination of BMPs serves to both increase the diversity of treatment/detention types, essentially creating redundant systems.
that would not be prone to failure in similar conditions, and as a way to have a large environmental effect with minimal aesthetic impact.

Katie Williams and Carol Dair say things similar to what Strange and Banning said in their article “A Framework of Sustainable Behaviours That Can be Enabled Through the Design of Neighbourhood-Scale Developments” published in Sustainable Development. The main point of the article is that there are two types of sustainability to be looked at. People traditionally only look at what might be called technical sustainability, or implementing BMPs for sustainable purposes. Often the behavioral side is forgotten, however, and it is at least as important. Creating a culture that recycles, takes public transportation instead of cars, and even turns off the lights has a large effect as well. Williams and Dair argue that while some ideas that are behaviorally sustainable are directly linked to the built environment (bike trails, for instance), other behavioral things can be affected by the built environment as well. It goes back to Strange and Banning’s talk of the non-verbal communication of a design effecting peoples behavior. It emphasizes the importance of not designing a place that is sustainable but looks like everywhere else, but of designing a place that is overtly sustainable, while encouraging people to act more sustainable.

**Stormwater Best Management Practices**

I started looking at Stormwater BMP data by looking at “Performance of Vegetative Controls for Treating Highway Runoff” in the Journal of Environmental Engineering. Michael Barrett, Patrick Walsh, Joseph Malina Jr., and Randall Charbeneau ran water quality tests on grassy medians along two different stretches of highway in Texas. They found that by running the water through lawn grasses there can be a big impact on some of the key pollutant loads in stormwater: Total Suspended Solids, Organic Carbon, Nitrogen, Phosphorus, Zinc, Lead and Iron. The only areas tested that they found an increase in negative numbers were in fecal coliform and fecal strep counts, likely due to animal droppings, even in the relatively isolated highway medians. The most interesting thing they found, however, was that little cleaning was done along the length of the
swale. The majority of cleaning was done on the side-slopes of the swales, as the water sheet-flowed across what essentially is a vegetative filter strip.

“Low-Impact Development: An Innovative Alternative Approach to Stormwater Management” in the Journal of Marine Science and Technology was written by Chao-Hsien Law, Mow-Soung Cheng, and Tao-Lung Tsai. This paper gets into some of the fine details of what BMPs are most effective at working towards the various goals of Low Impact Development. The first thing they talk about is that a single large-scale BMP is almost never effective in cleaning the water, reducing the volume, and delaying the time of concentration to pre-settlement levels. Part of LID is creating many smaller BMPs spread out over a large area, so that instead of treating all the water for an eighty acre site in one large pond, you make small treatment areas that only have to clean water from a few hundred square feet. This both makes the site more sustainable on a fine scale, and also reduces the threat of catastrophic failure. It is also beneficial to spread these out as you can tailor the treatment type based on the conditions, putting infiltration basins in porous soils and impervious surfaces in areas where the soils is also impervious. On a design level, this setup is also more similar to naturally occurring conditions.

To restore predevelopment time of concentration they recommend slowing water flow to the speed it would have been pre-development through reduced slopes and diverted paths, increased surface roughness through vegetation and swales, detaining flow, and reducing areas where water flows over impervious surface. To reduce total volume, the BMPs they recommend are rain gardens, infiltration swales, retention ponds, green roofs, and irrigation ponds. They also recommend the use of swales with check dams and constructed wetlands and ponds as a way to add storage and infiltration possibilities if available space is an issue. Lastly they speak to the fact that for these ideas to gain a foothold on an individual homeowner level, when people are educated about the design techniques they must also be educated about the various maintenance needed for the different BMPs to remain effective.
“Long-term Stormwater Quantity and Quality Performance of Permeable Pavement Systems” in *Water Research* is Benjamin Brattebo and Derek Booths look at the efficiency of alternative pavement types built by Booth and Leavitt six years prior. In the nine parking stalls they compared two stalls with Grasspave, two with Gravelpave, two with Ecostone, two with Turfstone, and one asphalt control. The stalls were located in the parking lot for a public works facility in Washington where they would get consistent weekday parking. The different treatments did vary in how they reacted to wear and tear, as the Grasspave showed some spotty grass growth and the plastic structure shifted slightly out of the soil in the area under the rear tires of parked cars. Grasspave was also showed the most runoff of any alternative pavement. Most of the runoff showed up during working hours, when cars would have been creating impervious surface for the rainwater with concentrated sheet-flow off the car onto the Grasspave. One of the two instances where the Grasspave showed runoff was during the heaviest rain event of the study, with 121mm of rain resulting in 4mm of runoff, for a total infiltration amount of 97%.

Gavin Birch, Vasrsten Matthai, Mohammad Fazeli, and JeongYul Suh wrote “Efficiency of a Constructed Wetland in Removing Contaminants from Stormwater” for *Wetlands*. This article focused on stormwater water quality testing for a constructed wetland in Sydney, Australia. They found that, similarly to the swale tests mentioned earlier, the wetland was good at removing some contaminants, but seemed to add other contaminants. The group found that while the wetland was removing most trace metals moderately well, it was more efficient when in average storm events and smaller, while large storm events noticeably reduced efficiency, as would be expected. Fecal counts did rise in the wetland, however it is believed this is in part due to a dog park adjacent to the wetland, and in part due to possible Combined Sewer Overflows upstream of the wetland in high-flow storm events. Unfortunately, they did not perform proper testing to verify a point-source of the fecal coliform.
“Sustainability and Urban Greenways: Indicators in Indianapolis” by Greg Lindsey is an article in the APA Journal that speaks about the greenway systems in Indianapolis and their success in meeting five goals. The goals established by the 1994/1999 master plan are: provide recreational opportunities, protect wildlife habitat and promote open space conservation, link neighborhoods with each other and assets, and becoming an economic asset by promoting development. While this project also focuses on wildlife, open space, and neighborhood links, this project focuses on education more than economics. The Indianapolis greenways did a good job at linking neighborhoods and creating increased access to community assets, as they are designed in a way that allows for easy movement through the corridor. The study found that the weakest aspect of the greenways was in fact their environmental sustainability. This is largely based on the facts that the makeup of the riparian forest is dissimilar to traditional mature riparian forests in the same area, and that there was a danger of invasives taking over in the same forest areas. Lindsey does not discuss possible causes for these problems, however, so it is more important as a reminder of possible problems in the future of the design.

One paper that worked as an overview on things to consider when creating greenways that will also be public open space was written by Clive Briffett in Landscape Research. “Is Managed Recreational Use Compatible with Effective Habitat and Wildlife Occurrence in Urban Open Space Corridor Systems” touches on a greenway’s ability to function with people, and more about how to design a greenway that will function in general. On of the important points he makes in regard to this project is that narrow greenways that have limited diversity can still function successfully as wildlife corridors when they are of limited length, and serve as a thread to connect two larger habitat areas. It also mentions several important design features to consider in a recreational greenway such as the fact that corridors should be as continuous as possible to allow for movement, and that pathways should be well defined and well lit to prevent vandalism and pedestrian damage to the environment surrounding the path.
The final paper I used in regard to greenways was “The Human Dimensions of Urban Greenways: Planning for Recreation and Related Experiences” by Paul Gobster and Lynne Westphal, found in Landscape and Urban Planning. This study of public opinion around the Chicago river has some important insights into the public’s thought process on what makes a habitat healthy. Many in this study felt that the “cleaner” a habitat looks, whether it is through reduced underbrush or clear blue river water. This study was based on data taken in the early 1990s, so while it is likely that many in the public have learned a more accurate picture of healthy landscapes, there are some people who will see what is actually a healthy wetland as an area that needs maintenance. The fact that there are those in the public with similar views means that you must include visual clues that the area is maintained if a key element of it, such as a wetland or a swale, is going to look messy to some people.

Case Study: Westergasfabreik Park, Amsterdam, Netherlands

As part of my research for this project I studied and visited Westergasfabreik Park in Amsterdam. Westergasfabreik sits on the site of a former coal-to-gas conversion plant to the west of Amsterdam’s city center. After being shut down in 1960, the owners used the land for storage until 1990, when the majority of the sites buildings were named industrial monuments. For the next ten years the site was in limbo as the local government attempted to get a developer to buy and build on the site. Finally in 2000 a willing developer came on, and held a private design competition for the redevelopment. Gustafson Porter was chosen as the landscape architect, and the project was started in a series of phases. After numerous delays due to far worse contamination then was believed to exist on the site, the park and buildings were finished in 2006.
This site is one of the best examples of brownfield redevelopment in the world, as it took a highly degraded site, and used private funds to create an area that is both economically and culturally vibrant, and is now seen as a key asset in the city. It also managed to create a sustainable landscape design while sitting on capped polluted land. It does this through collecting the stormwater, letting its suspended solids settle, and then moving through a series of pools where different plants clean and use much of the water. Finally it moves through a small stream where it is aerated and then some water is piped back up to be cleaned again, and some flows off into a nearby canal. One of the parks main successes, and where it strongly influences this project, is in its ability to clean stormwater in a way that is both aesthetically pleasing and also obvious to the public. This ability to bring the underlying landscape processes to the surface is key to creating a sustainable site that is educational as well.

Part of the success of the design is due to the fact that in the earlier stages of the cleaning process, the pools and wetlands are very angular and obviously designed, and as the water moves downstream and is cleaned, the treatment take on a look that becomes more naturalistic. This visual clue of a transition from artificial to natural helps to reinforce the cleaning process in the publics mind. The very fact that the water starts by flowing
through obviously human designed wetlands, and ends flowing in a naturalistic stream is a clue that something is happening during the waters journey from one area to another.
Site Visits

I also visited a few other sites for information during the process of the design. One of the places I went was the University of Connecticut Football Practice Facility. This site, across the street for the UConn football stadium, is designed with a sustainable landscape. It includes porous pavements, bioswales, and infiltration basins. One of the most useful things this visit provided me with was the ability to see how a landscape can be built on a major campus, in a high visibility area, and look well kept and also sustainable. One of the things that is very effective is the combination of native plantings and bioswales located next to an entry plaza that is ornate, with the school crest created with pavers. This juxtaposition seems to be very effective both in calling more attention to the sustainable aspects of a design, but also to let people know that it is a well cared for site. The presence of the sustainable plantings will also alert some visitors to the fact that the ornate paving is in fact porous. This project is smaller in scale than mine in many ways, but it was still an instructive experience.

Uconn Football Facility
I also visited the mall at the Minnesota State Capital in Saint Paul. The mall is home to numerous memorials for everything from the civil rights movement, to women’s suffrage, Charles Lindbergh, and the first American gun fired in World War II. Visiting all of these memorials, seeing how various designs and locations effected their spirit of place, and seeing how they were located relative to their surroundings was useful. Many of the memorials were very visual, with some obvious clues to meaning included. They also often used a lot of materials from Minnesota and used native vegetation to help enclose them for privacy and increased sense of defensible space. I can also attest to the fact that a few of the memorials were adjacent to walking paths, and the instant anyone walked past on their way from lunch, you were pulled out of the memorial and back into a public park. Another thing I also noticed was that while many of the non-war based memorials were dedicated to those who worked to make a movement a success, and lived to see its benefit, war memorials focus on those who died in the process.
Lastly, I conducted multiple visits to the site itself. While I attended school at the University, I only occasionally parked in the lots where the stadium is now located. My broadest experience with the area was on one of the shuttles moving from the East Bank to the Saint Paul campus every day for classes. I also was so caught up in the experience of attending school there that I never really critically looked at the campus and why it created the spirit of place that it did. By visiting both the site itself, and the campus as a whole, I was able to gain more insight into what gives the East Bank campus its feel, and what the site is like from an outside perspective.
III. Methodology

I came into this project with a fair amount of knowledge already amassed. From a site perspective, I grew up in the Twin Cities, and visited the University often, before attending for my junior and senior year of college. This gave me intimate first hand knowledge of the site and the university as a community member and as a student. From a research perspective, I have taken multiple classes that gave me knowledge that I used during the process of this project, both in my Undergraduate and Graduate career.

To work on this project effectively I preformed research in a few different areas. I started with a focus on Campus Planning to ensure that my overall design would fit in with the existing school. I then moved down in scale to Sustainability in general, and then sustainability in urban areas. I then researched existing Stormwater Best Management Practices to see if there had been any major breakthroughs since I had done the majority of my related coursework. I also visited the University of Connecticut’s football practice facility- which has a landscape designed to infiltrate/store much of its stormwater, the Minnesota State Capital Mall- which has a large variety of memorials for various wars and causes, and Westergasfabriek in Amsterdam- which is a large scale sustainable brownfield redevelopment.

Once I completed the research regarding the overall issues of the project, I moved to researching the site itself. This included reading the University’s Environmental Impact Analysis, and doing GIS research into context and historical vegetation. I visited the site multiple times while working on my project both to inspect the site and look for any differences between the site plans and what was on the ground, and to take site photos. I also researched the history of site and the university. Lastly, I looked at the University’s own proposals for the design for the 80 acre expansion.
I then contacted the University’s facilities department and received a copy of their AutoCAD file that contained: the existing conditions, the new survey they had done over the entire site, and one of the University’s proposed layouts. This layout included the new stadium, a basic building layout, and the new road alignments, which were consistent in all of the University’s proposals. I used their road layout and stadium alignment, as work on the roads and the stadium had begun at the time when I started working on the design phase of the project.
Using the new road layout and the stadium as an addition to the existing conditions, I completed an analysis of the site. This analysis, which will be included in detail later, involved looking at the campus as a whole, including the existing East Bank campus. Doing this allowed me to insure that the expansion area would be designed not as a separate place, but as a part of the larger whole. I looked at drainage, transportation routes, parking, areas of different building uses (athletic buildings, bio-medical buildings, etc), gathering places, iconic spaces that created the campus’s spirit of place, restaurants/food court areas, and the figure-ground. Doing this allowed me to both maintain a similar feel and functionality to the new campus, and to ensure that everyone’s needs would be met as they are on the existing campus. It also allowed me to create building massing that both fit the character of the campus, and that created similar spaces to the existing iconic campus spaces on the East Bank Campus.
Upon completing my analysis, it was clear that there was a great opportunity to create a large scale transportation node on the site. The proposed light-rail line between Saint Paul and Minneapolis is laid out to run not just near the site, but through it, and close to where the shuttles between the campuses run. I used this information, combined with my other analysis data, to pick the location for the transportation node in a spot that puts it equidistant from University Avenue, with its bus lines and vehicular traffic, and the campus shuttle. It is also within a block of one of the stadium entrances. I also blocked off the surrounding area to be for parking, to supply the transportation node, stadium, and the campus itself with the 3,300 parking spots required by the university.

One of the things the University has in their own plans is for the new campus to include an eight to twelve building bio-medical research area. They have already received some federal money for this project, so I wanted to include these buildings in my proposal. Part of the University’s reason for locating these buildings here is because the current bio-medical building is on the site, along the northern edge of the land currently owned by the school, so I was able to easily create a biomedical center on campus. As they bought a large portion of land to the north and east of that building from the railroad, I placed the biomedical buildings along an arc on the northern edge of the site.

Once I had the general locations for buildings picked, I was able to go about filling in other areas with buildings or open space to create massing and spacial layout similar to that of the East bank, while adjusting it to account for the massive stadium that sits at the core of the site. Once I had the rough massing figured out, I then worked on figuring out how to move water through the site, from buildings and paving, through infiltration systems, and, if need be, eventually to the river in extreme storms, via a swale or storm sewers.
After locating the water treatment areas, I programmed the open space. First I looked at the various spaces I needed to include for to allow the space to function well (such as entry areas), spaces I needed to include based on project stipulations (such as a memorial), and areas I wanted to include to enhance the educational function of the space (the green mall, and other areas where people are brought into contact with hydraulic processes). After a rough layout of where these might work, I did some conceptual designs of the focus areas to insure that they would work where I placed them. After adjusting to make sure they would all work as well as possible, I began the detailed design of the focus areas.

My plan renderings were rendered in Photoshop over an AutoCAD plan. The 3D model used for my renderings was made in a multiple step process. First, I used 3D Studio Max and SketchUp to create the stadium model, using sections, plans, and hand drawn renderings provided on the website for the stadium fundraising drive. I then pulled my AutoCAD base file into SketchUp, and used the linework to create a detailed 3D model in SketchUp. I exported the SketchUp model into 3D Studio Max, where I created advanced lighting, and was able to create multi-layered textures in Photoshop to skin my model. I also found images of plants online, and created masking layers for them in Photoshop, and used the original and the masking layer together in 3D Studio Max to create my plants on flat planes. I then rendered the model using ray-tracers and light-tracers.
IV. Application

Analysis

Regional Context

The Twin Cities of Minneapolis and Saint Paul are the home to 696,000 people, with the surrounding seven county metropolitan area home to 2.6 million Twin Cities Metropolitan Area - Statistical Profile). Minneapolis is the federal government’s seat in Minnesota, while Saint Paul is the home to the state government. The Twin Cities also boasts professional football, baseball, and basketball in Minneapolis, and hockey in Saint Paul, along with Minneapolis having the highest per-capita number of theaters in the country. The Minnesota State Fair also takes place on the northern border of Saint Paul, and adjacent to the Saint Paul campus of the University, for one and a half weeks a year, bringing in a record 1.79 million attendees from around the state in 2009 (“Fair Attendance Numbers”).
There are over 18,000 lakes within the state, and 16 inside Minneapolis and Saint Paul. There are also areas of Oak Savannah, Prairie, Wetlands, Deciduous Forest, Coniferous Forest, and the Mississippi river within the Metropolitan area. This creates a strong connection between many Minnesotans and the environment, which is a large benefit when trying to create an area that is environmentally sensitive and get public support for it. This diversity both makes the community more aware of water quality issues than most, and it also makes it an area with a variety of native plants available for multiple situations. The site also currently feeds its stormwater into the Mississippi River, contributing to its degradation. A project that will help reduce pollution reaching the Mississippi will likely find not only support in the area, but the public will likely want to see future projects take a similar approach in the area if the project is a success.
The Twin Cities campus is the original, and largest campus in the University of Minnesota system, which contains three additional campuses around the state. Founded in 1851, the Twin Cities campus actually predates the state by seven years. As the only school in the state that is involved exclusively in NCAA Division I Athletics, the university is the main representation of the state colleges and universities on a national stage.

Local Context

The site is itself urban, placed within minutes, and directly between, both downtown Minneapolis and downtown St. Paul, and adjacent to rail lines and grain silos that are to the north, neighborhoods to the east, Commercial development to the south, and the University to the west. The main bus route between the two cities runs past the site on University Avenue, and there are plans for a lightrail line along the same road by 2012, with proposals for future commuter rail lines going in among the existing rail lines to the north of the site. Interstate 35W runs along the western edge of the West Bank campus, and Interstate 94 runs a few hundred yards south of both campuses and the site. The site is also the entrance to the Minneapolis Campus from the St. Paul campus when using the University’s shuttle system. This creates makes the site into a multi-modal transit intersection, which can be made into a large transit hub, increasing visibility and also being an ecological aid as a transit hub of that magnitude in that location could prove beneficial to ridership on public transportation on a regional level.
A big advantage to being in Minneapolis is that along with smaller greenways, there are a few large greenways in the area: the Chain of Lakes and the Mississippi Riverfront. The Chain of Lakes, found west of the Mississippi, is a series of five natural and man made lakes and surrounding park land that connect to each other and to the Mississippi, and are a highly used asset in the area. The Mississippi River, just over one third of a mile to the south-west of the site, is itself a large greenway, with relatively untouched buffer areas along the majority of its route in the area. The Mississippi River then leads south to its confluence with the Minnesota River. The confluence is the edge of the Minnesota Valley National Wildlife Refuge, a large source of biodiversity for the area.
University Context

The University of Minnesota was founded in 1851 (“General History of the University of Minnesota”), and after a few years moved to its current location, centered on the eastern bank of the Mississippi River in Minneapolis, Minnesota. Starting with a class of 15 in 1857 in a single building, the University’s Twin Cities Campus has grown over one hundred and forty nine years to a total student population of 50,402 on over 350 acres (“Campus and Unit Enrollment”). The campus originally was centered around an area now known as the knoll. Since around 1930 however, the center of the University has been Northrop Mall, an open mall originally designed by Cass Gilbert. The Twin Cities Campus now has three campuses within it, the East and West Bank, on opposite sides of the Mississippi River, which are connected by two pedestrian bridges; and the St. Paul campus, connected to the other two by a dedicated bus system.
Each of the three campuses has a distinct look and feel, even though they all use brick primarily. (There is a rumor that there is a requirement that all University buildings be at least 30% brick, which is why Frank Gehry's Weisman Art Museum has brick covering the two rear facing sides.) The West Bank campus was constructed in the later years of the university, and has a modern look with generally orange bricks. The St. Paul Campus has a diverse style of buildings, generally dark brick, and it has a very open, rural feel, as it is home to horticulture, and agricultural fields of study, as well as experimental farm fields. The East Bank, adjacent to the project site, is primarily old, dark brick, with concrete detailing. There is also some diversity in architecture seen in some of the oldest and newest buildings, such as Pillsbury Hall (The second oldest building at the University) which is constructed out of Minnesota Sandstone, a design inspired by the work of H. H. Richardson (“About Pillsbury Hall”). There is also a Copper Clad expansion to the Design School that was designed by Steven Holl and completed in 2002, and the aforementioned Weisman Art Museum by Gehry, clad in mostly stainless steel sheeting. In general however, these buildings act as accents that call more attention to
the fact that most of the campus is comprised of brick buildings with stone or concrete columns, creating a very traditional “Old University” feel.

Site Analysis

The stadium is going to be located on the eastern edge of the East Bank campus. This may seem to be a remote location at first glance, but it is actually fairly central in many ways. First, the location is across the street from both the Hockey Arena (Mariucci Arena) and the Men’s and Women’s Basketball Arena (Williams Arena). It is also within a few blocks of the baseball fields, the Swimming center, and the main gymnasium on campus. It essentially will become the new heart of the athletic area of the University. The site is going in an area that is currently commuter parking, and that will need to continue to hold approximately 3,000 commuter parking spots. The site is also located along the dedicated bus line that runs from the East/West bank campuses to the St. Paul campus, so while it is at the edge of the Minneapolis campuses, it is at the center of the
Twin Cities Campus as a whole. As an added connection to outside population, the Metropolitan Council is building a Lightrail line that will run from Downtown St. Paul to Downtown Minneapolis, and it will have a stop at the stadium site, as previously stated.

The site is also located due east of Dinkytown, the campus village. This area is filled with specialty shops, bars, and restaurants. The site is also due north of Stadium Village, an area that grew economically from Memorial Stadium. It is also north-east of the University’s Greek Row. These all create areas that would serve to convey people into the stadium site, both benefiting the businesses along, and also adding character, to the pedestrians’ routes.

Just north of the Site is an extensive old rail yard, which used to extend into the area where the University currently has parking. The first thing this means is that much of the site is currently compacted gravel where it is not paved. Another problem is a known Creosote plume on the site (“University of Minnesota On-Campus Football Stadium: Final Environmental Impact Statement.”) from when the area was used to treat railroad ties. This contamination plume will have to be treated in one of two ways. Either the area can be sealed, keeping the creosote sealed in a small area, or it can be removed from the site. It could be removed through traditional means, or through phytoremediation. The advantage to removing the contamination would be that the area could then have water flow through it into the groundwater, which would make the most sense with the sustainable emphasis of this project. The other impact to the site from the railroad is the minimal slope on the site itself. From the northwest corner of the site to the southeast corner there is only an elevation difference of 15’ over a distance of around 1800’, giving an average slope of 0.8%. 
There is also a spur of removed rail line that currently goes from the site, underneath Dinky Town, to the Mississippi River, and a pedestrian bridge. This area is currently used by the University as an access road to several buildings that back up to the rail line, and there are some utility lines buried there as well. This appears to have potential for a possible connection from the site both to the river and to the pedestrian bridge that goes to the Western Bank of the river.

With the site being former rail yards and parking lots, the existing vegetation is minimal, and for the most part limited to young street trees. None are considered significant enough to warrant a concerted effort to save them.

**Design**

_Campus Design_

![Campus Plan](image)

Fig 1 – Campus Plan

The overall design for the campus expansion needs to fill two design roles. First, it must create a similar feel to the existing campus to maintain a consistent identity for the university. Secondly, it needs to convey new, cutting edge technology and attitudes towards sustainable design theory. These roles may seem to be at odds, but by using a
traditional skeleton, and covering it with a sustainable skin, an area will be created that both meshes with the existing campus, and is also overtly sustainable and ecologically-minded.

For the expansion campus design to be truly successful, it must both function and feel like it is not just a part of any school, but like part of the University of Minnesota. This unity is achieved by capturing the University’s “spirit of place”. “Spirit of place” is a difficult thing to recreate, and the first step I am taking is to create a place that physically feels and appears similar to the main campus.

![Fig 2 – Typical East Bank Building](image)

The first way the expansion campus is designed to physically mirror the East Bank Campus is through the use of similar materials. The East Bank primarily uses dark red brick, with light concrete for accent purposes (Fig 2). This is also the same aesthetic being employed in the facade of the new football stadium (Fig 3). The new campus buildings would follow a similar pattern of materials, and also, like the majority of the East Bank Campus, and the new stadium, use classically inspired architectural details. This classic architectural essence helps give the campus a feeling of a university as it signals back to images of universities like Harvard and Yale, and to the University of Virginia.
Along with having similar materials, a similar spatial layout also is key to creating a similar physical experience. Similar-sized buildings were used, but more importantly the buildings have spacing similar to that seen in the East Bank (Fig 4). The road section in the new campus is also designed to mimic the one found in much of the East Bank. This was all done within the existing road layout for the expansion campus by both creating buildings of a similar footprint, height, and distribution, and also through creating a new campus mall, similar to Northrop mall on the east bank.

Along with embodying the spirit of the school, it should also have its own spirit, as it is a sub-campus of its own. This spirit will come from modern design theory and modern science throughout the campus. The design ideas are found in the visible emphasis on sustainability. Sustainability is seen on a small scale throughout the expansion campus, which will be discussed in detail later, but also in the layout of the new campus as a whole. The layout was created on top of the existing road layout, with an eye towards pedestrian use, vehicular traffic, and to create efficient links between pedestrian, private vehicle transportation, and mass transit.
As the base for the campus plan, three arcs radiate out from the Williams Arena Plaza, creating the three main spatial corridors and one of the key organizational forms for the campus (Fig 5). The buildings along the northern edge of the campus are a series of new biotech classroom and lab buildings. These buildings form a new biotechnology core that the school has decided should be developed on the new campus as a way to become one of the next century’s premiere universities.
Complicating the design of the transportation network of the campus expansion is that it has to function in three common and distinct modes. It must function the majority of the time on days when there are classes and the university is in session (Fig 6). This condition has most pedestrian flow moving between academic buildings and to transportation nodes, along with foot traffic to the East Bank campus. The second mode it must function in is days when there is an event at the stadium, or at one of the other athletic venues (Fig 7). These create the most concentrated spikes of users brings the largest volume of off-site people coming to the site. The last mode that is seen often is days when school is not in session, but businesses in the area are open, such as weekdays in summer and when the school is on winter or spring break (Fig 8). The majority of flow in these instances is using the site as a way to move from one transportation network to another, with a small number of people doing academic work over the summer.
The one key transportation issue seen in all of these scenarios is the need for people to easily move between auto, bus, and rail transit, and to have the University and athletic buildings be easily accessible by all of these network as well. This is accomplished by creating a transportation hub which serves to both solve the problems seen for the site, and also creates a regional resource to increase the ease of use of mass transit, promoting sustainability. In addition to the road layout, the location of the future lightrail path as it moves through the site has been predetermined by the Metropolitan Council and EDAW. After locating the expansion campus’s stop along that route, that was used as the core for the new transportation hub.

The core of the hub would be a large structure with the lightrail station beneath it. This structure would also house parking and a variety of shops and a food court area, making it not just the hub for transportation but the hub for the campus expansion area as a whole. The majority of permanent parking structures are located in close proximity to the lightrail stop, and the parking structures and the hub building are connected with skyways for ease of movement, especially during February cold snaps or August rain storms. A plaza on the north end of the building, at the base of the campus mall, would act both as an outdoor eating and gathering place and also as a place to gather for bus and campus shuttle service, which would be routed to stop there. By doing this it becomes very efficient to move between modes of transportation, and people would also have the ability to choose between public bus service, lightrail, and the university shuttle, all within a few hundred feet. While this is very helpful on school days, allowing for more efficient transportation for commuting students, it also serves to create a main entry point for non-students attending sporting events. It also would create a useful commuter hub, which could include a park-n-ride for people commuting from one side of the metro area to the other.

The pedestrian system is designed to allow for maximum ease of movement between all buildings. There are also multiple routes and paths, to prevent “Cowpaths” from forming where people want to walk, but where there is no built path. The landscaping has also been planned to prevent cowpaths but using topography and plantings to reduce the ease
of movement through shortcuts. This encourages people to stay on the path in a way that appears to just be aesthetically pleasing design. By making these barriers covert, there is more of a chance of people who might be motivated to break through them to stay clear.

Fig 9 – Drainage Diagram

One of the main issues addressed in the campus design is stormwater runoff mitigation. The campus is designed around a series of stormwater treatment features, designed to hold, clean, and then infiltrate water within 24 hours. This maximum time to drain is key to prevent mosquito eggs hatching. Water from around the site is focused into one of several systems of bioswales and infiltration basins (Fig 9). These are designed to contain enough runoff for a ten year storm. In larger storms the system is designed to allow cleaning, settling, and cooling of the water, along with delaying the time to peak flow, before draining into a swale running along the Greenway. This swale continues to cool and clean the water as it carries it down to the Mississippi. While draining into the river is not ideal, all of the stormwater collected in the Twin Cities currently flows there in pipes, so by this method it may end up there in large storms, but in a cleaner, slower, cooler way.
Fig 10 – Overview Render
Other than parking structures and any existing buildings that might not be cost effective to retrofit, the buildings in the expansion area have a hybrid greenroofs/solar roofs. This is a design idea that has been used a handful of times worldwide, and that Portland State University has received a $300,000 National Science Foundation grant to study over the next three years (Santen). Each roof has ten-foot wide strips running east-west. The strips will alternate between green roof and solar panels. The solar panels will be oriented at an angle to take highest advantage of sunlight during the school year, and will be sized as to not shade any other solar panels (much as you might expect on a traditional solar panel covered roof). The main difference between the rows would be that the rows of greenroof would be slightly pitched to act as infiltration swales. While the rows of solar panels would be solid surfaces, pitched to drain to the green roof sections. The
water would collect in the swale and most would infiltrate and evapotranspire. (Fig 11) The remaining water would flow down the swale, to a pipe system that would then flow down to either the green mall or the sustainable ring, which ever is closer. This rooftop bio-swale will help reduce the peak flow volume and delay the peak flow that reaches the infiltration basins, giving them more time to work on ground level flow.

![Fig 11 – Typical Roof Section](image)

The power from the solar panels on the rooftops would be used for multiple purposes, including powering the streetlights in the expansion area, charging batteries that would power the stadium on game days, lighting classroom buildings, and powering the lighting and pumps needed for the "M" sculpture at the gateway plaza. As this is one portion where the sustainability of the design is fairly hidden from public view, there would be signs explaining the process located near some of the buildings with the green roofs, and near features that benefit from the power of the green roof, like the “M” sculpture. There is also a viewing area located on the green on top of the transit hub so people could see the greenroofs.
The majority of the 3,000 parking spots that need to be replaced on site are housed in four parking structures. The first of these parking structures is located on the southern side of University Avenue, across the street from the Alumni Building. The other three structures are located north of University Avenue and east of the stadium. All four structures have four levels of enclosed parking above ground and a rooftop parking deck. This size would maintain the scale found in the existing campus buildings and the proposed campus expansion buildings. The structures would also be clad in brick, with concrete detailing elements. This would help the structures to blend more fully into the campus community and feel.

While the parking structure to the south of University Avenue is fairly traditional with three enclosed floors, rooftop parking, and no basement parking due to the light rail line likely passing beneath the structure, the structures to the North of University are more complex. The transit hub is multiple-use with parking, an underground light rail station, a food-court, and a shopping area for students, commuters, and visitors. This transportation hub is at the southern edge of the Sustainable Mall and would be the Mass Transit core of the University. The other northern two structures would all contain green roof sections to help slow and filter stormwater runoff on its way to ground level infiltration systems, starting with the green mall. These green roof sections would double as useable green space, and they could contain cafes and vendors on game-days.

The top level of parking in these three lots would also be reserved parking on game days, as tailgating would be allowed on this level, and these spots could be priced at a premium for season ticket holders. The transportation hub is also the starting point for a skyway that connects the parking structures and the stadium. The skyway system connects the transit hub to the other two structures and enters the stadium at the stadium box level. Box seat owners could rent tailgate spaces on the garages, and then walk over the skyway right to their seating level. The skyways are also the entrance to the stadium for all attendees parked in the structures or who arrive by mass transit. The skyway is half covered and half open-air, (Fig 14) recalling the design of the pedestrian deck of the Washington Avenue Bridge (Fig 15) that runs between the East and West Banks of
campus. This allows for comfortable use of the skyways in any weather condition, along with providing a tie to a prominent campus landmark.

Fig 14 – Skyway

Fig 15 – Washington Ave. Bridge
While some portions of the northern three structures contain greenroofs, the amount of pavement present will create excess runoff. This runoff would flow through gutters and pipes into the nearest infiltration system—the green mall for the transportation hub and the building to its south, and the green ring of the structure just south of the stadium.

Fig 16 – Section Across Parking Area

Fig 17 – Parking Structure Renderings
The heart of the east bank campus is Northrop Mall, with its open turf core, bordered by a hedgerow, and tall shade trees to provide a canopy. The new campus includes a mall area as a bridge to connect the two campuses. While the Mall is similar in scale, it has a very different design. Instead of a turf seating area, the core of the new mall is a series of linear infiltration basins/created wetlands. These wetlands clean runoff from the streets, sidewalks, and buildings in the area. The wetlands are also connected to each other by pipes to allow for water flow through the system, from north to south, then into the twin wetlands that run East-West along the front of the transportation hub building. Any excess water would flow out via pipes that would run across campus to the greenway’s bioswale. The pipes would be sized and placed so the water flow would be slow through the system in small storms, but in large storms the flow would be great enough to prevent flooding. There are sidewalks along the length of the mall, and sidewalks that run along
the streets that cross the mall. These paths still severely limit mobility across the mall, and could lead to situations where crossing the mall from one building to another would require someone to walk 3-4 times as far as a direct path would allow, which leads to questions of public safety, as mentioned by Banning and Strange. For that reason, boardwalk paths cross the wetlands. These allow for both more direct walking access and also create areas where people can get inside the wetland area to experience it more intimately.

![Fig 19 – Mall Plan]

While there are trees in this mall, they are very different from the trees on Northrop Mall. These are smaller, more decorative trees. They serve both for small patches of shade, and to create some spatial canopy, but since they are all wetland trees they also serve to create diversity for the wetland environment. (Fig 20) A second important role they play is to bring additional seasonal color to the wetland. While some people already have warmed to the aesthetic of sustainable plantings, such as the use of native grasses and wildflowers, some have not, and the addition of these wetland plants that are commonly
used as decorative specimen trees serves as a transition for people to see beauty where they have not seen it before.

Fig 20 – Mall Section

Much like Northrop Mall has the Student Union anchoring one end of the Mall, the new Mall has the transit hub, with its parking and food court areas, as an anchor. This transportation hub creates a similar situation as is found at Northrop Mall, with the student union as a vibrant anchor for the heart of the campus. The hub also features a plaza area, as previously mentioned, which would be the main seating area for the mall on the south side. There would also be a smaller plaza area on the north edge of the mall.

Fig 21 – Mall Rendering
As people move from the green mall towards the stadium, they come to the rear entry plaza for the new stadium. Flanked by infiltration wetland pools, this plaza is the main entry way to the stadium for people using mass transit or parking, and on non-game days it is a main pedestrian node as people cross from one area of campus to another. This area could also be used during games as a vendor area. The wetland pools to the north and south are also the next stop for water flowing off the plaza itself that does not infiltrate in its porous paving, and any water that filters down from the green mall due to high volume.

The plaza sits directly between the transit hub building and the main student entrance to the stadium. The design allows for a comfortable transition from the pedestrian ring to the lower mall. Along with allowing the most direct pathway possible, it also creates an
area that has traffic mostly at the edges and the core area open for seating on school days, and vendors or lines on game days.

Fig 23 – Rear Stadium Entry Plan

Fig 24 – Rear Stadium Entry Rendering
Just to the north of the entry plaza is a bus/shuttle turn around and drop-off area. This would be used on normal school days as a stop for the shuttle that runs from the Minneapolis campuses to the Saint Paul campus, providing a stop near the heart of the new campus. On game days, the turn-around would be used for shuttles with students from all three campuses, which is convenient to the student entrance to the stadium on the northwestern side of the stadium, near the turn-around. The turn-around could also be used for Metro-Transit buses on game days.

The base component of the bus drop-off is the driveway that the buses pull into and stand in while loading and unloading. This drop-off is paved with porous pavers with gravel-filled gaps. This allows for the necessary support while still creating an area where water will infiltrate instead of running off. Any water that did runoff in severe storms would
sheet flow into the sustainable ring. The drive is one lane on the entry and exit paths, to minimize visual impact, and two lanes in the loading zone. This allows for multiple buses to unload while still allowing for traffic flow around them. After unloading, the buses will be parked in the temporary parking lot adjacent to the greenway. Between the drop-off area and the street there is a grove of trees, which helps shield the view of unloading buses from passers by. There is a paved pedestrian path along the loading zone, with enough room for a bus to unload passengers while another group is preparing to board. The path then heads to the west from one end, and the south from the other. These paths lead to the pedestrian loop around the stadium, either towards the rest of the sports complex, the stadium itself, or the transit hub. These paths both cross the infiltration ring and do so via a set of boardwalks paths, similar to the others used on the site.

*Sustainable Ring and Entry to University*
Surrounding the stadium is the Sustainable ring. The Sustainable ring is actually a series of rings, each serving its own purpose and function, but working together to be sustainable in multiple ways. The first ring is the stadium’s arcade, a covered walkway that provides a unique spatial feeling and also allows for more comfortable walking during inclement weather. Just outside the arcade is the plaza and pedestrian ring to be used both as a walk and also as a vendor area on game-day and during events. This ring, paved with porous pavement and sloped to drain away from the stadium, is broken only by the two stadium entry plazas. The outward slope allows any excess runoff from the paved ring to flow into the next ring, a series of bioswales and pools.

This third ring, also only broken by the entry plazas, collects the stormwater from the site and starts the cleaning and infiltration process. The high point of the two swale systems are the pools adjacent to the read entry plaza that collect water from the plaza. The swales drain from the eastern side of the stadium to the west, along the north and south side of the stadium. As it flows through the bio-swale, stormwater is cleansed by native
messic wetland plantings and specialty plants selected for their cleansing properties. As the water flows, it moves through occasional detention basins as well. These provide areas of reduced flow to allow further infiltration, and also serve to allow suspended solids to settle out of the water. This swale system starts at a depth of only one foot relative to the edge of the pavement area, and drops to two feet before feeding into the final settling pools. This allows for the water to flow along the swale while the plaza edge remains level.

Through this series of swales and pools, the water cools to the ambient temperature, is cleaned, and much of it infiltrates into the ground water. As ground water, this water will then feed into either an aquifer or into the Mississippi River through subsurface flow. The final pools on the north and south side also have two overflow drains; the first, lower drain, leads to the swale that runs along the greenway, allowing for water to be further
cleansed before flowing into the river. The second drain, high enough that it will be used only during flood events, connects into the city storm sewer system. Traditionally, this water would all flow directly from a parking lot, sidewalk, or rooftop with little to no filtering or cleaning. This leads to hot, dirty water flowing into the Mississippi River in one rapid storm surge, increasing flooding. However, by the time the water in a storm event reaches the overflow pipe, it will have been through a cleaning and cooling process, and it will have been slowed, creating a much more sustained and ecologically sound outflow into storm sewers, and in turn, the Mississippi river.

As a way to create transparency in the sustainability of the site, there is a series of walkways that cross both the swales and pools to allow students to move through the area, seeing the multiple stages of the cleaning process along the way. Signs alone these paths explain the system, and perhaps show examples of what the water looks like pre- and post-cleaning. Another way to connect visitors to the swales is the series of small seating areas off the pedestrian that sit on decking above the swales.

Large trees line the Sustainable Ring, and fill the area between it and the roads. These serve to create a semi-wooded ecosystem on the site and soften the massing of the stadium. Stadiums are often fully visible from a distance, without obstructions from their base to their top, which makes them very intrusive and emphasizes the enormity of the structure. By surrounding the stadium with trees that are approximately one-third of the height of the structure, the building itself appears smaller from a distance. The trees also would create a similar form to the arcade that surrounds the stadium on the outer edge of the walking path that surrounds the stadium, with the trunks replacing the brick columns, and the canopy replacing the ceiling over the arcade. This sense of balance makes the area near the stadium a much less imposing, and a more comfortable space for pedestrians.

There is also an entry to the sustainable ring from University Avenue, at the large infiltration pool on the south edge of the ring. Walking off of University, the visitor steps onto a pathway that leads over the infiltration pool towards the stadium and onto the
pedestrian ring. This move from a busy, urban road to a boardwalk over a wetland creates an immediate change in the sense of place. Heading West, it also opens the view to the stadium, after having it blocked by the parking ramp, while the ring of trees just outside of the pedestrian ring serves to further soften the stadium’s visual impact. The boardwalk becomes the transition zone between the ring and the road, while also being a key part of the ring and its ecological function.

Fig 29 – University Entry Rendering
Memorial Design

Fig 30 – Memorial Location

Fig 31 – Memorial Plan
When the State agreed to partially fund the stadium, one of the requirements was that the stadium either be named “Memorial Stadium”, as the previous on-campus stadium had been, or the site feature a memorial area. Since the University sold the naming rights to TCF Bank, a memorial is required as part of the stadium design. I placed the memorial to the north of the horseshoe opening in the stadium, just outside the pedestrian ring. With the educational and innovative nature of a university, this memorial is not a traditional memorial to fallen soldiers alone; instead the memorial is for any students, alumni, or staff who aided our country through military service, service to keep troops safe through medical practice, who may have kept our troops out of harms way through working to maintain the peace, and those who worked in armories and factories in war time to keep our troops armed.

Fig 31 is the conceptual plan created for this project, as this one design area could have been a focus of a thesis of its own. The plaza is entered by walking down a granite ramp that leads three feet below grade. This drop serves both to make the public space into a semi-private space, and to give visitors a feeling of security by providing raised topography on all sides, creating cover. Security is provided because by only being 3 feet below grade, it also allows visitors inside to see anything approaching from outside the space. The memorial itself is comprised of two overlapping geomorphic shapes, the plaza area, and an infiltration pool fed by the sustainable ring through a small waterfall. This infiltration basin, much like the final basin along the southern edge of the ring, would have dual outflow pipes, one to the storage wetland to the north, and one for emergency purposes that ties in to the storm sewer. The overlapping geomorphic shapes create a sense of drama, as the form of the plaza pulls your eyes to the pool, the space compressing as you approach the pool. The form of the pool then opens up quickly, allowing the space to release. The widest expanse of the pool occurs at the edge of the plaza shape, creating an area that from one point of view is compressed, and another is open. This dichotomy of space gives the memorial a physical manifestation of the way memorials function emotionally, both as a place for mourning and a place for honor.
The plaza’s ground plane is surfaced in granite from northern Minnesota, with the University’s crest etched in it. This both allows the crest to be seen in summer, and also in winter, when the snow is cleared, but the recessed areas of the crest would maintain a thin layer of snow, further emphasizing the form. Where the plaza then extends over the pool space the granite is replaced with wood decking, allowing both forms to be clearly seen simultaneously. The plaza area is surrounded with a polished granite retaining wall that matches the grade outside the plaza. On the northern side and a portion of the western side, the retaining wall extends to a height of three and a half feet. In this higher wall, the seals for the Red Cross, Army, Navy, Marines, Air Force, Merchant Marines, United Nations, and ALF/CIO are embossed. These organizations represent the people honored by the memorial, Minnesotans who gave of themselves for the betterment of the country and the world, not just by sacrificing themselves for their country, but also the people who worked to create peace. There is also a bronze bench in the southwestern corner of the plaza, allowing reflection both towards the pool area and to the engraved wall.
Fig 33 – Memorial Rendering

Gateway Plaza

Fig 34 – Gateway Plaza Location
At the far western edge of the expansion campus, there is a small overlap between the new campus and the old, in front of Williams Arena, where the University’s basketball, volleyball, and gymnastics teams compete. Oak Street carved a path between Williams Arena and a historic fire station until the new road alignment was announced as part of the campus expansion project. With this alignment change, there is an undesigned open area that sits on the hinge point between the old campus and the expansion campus. This gateway area is very important as it is where there will be a transition from the old campus’s style and the style and aesthetic of the expansion campus.

A large plaza area is added to used both as a gathering place with chairs and mobile cafes, and also as a meeting place before and after athletic events. It also is the intersection of multiple paths that cross in the area. Just to the east of the plaza is a small
reflection pool with a wire mesh version of the school’s “M” logo, at the center. The wire mesh is held by thin pipes that seep water, creating a film of water over the “M” in the summer, and a thin sheet of ice in the winter (Fig 36). This sculpture is the focal point of the plaza, and is visible from much of the stadium and also the Walk of Fame. To the east of the pool there is a large turf area ringed by a hedge. The area is kept clear of trees to ensure maximum visibility of the pool and the stadium. It also is one of the few open lawn areas in the expansion campus, allowing for students to relax and enjoy themselves. It also could be used on event days as an area for vendors to set up and sell food and merchandise. The vendors would set up booths inside the hedge, have counters that are made to straddle the hedge itself, and sell to people on the outside of the hedge.

While this area is paved with porous paving, it is a large enough area that in heavy storm events it is bound to create runoff. This runoff would first flow to the east, and into french drains. These would feed first to the pool surrounding the “M” sculpture, reducing the amount of potable water needed to keep the sculpture flowing. Water not needed to fill this pool or its reserve cistern would then flow into the wetland across the street along the walk of fame.

Fig 36 – Memorial Rendering
South of the memorial, facing Williams Arena, the “M” water feature, and the original East Bank Campus, is the University Walk of Fame. Transposed against the background of the new football stadium, where people are accustomed to seeing athletes honored with retired numbers, this is an area to honor people who have brought honor to the university through academic or other professional achievements. The walk itself is a brick paver arc that follows the curve of the stadium in the open area of the horseshoe. Between the road and the brick walk is an infiltration pool that cleans and collects the runoff from the surrounding plaza areas and the gateway plaza. The brick walk is shaded by a cantilevered arbor that serves both to shade the walk and act as a ceiling to the space, making the area smaller and more intimate then if it was open to the air. The arbor also serves to call attention to the Walk of Fame, and the arbor joists are appear to be directed
out in rays, pointing towards the Minneapolis skyline, a symbol of the effect that the work and study at the school have had over the outside world.

The arbor is supported by brick columns, smaller in scale but similar in style to the columns that ring the stadium’s arcade. The columns would hold plaques honoring influential and important people from the University’s past (Fig 39). These plaques would serve as an example to students that even at the site of this multi-million dollar stadium, the people who deserve the true honor and respect of the school are not just athletes, but people like Norman Borlaug, one of only five people to receive the Nobel Peace Prize, the Congressional Gold Medal, and the Presidential Medal of Freedom.

Along the western side of the walk of fame is an infiltration wetland. It is fed both by the runoff from the gateway plaza, and any runoff from the walk of fame itself, and from the surrounding entry plaza. From here, and water that does not infiltrate flows out to the same holding wetland as the sustainable ring, and then on to the greenway swale.
Fig 39 – Walk of Fame Plaque

Fig 40 – Walk of Fame Section

Fig 41 – Walk of Fame Rendering
Temporary Parking

Fig 42 – Parking Location

Fig 43 – Parking Plan
There are two temporary parking lots to the north of the stadium for tailgating and football game parking. One lies between the sustainable ring and the road to the north, with the other to the northwest, adjacent to the greenway. These parking areas would have gravel driving lanes and turf parking stalls with a “Grass-Pave” like structure to allow vehicles to park and drive without killing the turf. This would allow for easy delineation of parking and driving during snow and heavy rain, unlike simple painted lines, while still achieving maximum infiltration. Any water not infiltrated would flow south into the sustainable ring. Based on Brattebo and Booths study, this also allows the driving lane to have a material that is more durable, while the parking stalls, with their less intense use, can remain more aesthetically focused. This area would also be good for tailgating, as people would be able to place hot grills over gravel, while they could sit and have fun on the grass. Also, by slightly grading the parking areas to drain into the gravel, it would give the parking area the appearance of a turf lawn from a distance, as the raised turf will hide the gravel strips.

In any small wedges that are not parkable but don’t need to be drivable either, shrubs are planted. This will keep cars off of those areas and allow decorative shade trees to be planted, giving shade in the summer, but also adding a burst of color in the fall, when football season is in full swing. Cars enter the parking lots through a gravel drive, flanked by sidewalks on either side. This drive “T”s, and there is a turf strip that takes its place running between the two walks. This open corridor would be the main gateway for people coming to the stadium from the greenway, creating an entryway onto the site from the north.
Fig 44 – Parking Rendering

Greenway

Fig 45 – Greenway Location
Currently, train lines run from the train yard on the north edge of the site, east through a trench below Dinkytown to the Mississippi, and then north along the river. However, there is an abandoned spur line that used to run over a bridge across the Mississippi, and its bridge currently serves as a pedestrian bridge. This bridge gets little use, largely because it is only accessible on the East Bank side by walking down through a parking lot behind one of the university buildings. By working with the unused half of the railroad right-of-way, a greenway and pedestrian corridor is created to provide key environmental access, creating a passage from the stadium through the heart of Dinkytown and to the pedestrian bridge. This greenway would create vital natural access to the site, increasing its sustainability, while also establishing a vital additional access route to the new campus area and the stadium.
On a regional environmental scale, this greenway would be very important, as it would establish a link between the sustainable ring, the Mississippi River and the Mississippi greenway, which connects to the Fort Snelling State Park and the Minnesota Valley National Wildlife Refuge. This would create a way to add biodiversity to the greenway habitat through the addition of the inland species that may not be found in the band of greenway along the river, and the introduction of species from the river’s edge to the sustainable ring.
Pedestrians will move down the greenway on a path of porous pavers that would be laid between the rail road lines. This serves both an environmental and a social purpose by infiltrating runoff and recalling the path’s former purpose as a rail line spur. It also creates the all important well defined walking path mentioned by Briffett. Along the northern edge of the path, a bio-swale with periodic weirs cleans and transports much the excess runoff from the site. This provides a final cleaning before flowing into the Mississippi, the runoff will be as clean as possible chemically, and with temperatures that are closer to presettlement levels, when it enters the river. Just past the bioswale is a high berm separating the active track from the path. This berm already exists on much of the path, and in all areas a tall fence is added to prevent people from entering the railroad right-of-way. To the south of the path is a shallow swale designed to drain at certain points through pipes under the path and into the main bio-swale, preventing flow over the path. Past this smaller swale is a gentle slope running up to the wall of the trench.

Trees are planted inside the fence near the base of the berm, and native grasses and shrubs are planted over the rest of the open space. There are occasional benches on the northern edge of the path, on small decks similar to those seen in the sustainable ring, but on a smaller scale. There would also be occasional tall lights, low path lights, and safety phones, to address safety concerns. At major road crossings, there are decorative and enclosed stair and elevator towers to provide access to and from Dinkytown and its shops from the greenway.
Fig 49 – Greenway Rendering
V. Conclusion

As mentioned earlier, this project has three primary goals:

1. *Create a Site Design Anchored in Sustainability*
2. *Create a Site That Teaches About Sustainability*
3. *Create an Area That Functions as Part of the Campus*

To evaluate the success of the design, it is important to look at the success of each of the design guidelines set out for the project. The successes and failures of these will shed light onto the overall success of the project.

1. **Create a Site Design Anchored in Sustainability**
   - Create an effective transportation node.
   - Concentrate nodes for all transportation methods (car, bus, lightrail, bike, pedestrian) in one area to allow ease of cross-use. It may have been optimal to locate the bus turnaround closer to the transportation node if possible, but the campus design goals superseded this desire. Overall, the project was successful in providing a regional transportation hub.
   - Create amenities needed to facilitate movement between nodes. With the transportation hub providing space for retailers and restaurants, enclosed skyways between three of the four parking lots, and an enclosed lightrail station, movement between modes of transportation is extremely easy.

   - Use Sustainable Energy Sources.
   - Use Solar Panels to Power Pedestrian Lighting and “Unnecessary” Landscape Features like Fountains. Optimally both wind and solar power would have been harnessed in this project for maximum energy generation. While I was successful in adding a good supply of solar
power to the design, the addition of wind turbines would increase the energy output. I decided to not include any as a design choice, as I felt the towers would have had an adverse effect on the spacial relationship people would have felt with the design.

- **Reduce Heat Island Effect.**
  - **Utilize Green Roofs to Mimic Forest Canopy** While green roofs were utilized in part, the addition of solar panels reduced the amount of effect they could have in terms of light absorption and raised albedo of the roofs.
  - **Use Light Colored Pavement Materials Where Possible** Light pavement is used throughout the design, with the only exceptions being the roads and memorial. If the design was truly a blank slate a light road pavement would have been used.
  - **Parking Ramps Paved With Light Material** The parking ramps area topped with either light colored concrete or greenroof areas.
  - **Surface Lots Paved With Light Material or Turf** All surface lots are a mix of turf and light colored gravel.
  - **Increase Tree Canopy** The tree canopy has been increased greatly between the street trees that were added and the forested area of the sustainable ring.

- **Change the Hydraulic Curve of The Site to Come Closer to Pre-Settlement.**
  - **Minimize and Delay Runoff from Roofs Using Green Roofs** Greenroofs are used on every building that is suitable in the expansion area. The square footage of greenroof is lowered slightly due to the solar panels, however.
  - **Minimize and Delay Runoff from Paving Areas Using Porous Paving** Porous paving was used in most plaza areas on the site.
- **Clean and Delay Runoff by Moving it Through a Series of Stormwater Best Management Practices (Bioswales, Infiltration Basins)** An extensive chain of treatments BMPs is implemented on the site in a way that cleans, infiltrates, and slows water flow from a storm for even very large storm events.

- **Increase Biodiversity and External Ecological Links.**
  - *Create a Greenway Connecting the Site to the Mississippi River and the Minnesota River National Wildlife Refuge* While not as wide as optimal, the greenway created should suffice as it serves to cover the short distance between the larger ecological areas of the sustainable ring and the Mississippi River.
  - *Create Wetland and Forest Habitats Similar to Those Found Natively in the Region* The created wetlands should become a good habitat for native plants and animals alike. The created forest should be successful for most canopy dwelling animals, but due to safety concerns the understory had to be controlled enough that it may be less effective habitat.

2. **Create a Site That Teaches About Sustainability**
   - **Make Landscape Processes Visible Through Design.**
     - *Bring Water Movement to the Surface* With the exception of water piped under roads or paths, water flow is visible from the time its hits the ground to the time it goes into the river.
     - *Pedestrian Flow to Follow and Cross Water Flow* Pedestrian traffic crosses the water flow, and also has areas for reflection, such as the memorial and seating areas, suspended over the wetlands, bringing a focus to these areas.
     - *Multiple Wetland Areas* There are more than 15 wetlands/infiltration basins throughout the site, not counting the bioswales.
- **Visible Green Roofs and Solar Panels** The solar panels would be visible from a short distance away on the ground, while the greenroofs would only be viewable from above, such as on the parking structures. While this is not optimal exposure, without creating extremely intensive greenroofs, complete with trees, visibility is always limited to ground level traffic.

- **Have Multiple ways to Address Sustainability in All Design Elements.**
  - **Native Plants When Possible** The majority of plants would be natives, with rare exceptions for plants that would increase stability based on similar climate in its region of origin, and with similar restraints on spreading to prevent invasive tendencies.
  - **Maximize Use of Porous Pavements** As discussed, porous pavements, from plazas to turf parking, is used as much as possible, with the one exception of the road system.
  - **Native/Local Materials** Other then the memorial, which is designed to specifically use local materials, all of the materials used should be easily procured locally. The one exception is the Grasspave and Gravelpave systems, as they are only made by a few companies, non of which have a local factory.
  - **Visible Transportation Network Interaction** With the transportation hub, the interaction between modes of transportation has a physically manifestation in the landscape.
  - **Combine Green Roofs and Solar Roofs** Green roofs and solar roofs were combined on any roof that could support the two structures, other then the parking garages, as they supply both parking and greenroofs.
  - **Stormwater Best Management Practices** Greenroofs, engineered wetlands, bioswales, infiltration basins, weirs, and porous pavement are all used prominently on the site, and in combination.
- **Signage to re-Emphasize Sustainability Lessons and Outline Methods.**

- **Signs to Inform on Effectiveness of Best Management Practices** Signage is located on many of the boardwalks, giving information about the cleaning methods where people interact most closely with the water.

- **Water Quality Testing Stations** Some of the signs show water quality test results, letting people see real-time how much cleaning the wetlands are doing.

- **Explain Functional Roles of Greenway and Greenroofs** Signage will be found both on the green mall and on the parking structures explaining the greenroofs and their dual function. The greenway itself, and the bridges over the greenway will contain signage explaining its function.

- **Show Energy Derived from Solar** Signs by the main entrance of each building with solar panels stating what their 24-hour energy generation rate was. Signage near the fountain and occasional streetlights explaining where the power comes from.

- **Design to Evoke Thoughts of Sustainability and Natives While Maintaining Aesthetic Appeal.**

- **Use Plants That Provide Mental Link (Cattails), and Also Plants that Provide Commonly Seen Year Round Aesthetic Interest (Big Blue Stem)** Both using native and aesthetic plantings simultaneously, along with using forms that are geometric, showing human intervention, help make the wetlands appear more designed and beautiful.

- **Fountains Use Stormwater and Function Year Round** By running primarily using water in cisterns fed by stormwater, very little potable water would be needed to maintain the fountain.
- **Hide Parking Under Turf Camouflage to Show Functionality and Form at the Same Time** By using both gravel and turf, the parking areas would appear to be a lawn with geomorphic patterning on them, but when looked at more closely would clearly resemble a parking lot layout and scale, both hiding the use and revealing the use.

- **Use the National Attention That a Big Ten Football Stadium Draws.**
- **Create Design that Highlights Sustainability in an Attractive, Innovative Way That Begs TV Cameras to Shoot Video** With multiple iconic spaces in the landscape that should photograph well, television camera should have plenty to shoot that both show beauty and sustainability to a nationwide audience.

- **Create a Design so Filled with Sustainability That It is Impossible to Miss** Between the solar/green roofs, green mall, sustainable ring, memorial, walk of fame, and the greenway, it would be difficult to find a spot on the campus where sustainability is not obvious.

- **Fill Gateways with Sustainable Design to Grab Attention of Visitors to the Site** The only gateway not filled with overt sustainability is the gateway plaza in front of Williams Arena. This area is kept more traditional due to it being the hinge connecting the two campuses, and it functions somewhat as a buffer zone. Every direction you move off of the gateway plaza, however, leads you to areas with high sustainability.

3. **Create an Area That Functions as Part of the Campus**
   - **Maintain a Similar Sense of Place to the Existing East Bank Campus.**
   - **Maintain Use Of Materials and General Architectural Elements Building** materials are kept similar to the materials on the East Bank campus, with dark red brick and concrete detailing.
- **Similar Figure Ground Layout and Building Massing** The campus was designed to mimic both the figure ground of the East Bank campus, and so the roads cross section is similar as well.

- **Create Areas That Are Similar in Feel to Established Iconic Campus Areas** With the green mall mimicking Northrop Mall, one of the most iconic spaces is recalled in the new campus. The East Bank campus is also filled with tree lined streets and small gathering spaces similar to those found in the expansion campus.

- **Create a Functionally Effective Campus.**

  - **Create an Area That Functions on Game Day, School Days, and In Summer** The pathways, and building layouts are designed to allow high volumes of traffic both from transportation node to transportation node for summer, transportation nodes and the East Bank for game days, and from building to building for school days.

- **Create Effective Pedestrian and Vehicular Traffic Patterns** With multiple routes to and from buildings, and fairly direct routes possible between most, pedestrians should never feel they are wasting time taking the “long way”.

- **Connect to the East Bank, Dinkytown, Stadium Village, St. Paul Campus, and Both Cities.**

  - **Create Gateway Areas to East Bank, St. Paul Shuttle Route, University Ave., and Stadium Village** The transportation hub and bus and shuttle stops in the campus itself, connections are frequent on the campus, allowing both pedestrian movement between campuses when possible, and alternate transportation modes.
Create a Greenway that Extends Through Dinkytown and Towards Minneapolis

The greenway reaches out to the west, both through the heart of Dinkytown and out to the pedestrian bridge, and also created to allow flora and fauna to move through the greenway to increase biodiversity.

While there are a few things that could have been slightly differently, given the scope and scale of the project, and myriad goals and objectives set out for the project, it was as successful as possible across the board. If this design was implemented, it would stand as an example to people across not just the University, or the Twin Cities, but the region of how sustainability can be done in an urban area in an effective, and aesthetically pleasing way.
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