Green Space Design for Ågadeparken: a Pilot Project for Daylighting Ladegårdsåen

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Green Space Design for Ågadeparken: a Pilot Project for Daylighting Ladegårdsåen

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Denmark Project Center
Report Submitted to

Anders Jensen
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Abstract

This project provided Miljøpunkt Nørrebro, a Danish environmental group, with designs for a stand-alone pilot project featuring a daylighted river and green space that addresses both stormwater and pollution concerns. This small pilot project is part of the larger vision of daylighting the Ladegårdsåen, which would lead to the creation of a city green strip and flood management highway tunnel. Public feedback and expert opinions, gathered through surveys, interviews, and a focus group led us to incorporate natural and multifunctional spaces into our green space design. We are confident that a successful pilot project will showcase the potential benefits of a larger scale green strip for the city of Copenhagen.

Acknowledgments

Our group had great help and support throughout the completion of our project, and therefore we would like to thank:

- Our project sponsors, Anders Jensen and Ove Larsen, for their help and guidance.
- Our project advisors, Professor Melissa Belz and Professor Zhikun Hou, for their timely feedback and assistance throughout our time in Copenhagen.
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- Professor Steven Taylor, Director of the Copenhagen Project Center for his organization of the project center and sponsors.

Executive Summary

On July 2nd 2011, a severe storm hit Copenhagen and released massive amounts of water on the city, shown in Figure 1 below. The cloudburst continued for two days and caused immense damage to roads, public transportation, private homes, and businesses. By the end of the storm, total damages amounted to over 6 billion DKK, approximately 1 billion USD (Mufti, 2012). In the aftermath of the storm, Copenhagen was left to rebuild due to the 160 mm of rain the city experienced in less than three hours. People in the city are very concerned about the possibility of another cloudburst happening in the near future. Therefore, Copenhagen has been looking for ways to incorporate more green spaces within the city that will help to better manage the floodwater in order to prevent another major flooding disaster. Following the cloudburst, Miljøpunkt Nørrebro, a non-profit environmental organization, began creating a proposal for a potential solution to address Copenhagen's flooding concerns.

Figure 1: Flooding from the July 2011 Storm (Jensen, January 2015)

Ågade and Åboulevard are two major roadways that form the border between Nørrebro and Frederiksberg. These roads are a major source of traffic, producing large amounts of air and noise pollution. Additionally, the roads prevent storm water from draining, causing flooding in the city. In an attempt to address the problems of pollution and flooding with a single solution, Miljøpunkt Nørrebro proposed replacing the roadways with a green space that restores the Ladegårdsåen, a river that is currently under the two major roadways. In the proposal traffic is diverted through a tunnel, lessening the air and noise pollution and opening up surface area for the development of a

city green strip. This larger project would become a major conduit for floodwater management in addition to adding a new major attraction for the area, Figure 2 below.

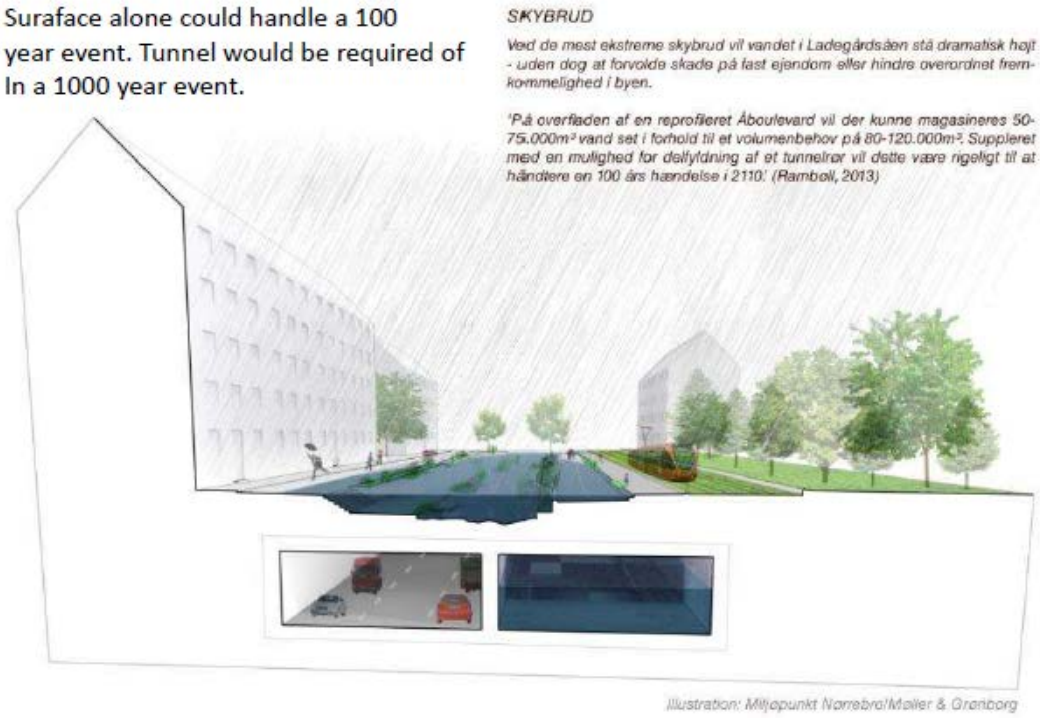

Figure 2: Cross-section of Miljøpunkt Nørrebro's larger green strip daylighting proposal

The idea of creating a pilot project was incepted while we introduced our background research to our sponsor, Anders Jensen, Center Leader for Miljøpunkt Nørrebro. Ågadeparken is a small park that runs alongside the Ågade, and is currently underdeveloped, compared to the standard of green spaces in Copenhagen. Anders' idea is to use the park as a test area for river reconstruction methods in order to provide evidence for the feasibility of the larger project. Along with designing the green space to test methods for the larger daylighting project, it should function as a stand-alone green space as well as a potential future addition to the larger Ladegårdsåen project.

Problem Introduction

Urban green spaces have long been viewed as a way of infusing urban landscapes with both open space and fresh air. In the past, industrial cities suffered from cramped living quarters, poor sanitation, and factory smog. Parks and green spaces were considered an important remedy for such toxic environments, perhaps being the only way to provide people with access to recreational

outdoor space. Today, cities suffer from different forms of congestion and pollution, brought on by the increased traffic. These problems increase the support for the development of new green spaces in cities where existing spaces are lacking.

In the early 1900s, Copenhagen buried the Ladegårdsåen to expand buildable space and accommodate the growing city population. Now, after more than a century, people are advocating for the Ladegårdsåen to be brought back to the surface, through a process known as daylighting. This is the action of bringing a river back to the surface after it was piped underground during urban development. The process of daylighting provides many environmental, social, and economic benefits to the area. Some of these benefits include increased biodiversity and improved water and air quality (Sinclair, 2012). Bringing a river above ground also provides an increased amount of community space that can be used for social gatherings and recreation. In addition, with the involvement of local businesses, the economy of the surrounding area will grow (Sinclair, 2012).

Flood management is another issue that daylighting can address. Since cities are built primarily with impervious materials, such as asphalt and concrete, water accumulates and does not drain (Mufti, 2012). By replacing impervious surface areas in urban centers with natural surfaces, the likelihood of damaging floods is reduced, as the environment is better suited for handling larger amounts of storm water (Kaufman, 2013).

Even though daylighting the river would be a major investment for the municipality of Copenhagen, the positive benefits highlighted in our report suggest that Miljøpunkt Nørrebro's proposal would offset development costs in the long term. This proposal is in line with Copenhagen's current vision of sustainability, which calls for a blue-green capital city with easily accessible green spaces for all residents by 2015 (Copenhagen, 2007). Blue-green parks incorporate water management solutions into green spaces to address flooding concerns.

Methodology

The goal of our project was to assist Miljøpunkt Nørrebro in designing an environmentally focused daylighting pilot project to garner support for the proposed daylighting of the city green strip, incorporating public feedback and various neighborhood opinions in our designs. In order to accomplish this goal, we achieved the following objectives:

1. Gather and understand local opinion and appeal of a pilot project to residents of Nørrebro and Frederiksberg.
2. Determine the best possible plant species and riverbed techniques to address flooding concerns and ecosystem development in proposed surface designs.
3. Develop appropriate green space concept plans for Ågadeparken.

To achieve our objectives, we distributed an electronic survey, conducted a focus group, completed case study research, field research, and conducted semi-structured interviews with PhD students and landscape experts. The survey and focus group gave us valuable information about respondents' approval for the project, as well as their opinions of green spaces. Our background research prior to coming to Copenhagen provided us with knowledge about successful green space projects. Through our case study research, we identified successful riverbed construction techniques and viable plant species. In addition, we visited green spaces in Copenhagen to gain a better understanding of the desirable green space elements. In conjunction with these visits, we conducted semi-structured interviews which educated us about landscape techniques and plants that create experiences and rooms in parks for all visitors to enjoy.

Findings

We found that a small pilot project would help push the project forward, because public opinion is very influential in Copenhagen. We discovered that the active and continued involvement of local stakeholders contributes to the success of daylighting projects and green spaces. We determined that support of daylighting the Ladegårdsåen project was not affected by resident's mode of transportation. Cyclists and car owners both expressed strong support for the daylighting project in our electronic survey. Our project identified the four most important issues that should be addressed in green space design, as indicated by our survey respondents. One of the most important findings was that green spaces should be multifunctional and natural, so that residents can use the park as they desire. From these findings, we were able to formulate multiple designs for presentation to Anders Jensen.

Recommendations

After the completion of our data collection and analysis, we concluded that Miljøpunkt Nørrebro should propose the renovation of Ågadeparken. Some park features we recommend are grilling areas, hammocks, a paver stone walkway, hedges for seclusion, and trees to absorb pollutants,

shown in Figure 3. We also believe they should actively engage the municipalities of Copenhagen and Frederiksberg on the benefits of daylighting the Ladegårdsåen. More data on public opinion in Frederiksberg should be collected in order to advance and inform people of the benefits of the larger project. Finally, we believe Miljøpunkt Nørrebro should determine if people in Copenhagen and Frederiksberg are opposed to the project.

Figure 3: First-person point of view perspective of Ågadeparken design (Simone Hochreiter, 2015)

Conclusion

There is no way to prevent a natural disaster such as the Cloudburst of 2011 that Copenhagen experienced. Copenhagen is constantly expanding due to its growing population, causing an increase in the use of impervious materials for construction purposes. Miljøpunkt Nørrebro is attempting to mitigate the possibility of another disastrous storm by proposing the creation of green spaces throughout the city capable of providing floodwater management. This organization is providing politicians with environmentally friendly solutions to flooding concerns and addressing

the lack of green spaces in Copenhagen. Miljøpunkt Nørrebro believes daylighting the Ladegårdsåen and moving Åboulevard and Ågade into an underground tunnel is the best solution to address the aforementioned environmental concerns. We believe that through our research and recommendations, Miljøpunkt Nørrebro will accomplish their goal of designing a pilot project in Ågadeparken, and advance the larger goal of daylighting the Ladegårdsåen.

Authorship

Every member of the team contributed to all aspects of the paper, including writing, editing, research, and methods. This list provides the authors of each section of the paper.

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Executive Summary	Campbell, Salem, Clark, St Germain
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Chapter 1: Introduction	Campbell, Salem, Clark, St Germain
Chapter 2: Literature Review	Campbell, Salem, Clark, St Germain
2.1	Campbell
2.1.1	Campbell
2.2	Clark
2.2.1	Clark
2.2.2	Salem
2.2.3	Salem
2.3	Clark
2.3.1	Salem
2.3.2	Campbell
2.3.3	Campbell, Salem, Clark, St Germain
2.4	Clark
2.4.1	Clark
2.4.2	Campbell
2.5	St Germain
2.5.1	St Germain
2.5.2	St Germain
Chapter 3: Methodology	Campbell, Salem, Clark, St Germain
3.1	Campbell, Salem, Clark, St Germain
3.1.1	Salem
3.1.2	St Germain
3.2	Campbell, Salem, Clark, St Germain
3.2.1	Clark
3.3	Campbell, Salem, Clark, St Germain
3.3.1	Clark
3.3.2	Clark
3.3.3	Salem
3.4	Campbell
Chapter 4: Findings	Campbell, Salem, Clark, St Germain
Finding One	St Germain
Finding Two	Campbell
Finding Three	Campbell
Finding Four	Campbell
Finding Five	Salem, Clark
Chapter 5: Conclusion & Recommendations	Campbell, Salem, Clark, St Germain
5.1 Recommendations for Open Space Considerations	Campbell
5.2 Recommendations for Riverbed Construction	Campbell
5.3 Recommendations for Plants in Ågadeparken	Clark
5.4 Park Features and Design	Salem
5.5 Influence of Public Opinion	St Germain
5.6 Stakeholder Involvement	Campbell
5.7 Recommendations for Future Students	Salem
5.8 Deliverables	Campbell, Salem, Clark, St Germain
5.9 Conclusion	Campbell, St Germain
Appendices	Campbell, Salem, Clark, St Germain

Table of Contents

List of Figures

List of Tables

Chapter 1: Introduction

Urban expansion and the loss of natural landscapes in sprawling cities are growing concerns to environmental groups and residents. Natural habitats and rivers are often destroyed to make space for suburbs and highways, negatively affecting the health of local ecosystems. The increased amount of asphalt needed for roads and parking due to continued urban sprawl makes flooding a greater concern for cities and their surrounding neighborhoods.

Instances of flooding increase with a rise of impermeable surfaces, such as roads and parking lots, exacerbating problems with inadequate drainage systems. The city of Copenhagen suffered the consequences of its dense urban environment during a cloudburst in 2011 an intense rainstorm that deposited over 160 millimeters of rain in three hours, causing over 6 billion DKK worth of damage (Jensen, January 2015). Many solutions have been proposed to lessen the impact that cloudbursts will have on Copenhagen in the future. Copenhagen is creating more green spaces in and around the city to encourage water infiltration. However, there is no agreed upon design or solution to flood mitigation and prevention.

Green spaces provide natural areas for people to use and recreate in at their leisure. These spaces improve air quality in an area, as well as increase life expectancy and general levels of happiness (Takano, Nakamura, & Watanabe, 2002). Other documented benefits of green space include the reduction of both air and noise pollution. Successful green spaces use native species of plants to create a more natural ecosystem with thriving wildlife. Ecosystem development is often facilitated by daylighting, a technique that brings a piped river back to the surface. This technique is often used in conjunction with the design of modern green spaces where buried rivers are present. While green spaces provide a natural environment in cities, often times pre-existing structures, such as roadways, are removed or relocated to make room for these spaces.

To alleviate the traffic displaced by a daylighted green space, one possible solution is the creation of a tunnel. Miljøpunkt Nørrebro, an environmental non-profit in Copenhagen, has proposed such a solution. They suggest to place the existing Åboulevard roadway below ground in a tunnel, and create a green space built around the daylighted Ladegårdsåen. The proposed plan will provide a form of stormwater management for Nørrebro, because the surface will be used for 10 and 100 year floods, and the tunnel will act as a stormwater pond during these major flooding events.

Previous studies have examined the feasibility of such an undertaking and determined that the tunnel and green space design would be suitable in the area.

Miljøpunkt Nørrebro has begun the process of creating design solutions and methods of implementation for a successful green space and have asked for assistance. We will propose the creation of a small pilot project in Ågadeparken. This small, underdeveloped park lies alongside both Ågade and Åboulevard, bordering the municipality of Frederiksberg and the neighborhood of Nørrebro. The purpose of this project is to utilize the space to test daylighting and riverbed stabilization methods that could eventually be used in the development of the larger Ladegårdsåen daylighting project. The pilot project is designed to stand alone, in the event that the larger project faces long delays or strong opposition. If the larger project is completed, Ågadeparken is intended to integrate into the park space of the larger project.

The main purpose for the small pilot project is to provide evidence that the designs and techniques, which include vegetation and landscape choices, used are successful and capable of being scaled up for the larger project. The team analyzed local opinions and awareness of the proposed green space, determined the best ecological factors that should be used in the development of a natural landscape, and developed green space designs for delivery to Miljøpunkt Nørrebro. Collection and synthesis of this information will allow Miljøpunkt Nørrebro to generate surface designs to advertise the appeal and benefits of a new green space to the municipalities of Copenhagen and Frederiksberg.

The following chapters detail key projects around the world that relate to this project, and we used the analysis of these examples to assist Miljøpunkt Nørrebro. The examples and methods identified in the following chapters will illustrate what the team accomplished while completing this project. The remaining chapters will discuss the findings we learned through our methods and what recommendations we have for our sponsor.

Chapter 2: Literature Review

Urban green spaces have long been viewed as a way of infusing urban landscapes with both open space and fresh air, known to promote good health for residents. Industrial cities suffered from cramped living quarters, poor sanitation, and factory smog. Parks and green spaces were considered an important remedy for such toxic environments, perhaps being the only way to provide people with recreational outdoor space. Today, cities suffer from different forms of congestion and pollution, brought on by the increased amount of traffic that fill the streets. These problems increase the support for the development of new green spaces in cities where existing spaces are lacking.

In the early 1900s, Copenhagen buried the Ladegårdsåen River to expand buildable space to accommodate the growing city population. Now, Copenhagen struggles with heavy traffic, coupled with air and noise pollution as a result of the 1000 new inhabitants to the city every month. To combat these maladies, Copenhagen has proposed the creation of a series of green spaces within the city. This proposal is in line with their current vision of sustainability which calls for blue green capital city with easily accessible green spaces for all residents by 2015 (Copenhagen, 2007).

2.1 Green Space

Green spaces have increased in popularity in recent years due to the ecological, economical, and social benefits to communities and cities that adopt them. These newly created natural areas increase the life expectancy of senior citizens, allow for more creative play, and improve the quality of life for neighborhoods that border the green space (Takano, Nakamura, & Watanabe, 2002; Taylor, Wiley, Kuo, & Sullivan, 1998). Green spaces preserve open space and contribute to a healthier community by "ameliorating the cumulative effects of a concentrated human population on its immediate surroundings," through the protection of ecosystems from fragmentation and human expansion (Silberstein & Maser, 2014, p. 28).

A well-known example of a successful green space is the Central Artery/Tunnel Project, commonly referred to as the "Big Dig" in Boston, Massachusetts. This project increased the economic strength of the region by connecting the North End and Waterfront neighborhoods to Downtown Boston. In addition, it created over 300 acres of parks and open space for recreational

and environmental purposes, and allowed for low-rise development in certain locations, as shown in the photos in Figure 1 (MassDOT, 2014).

Figure 1: A before and after image of the Rose-Kennedy Greenway, Boston, Massachusetts, with a ground view on the right (Adderly, 2013; Wikimedia Commons, 2015a).

While the Big Dig demonstrates the technical challenges that can arise when creating green spaces in cities, Bishan Park in Singapore highlights the ecological challenges of creating a living wetland capable of returning a built environment to its natural state. Through bio-engineering practices for slope stabilization of natural riverbanks and the creation of wetlands, Singapore's National Water Agency and Parks Board was able to recreate a naturalized river where previously there was a concrete canal (Public Utilities Board of Singapore, 2010).

The Big Dig and Bishan Park projects, coupled with smaller daylighting examples from the United States, and a flood management tunnel in Malaysia, form the basis of the literature review and provided the foundational knowledge for proposing a daylighted surface design for the Ladegårdsåen in Ågadeparken.

2.1.1 Benefits of Green Space

Increasing the amount of green space in urban areas reduces air and noise pollution for local residents by providing pollution absorption and noise buffers. High levels of air pollution have been linked to dangerous respiratory diseases, affecting the lives of millions of people (Chauhan & Johnston, 2003). Noise pollution is also a serious issue, as studies have shown that exposure to consistent noise levels in excess of World Health Organization (WHO) recommendations can contribute to adverse effects on human health, such as hearing loss and insomnia (World Health Organization & European Union, 2007).

Air pollution is a focal point for Denmark, as the national levels of nitrogen dioxide (NO_2) have consistently been above the European Union's allowable limits (European Parliament, 2008). This problem is visible along H.C. Andersens Boulevard, a major roadway in Copenhagen. The boulevard has experienced NO_2 levels significantly higher than the allowable limit, shown in Figure 2 below.

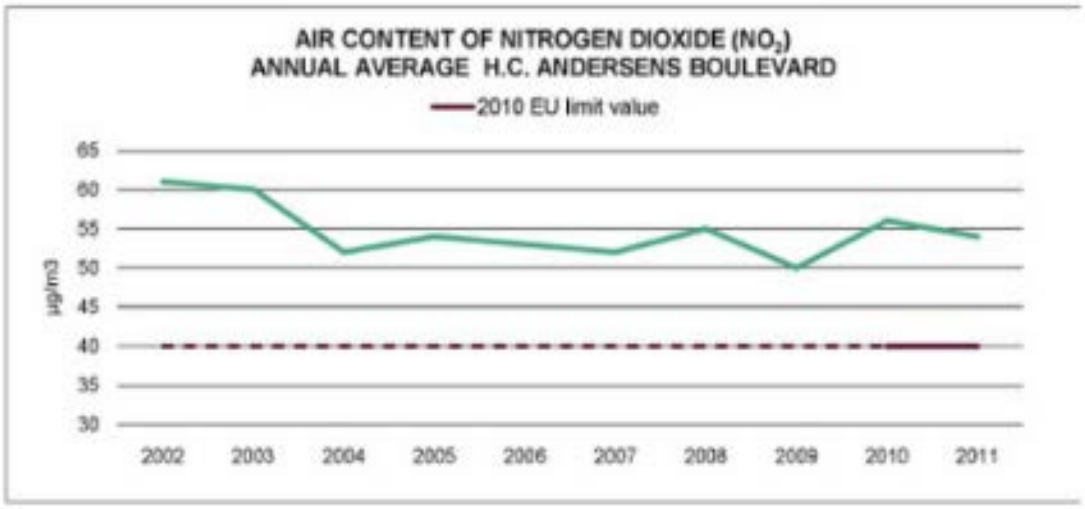


Figure 2: Air concentration of nitrogen dioxide near H.C. Andersens Boulevard (Copenhagen, 2012).

Noise pollution in Copenhagen exposes over 30,000 residents to noise levels greater than 65 decibels on a daily basis (City of Copenhagen, 2015). The WHO and European Union (EU) have established guidelines that warn against persistent levels of annual nighttime noise greater than 40 decibels. In order to reduce noise pollution, Copenhagen has lowered speed limits and begun using different types of rubber infused asphalt to reduce traffic generated noise (Copenhagen, 2013). Since 2011, 48 of the 290 total kilometers of roadways in Copenhagen have been re-paved with this asphalt to improve citizen health, shown below in Figure 3.

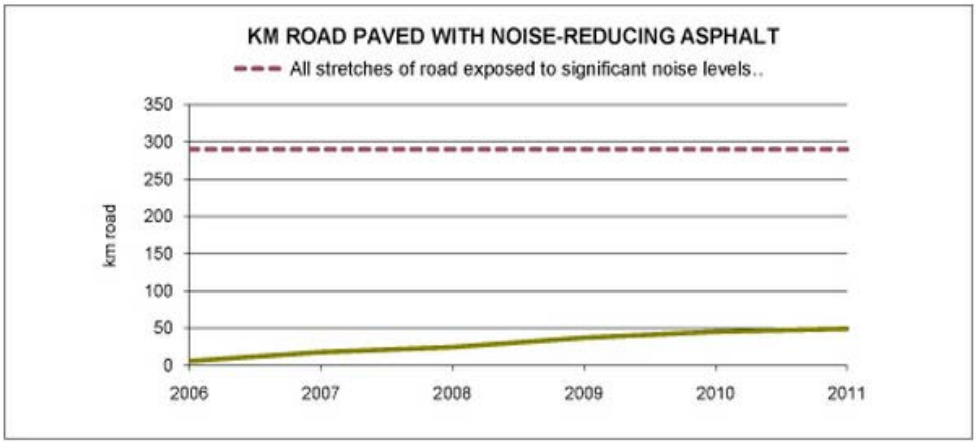


Figure 3: Amount of asphalt replaced since 2000 (Copenhagen, 2013).

2.2 Tunnels

One way to control traffic and alleviate noise and air pollution is through the use of tunnels. Miljøpunkt Nørrebro has proposed a tunnel to replace Ågade and Åboulevard in the Nørrebro neighborhood of Copenhagen to address pollution and traffic concerns. In addition, by placing these roadways in a tunnel, surface space will be made available for the creation of a new green space. A more in-depth examination of why tunneling is beneficial to this project is detailed in the following sections.

2.2.1 Central Artery / Tunnel Project (Big Dig)

The Central Artery was an elevated highway that ran through the middle of downtown Boston before the completion of the Big Dig in 2007 (MassDOT, 2014). One of the main goals of this project was to divert traffic from the elevated highway into tunnels in order to reduce the rapidly growing number of cars that travelled the highway daily. Simultaneously, the Big Dig created the Rose Kennedy Greenway, a green space that connects the North End and Waterfront neighborhoods to downtown Boston (MassDOT, 2014).

Before the Big Dig was completed, traffic in downtown Boston was rising on an annual basis due to a constantly growing number of commuters and residents. When the elevated highway was first completed in 1959, about 75,000 cars traveled on it per day. By the early 1990s, traffic along the central artery had increased to over 200,000 cars per day (MassDOT, 2014). In order to alleviate the growing traffic issues, higher capacity highways with more efficient linkages, such as one that goes directly to Logan International Airport, were constructed as part of the project.

In December of 1995, the Ted Williams Tunnel, shown in Figure 4, was completed and represented the first link connecting Interstate 90, the main east-west highway, to the airport. In addition to these interchanges and links, the Central Artery/Tunnel Project replaced Route 93, which consisted of only six elevated lanes, with an underground expressway that is eight to ten lanes wide (MassDOT, 2014). Average peak period travel time from the I-90/I-93 interchange to Logan International Airport decreased for commuters. The Central Artery/Tunnel Project succeeded in reducing traffic in downtown Boston created by the aging Central Artery and a growing population. The Big Dig successfully removed a physical and social barrier that separated two vibrant neighborhoods in Boston.

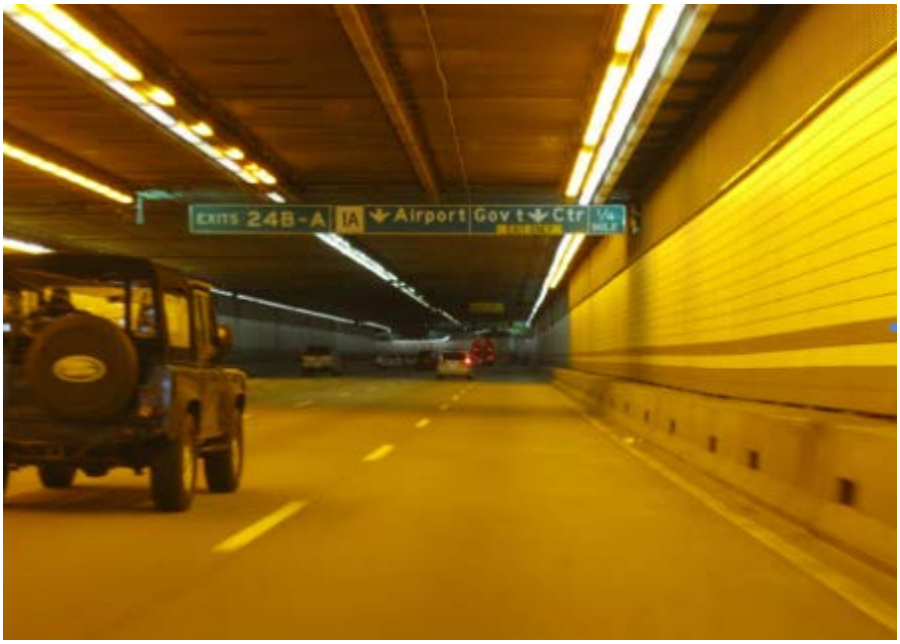


Figure 4: Inside the Ted Williams Tunnel, Boston, Massachusetts (Adderly, 2013).

2.2.2 Stormwater Management and Road Tunnel (SMART)

Kuala Lumpur, the capital city of Malaysia, is a fast-growing metropolitan area, and is subject to frequent flooding, with the country experiencing annual rainfall of over 107 inches (World Weather Online, 2015). Due to this large amount of rain, flooding is a constant concern in the city center and areas downstream of the Sungai Klang and Kerayong Rivers, as shown in Figure 5 (Helders, 2007).

Annual flooding, coupled with Kuala Lumpur's large amount of traffic, strains the infrastructure of the city to adequately address both issues. Despite having one of the most advanced public transportation systems among Asian countries, the average use of public transit by the residents of Kuala Lumpur is only 20 percent (Kiat, 2006). Daily rush hour is the primary concern for the Malaysian Government with regards to traffic and flooding, as millions of Malaysians are on the roads every day (Kiat, 2006).

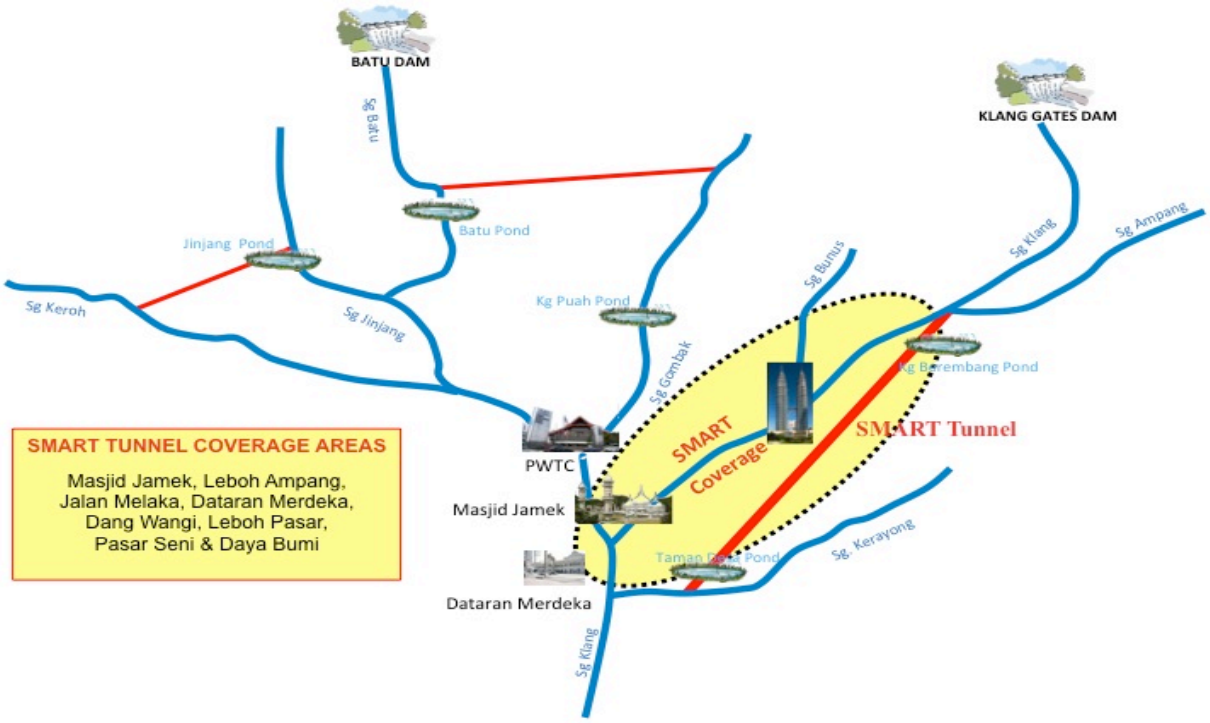


Figure 5: Map showing the rivers and lakes around the SMART. The red line represents the SMART (SMART Motorway Tunnel, 2015).

In an attempt to address flooding and traffic concerns, the Department of Irrigation and Drainage of Malaysia partnered with MMC Corp Berhad and Gamuda Berhad in a joint construction project, The SMART Tunnel, illustrated in Figure 6. Construction began on SMART (Stormwater Management and Road Tunnel) in 2003. SMART is "the longest and most technologically advanced tunnel in Malaysia" (Kable, 2012).

Figure 6: Illustration of concept for SMART (Kable, 2012).

The tunnel, displayed in Figure 7, is designed to alleviate flash floodwaters from the Sungai Klang and Kerayong Rivers during intense rainstorms, while also being able to handle over 30,000 cars per day during normal operation by providing more lanes for traffic and reducing travel time between two major roadways in Kuala Lumpur from fifteen minutes to four (Kable, 2012).

Figure 7: Picture of the SMART traffic tunnel (Gamuda, 2012).

2.2.3 Problems Addressed by SMART

The tunnel has three modes, Normal (Mode 1), Moderate (Mode 2), and Storm (Mode 3), illustrated in Figure 8 which enables SMART to handle all flooding scenarios Kuala Lumpur may experience. When flash floods occur Storm mode is engaged and SMART is closed to motorists. Then the tunnel becomes a large conduit for floodwater to drain.

A few months after SMART was completed in 2008, a major storm hit Kuala Lumpur, and the tunnel was first activated in Moderate Mode to pass traffic through the upper deck with stormwater running below. Once flooding began, SMART was activated in Storm Mode to close the tunnel to traffic. During the storm, SMART drained and held nearly 1 billion liters of water that would have otherwise flooded the two main rivers of Kuala Lumpur, resulting in the equivalent of millions of dollars in flood damage being averted. This was the first major test of the system, and SMART worked as expected, protecting the city from what would have been a major flood event. Since the first storm, SMART has been used a total of 44 times since data on the tunnel was published to divert excess floodwaters without failure.

SMART is the first example in the world of a dual purpose traffic/stormwater management tunnel. The successes and challenges of SMART can serve as an example of what to expect in projects of this magnitude.

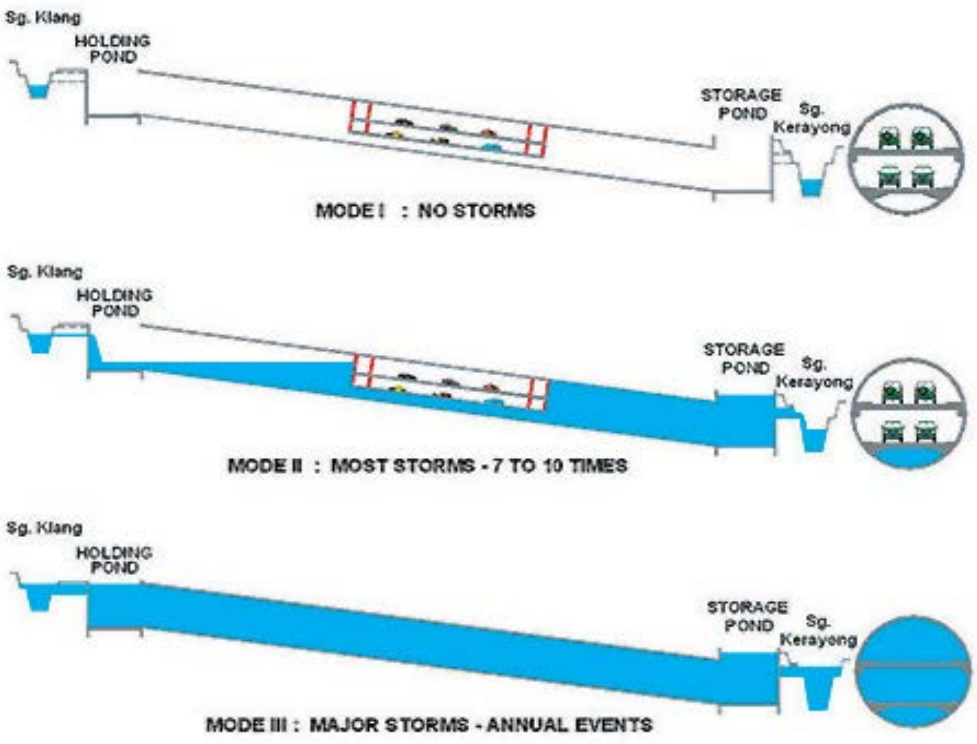


Figure 8: The three stages of the SMART's stormwater draining (Kable, 2012).

2.3 Daylighting

Daylighting a river is the process of bringing a river back to the surface after it was placed underground during development of the surrounding area. If the process is done successfully many environmental advantages arise, such as increased biodiversity and improved air and water quality (Sinclair, 2012). In addition, daylighting rivers leads to multiple social advantages, including an increased amount of community space, which allows for gatherings and recreation, and the involvement of local businesses to construct a thriving economy (Sinclair, 2012). Kalamazoo and Yonkers are examples of successful daylighting projects and how they are beneficial for the area in which they were constructed.

Daylighting buried rivers provides many economic benefits to a community, as well as improving the natural ecosystem and stormwater management capability of the area. Since cities are built primarily with impervious materials, such as asphalt and concrete, water accumulates and does not drain (Mufti, 2012). By replacing impervious surface areas in urban centers with natural surfaces, the likelihood of damaging floods is reduced, as the environment is better suited for handling larger amounts of stormwater (Kaufman, 2013).

2.3.1 Arcadia Creek in Kalamazoo, Michigan, USA

In a case similar to Copenhagen, Arcadia Creek in Kalamazoo, Michigan was buried in the early 1900s as a response to the city's rapid expansion to make room for the business district. During the 1980s downtown Kalamazoo, was struggling financially and socially, and was prone to constant flooding caused by an increasing amount of impervious surface area (Service, 2002a, 2002b). Now, Kalamazoo is a revitalized city which has embraced green space into the business district, shown in Figure 9 below.

Figure 9: A photo of Downtown Kalamazoo (Service, 2002b).

Due to increased flooding, Kalamazoo had to choose between enlarging the existing culvert or daylighting Arcadia Creek. The city determined that the latter option was more amenable for local community and environmental health (Service, 2002a). In 1992, Kalamazoo began addressing their flooding concerns by advancing their proposal to daylight Arcadia Creek, in order "to create a downtown amenity that could leverage more redevelopment" (County, 2011). This process of redevelopment and flood mitigation in Kalamazoo successfully enticed local businesses and corporations to redevelop and invest in the area, which increased the potential for a successful project. Arcadia Creek was successfully daylighted in 1995, due to widespread business and community support, while also adequately addressing flooding concerns of the city (County, 2011).

Daylighting Arcadia Creek involved creating a three-quarters of a mile long concrete channel through downtown Kalamazoo surrounded by new park space (Service, 2002b). Walkways were created for pedestrians along the channel, which ended in an amphitheater designed to collect and gradually release stormwater in the event of a flood. The amphitheater generates approximately 12 million dollars annually from summer festivals and tourism, providing a new source of revenue

for Kalamazoo (Service, 2002b). To encourage future growth, Kalamazoo offered surrounding businesses 30 year leases to encourage development around the creek with the option to renew for one dollar per year after the initial period (Service, 2002b). Ken Nacci, the director of the Arcadia Creek's daylighting project, commented that, "if you're looking for a return on your investment that is tangible, then getting commitments from local businesses and institutions early is critical" (Service, 2002a, 2002b). In the end, daylighting Arcadia Creek cost far less than the alternative of re-piping the underground river, and has provided a public amenity and tourist attraction for Kalamazoo.

2.3.2 Saw Mill River in Yonkers, New York, USA

In 2010, the organization Daylight Yonkers sought to revitalize businesses and ecosystems simultaneously by daylighting six blocks of the Saw Mill River in Yonkers, New York (Brenner, 2012; Groundwork Hudson Valley, 2015). The completion of phase one in 2012 resulted in two of six blocks being daylighted and the creation of 13,775 square feet of aquatic habitat in Yonkers (Brenner, 2012; Saw Mill River Coalition, 2015). Construction began on phases two and three in late 2013, which seeks to daylight the remaining four blocks by 2016 (Brenner, 2012; Groundwork Hudson Valley, 2015). In Figure 10 below, the photo on the left shows the Saw Mill River underground and the photo on the right shows the end result of phase one in Larkin Plaza.

Figure 10: The buried Saw Mill River and the recently daylighted portion (Kramer, 2014).

The costs of daylighting the Saw Mill River in Yonkers is estimated at 48 million dollars, with funding coming in the forms of grants from the Environmental Protection Agency (EPA), the administration of former Governor George Pataki of New York, and Groundwork Hudson Valley (Brenner, 2012; Environmental Protection Agency, April 2011; Saw Mill River Coalition, 2015).

Investment commitments from local realty groups and investors offset the substantial cost of daylighting the Saw Mill River, totaling over three billion dollars dedicated to redevelopment and generation of new construction projects in downtown Yonkers. The newly daylighted Saw Mill River became the "centerpiece of the city" according to Ned Sullivan, president of Scenic Hudson, a local environmental group that partnered with Groundwork Hudson Valley (Brenner, 2012; Saw Mill River Coalition, 2015). There are plans to encourage Yonkers' economy to rebound, such as the redevelopment of abandoned power plants, construction of mixed-use development centers, and construction of new 20 story buildings centered on the banks of the revitalized river. Residents are optimistic that a revitalized economy will spur development further and help Yonkers emerge as a vibrant, growing city, according to the executive director of Yonkers Downtown Business Improvement District, Steve Sansone (Brenner, 2012). Consensus to move forward on a project is often difficult to achieve before people can fully envision future benefits. Large-scale projects, such as Daylight Yonkers, have a difficult time being approved and pushed forward due to high costs.

2.3.3 Cost of Daylighting

Recreating and restoring natural river ways through daylighting and creating green spaces involves a significant amount of community commitment and financing. However, daylighting a river can come at a high price, but there are several economic benefits which include, increased revenue from tourism, increased real estate values, and space for recreation. The revitalization of Arcadia Creek cost the town 18 million dollars, with 7.5 million dollars being invested in daylighting five city blocks (County, 2011). The proposed daylighting of six city blocks of the Saw Mill River will cost an estimated 48 million dollars upon completion of the project (Kaufman, 2013). Additionally, there are communal benefits that can be gained, such as improved water quality, ecosystem revitalization, and reduced floods. Costs of daylighting can be less expensive than other alternatives available to address the issues mentioned previously (Trice, 2013).

2.4 Ecosystem Revitalization

A main aspect of daylighting and green spaces is the development of a surface design that takes into account ecosystem revitalization and growth. This is not only important for restoration of plant and animal life, but is also important for the success of the green space. This next section describes the Bishan Park project that recreated a wetland ecosystem utilizing natural riverbed

techniques. This project was an important resource in determining how to recreate a naturally flowing river.

2.4.1 Kallang River in Bishan Park, Singapore

Singapore, a city-state in Southeast Asia, has restored a concrete canal into a natural river ecosystem (CH2M Hill, 2012). The project began in 2007 by transforming the concrete canal into a new green space in 2012, shown in Figure 11. The construction of Bishan Park created new playgrounds and restaurants along with the renovated green space in Singapore. Due to the lack of long term planning in Singapore, water in the river was constantly polluted, which prevented residents from using the river for recreational purposes prior to the renovation.

Figure 11: The renovated Bishan Park, Singapore (CH2M Hill, 2012).

Using specific plant species and types of soil, the restored Kallang River allows for the filtration of water, resulting in clean water for the residents of Singapore (CH2M Hill, 2012). The design of the green space has proven to be successful, resulting in a 30% increase in biodiversity for the area. This increase in biodiversity is exhibited by the 22 species of dragonflies, 59 species of birds, and 66 species of wildflower that have been identified in the renovated park (CH2M Hill, 2012). Bishan Park, is an impressive ecological feat considering its proximity to a sprawling metropolis.

2.4.2 Construction of the Kallang River Test Bed

The Kallang River was incorporated into Bishan Park by utilizing fifteen different techniques to create a natural river capable of creating and sustaining an ecosystem while also fulfilling the recreational needs of residents. Before construction of the park, a 60 meter long test bed was constructed in Bishan Park to determine if a number of different bioengineering techniques used to stabilize slopes in Europe were suitable in Singapore, shown in Figure 12 (Public Utilities Board of Singapore, 2010).

Figure 12: The 60 meter test bed in Bishan Park, Singapore (Public Utilities Board of Singapore, 2010).

Gabion walls, riprap, fascines, reed rolls, and stone walls were tested during both dry weather and heavy rain to simulate the tropical climate of Singapore, in order to ensure that the naturalized river would withstand the variations in climate. Bishan Park consists of a meandering 3.2 kilometer natural river, designed to promote biodiversity and wildlife habitat, which is a portion of the park's overall vision (National Parks, 2014). The naturalized river has transformed into a focal point for Singapore's residents, as there are playgrounds for people of all ages and cleansing biotopes for pollution control. Bishan Park incorporates community activities while also managing and cleaning storm water and runoff through the use of wetlands and bioswales. The combination of

these different features have transformed Bishan Park into a thriving ecosystem with many benefits for the city of Singapore.

Bishan Park demonstrates how it is possible to successfully recreate a thriving ecosystem from a man-made environment. By incorporating the practices used in Singapore, in conjunction with the flooding and traffic solutions of SMART in Malaysia and the daylighting practices highlighted in Kalamazoo and Yonkers, a complete solution for an environmentally centered green space that addresses traffic and flooding concerns is a possibility.

2.5 Ladegårdsåen

The Ladegårdsåen River provided water to the neighborhood of Nørrebro in the 1800s. The river, flowing from Damhussøen to The Lakes, displayed in Figure 13 below, was used in the past for daily tasks such as bathing, cooking, and watering plants. However, in 1897, the Ladegårdsåen was buried underground in pipes and replaced by a road to accommodate the expanding Danish population (Loldrup, 2004). Now, after more than a century, people are advocating for the Ladegårdsåen to be brought back to the surface. Even though daylighting the river would be a major investment for the City of Copenhagen, the positive benefits highlighted in our case studies of daylighted rivers, green spaces, and tunneling suggest that the benefits of the proposals offset development costs in the long term.

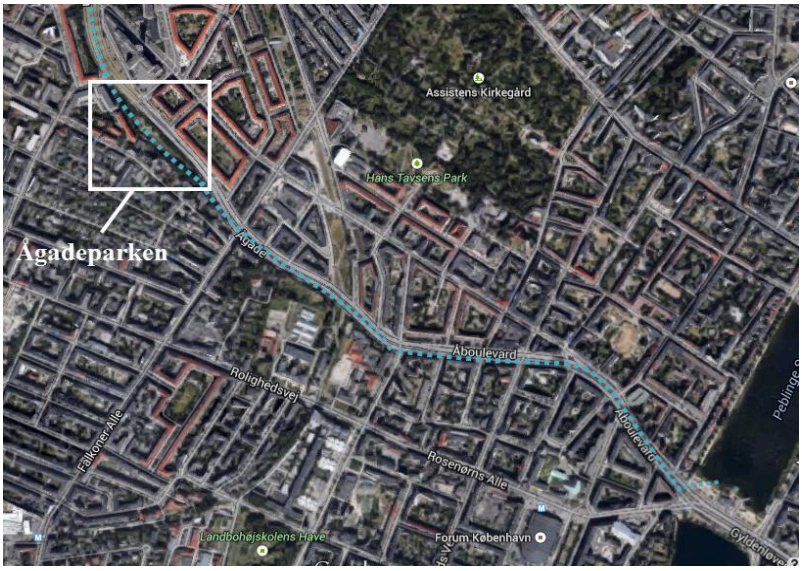


Figure 13: Path of the Ladegårdsåen

2.5.1 Consequences of Burying the Ladegårdsåen and a Possible Solution

On July 2nd 2011, a massive rain storm hit Copenhagen, releasing approximately 160 mm of rain in under three hours (Buley, 2011). The Cloudburst continued for about two days and caused immense damage to roads, public transportation, and private homes. By the end of the storm, total damages amounted to over 6 billion DKK, approximately 1 billion USD (Mufti, 2012). The storm left Copenhagen searching for a way to function after this massive flood, Figure 14 below. Public broadcaster, Preben Lund, said, "There is just one word to describe it, and that is 'chaos'…" (Buley, 2011).

Figure 14: Flooding from the July 2011 Storm (Jensen, January 2015)

People are very concerned about the possibility of another sudden storm. In fact, 45% of Danes surveyed by the Copenhagen Post indicated that they were fearful of another serious cloudburst (Mufti, 2012). In an attempt to prevent another flooding disaster, Copenhagen has been working to increase the number of green spaces in the city.

2.5.2 Daylighting Ågadeparken

Due to the ramifications of The Cloudburst of 2011, Copenhagen is aggressively addressing their flooding concerns through the creation of new green spaces. Following the lead of the city, Miljøpunkt Nørrebro is proposing the renovation of Ågadeparken to better manage flood waters in the event of another cloudburst. Ågadeparken is located on the border of Frederiksberg and Nørrebro and has an area of approximately 6,200 square meters, shown in Figure 15 and Figure 16 below.

Figure 15: An aerial view of Ågadeparken (City of Copenhagen, 2015).

Figure 16: Ågadeparken in Nørrebro, Copenhagen (City of Copenhagen, 2015).

Currently, the park is underdeveloped in comparison to other green spaces in Nørrebro, consisting of a couple of benches, a bike path, and a ditch where the Ladegårdsåen once flowed, shown in Figure 17. Aside from the park's lack of aesthetic appeal, it also lacks the necessary water capacity needed in order to protect Nørrebro from future cloudbursts. Under the Copenhagen Cloudburst Plan, Ågadeparken is expected to hold 7,400 cubic meters of water to alleviate stress on underground storm water pipes and mitigate flood damage to residences and businesses in the area (Rasmussen & Hauber, 2013). One solution for Ågadeparken, in line with the current Cloudburst plan, is to redesign the Ågadeparken green space with a daylighted river in a portion of the park.

Figure 17: Present image of Ågadeparken

With the possible renovation and redesign of the park, we believe that we can have a major impact on the use of the park from a recreational standpoint, as well as the considerations for floodwater management and hydrological care. We acknowledge that daylighting Ågadeparken will be an expensive undertaking, but we believe that the benefits of completing this project will outweigh the costs. If the pilot project succeeds, we hope it will serve as an example of a daylighted river for Copenhagen and will provide support for the larger Ladegårdsåen project.

Daylighting the Ladegårdsåen in Ågadeparken will provide a blue-green solution to address public concerns over another potentially devastating cloudburst in Copenhagen. Miljøpunkt Nørrebro has asked us to assist in the design stages of Ågadeparken as a small scale pilot project, by providing

specific design proposals to develop the park which could be applied to a larger solution for Åboulevard and Ågade. The following chapter explains the methods the team used to meet the goals of our project.

Chapter 3: Methodology

The goal of this project was to assist Miljøpunkt Nørrebro, an environmental non-profit organization, in designing an environmentally focused daylighting project in Ågadeparken, as a pilot project to garner support for the proposed larger daylighting Ladegårdsåen project, incorporating public feedback and various neighborhood opinions in our designs. The proposed designs for Ågadeparken allow the project to stand-alone, but are intended to further the larger development of the Ladegårdsåen. In order to accomplish this goal, we achieved the following objectives.

1. Gather and understand local opinion and appeal of a pilot project to residents of Nørrebro and Frederiksberg.
2. Determine the best possible plant species and riverbed techniques to address flooding concerns and ecosystem development in proposed surface designs.
3. Develop appropriate green space concept plans for Ågadeparken.

This chapter outlines the plan that our team used to meet the above objectives. The questions that were asked through our electronic survey and follow-up conversations are discussed in Section 1, with details provided in Appendix D. Section 2 explains the rationale that was used to best identify which ecological factors should be included in the creation of the pilot project. The research conducted during the background phase is documented in Section 3, along with the method of using background research as a starting point to backcast potential green space designs for Miljøpunkt Nørrebro. Backcasting is a planning method where a final goal is established and then steps necessary to achieve the goal are taken throughout development of the project. In addition, a Gantt chart has been provided in Section 3.4, indicating when these objectives were worked on and completed.

3.1 Objective One: Gather and understand local opinion and appeal of a pilot project to residents of Nørrebro and Frederiksberg

The first objective of this project was to obtain public feedback about the daylighting project for the Ladegårdsåen. Public opinion about this project has been gathered in the past, but we were tasked with collecting current information about respondents' opinions on a proposed pilot project. We gained valuable public insight on the approval and appeal of daylighting the Ladegårdsåen in

Ågadeparken. This objective was important to complete in order to identify components of green spaces that residents would accept in a new park. To achieve this, we created and distributed an **electronic survey** and created a follow-up **focus group** from interested individuals.

3.1.1 Data Collection on Public Opinion

We chose to use an **electronic survey** because Miljøpunkt Nørrebro has a mailing list of roughly 10,000 people, and also a Facebook page of 10,000 people. Surveys were the best way to take advantage of the large pool of possible respondents at our disposal. In order to obtain diverse responses and avoid potential bias, we attempted to acquire additional resources of contacts to broaden the variety of responses, but we were unable to obtain supplemental mailing lists. The electronic survey, administered through Qualtrics, consisted of questions about the respondents' awareness and approval of the project, and demographics such as age and proximity to the proposed project site. The electronic survey questions can be found in Appendix D.

At the end of the survey, a question was asked if respondents were willing to participate in a **focus group**. This was for us to gather more in depth responses on why respondents approved or disapproved of the daylighting project in detail. We asked the participants if they had any specific designs or uses for the green space they would like to see implemented in a pilot project. We also discussed what aspects of parks were unappealing to participants to ensure our designs would be widely accepted in the community. Questions for the focus group can be found in Appendix E.

The focus group we conducted was a success with seven participants, the recommended size for focus groups according to Duke University (Duke University, 2005). Our questions were open ended and exploratory and intended to facilitate discussion to allow for free flowing conversation amongst participants. This focus group provided us with personal insights and in-depth reasoning to support their ideas in relation to green space design. These methods of data collection were pursued in order to provide additional information on public opinion to Miljøpunkt Nørrebro and for the design of the Ågadeparken pilot project.

3.1.2 Analysis of Public Opinion Data

Miljøpunkt Nørrebro was interested in learning the general level of approval and disapproval of the public for the daylighted Ladegårdsåen proposal. They wanted data displayed based on respondents physical proximity to the proposed project location. This information was gathered in

surveys and presented in the form of a **heat map**, which illustrates where the respondents of the survey live and work. We generated **graphs** through Qualtrics, in order to quantify prior knowledge and approval of the project based on demographics. We also **cross tabulated** and referenced survey responses for easier analysis. Categories were decided upon through discussions Anders Jensen on what trends in the data he would like us to identify.

3.2 Objective Two: Determine the best possible plants and riverbed techniques to address flooding concerns and ecosystem development

The next objective of this project was to determine which plant species and riverbed techniques were suitable for the pilot project in Ågadeparken. To gain a better understanding of the factors involved in a green space, we visited parks in Copenhagen. In conjunction with these visits, we conducted a **semi-structured interview** with Peter Juhl, owner and director of Opland Landscape Architecture. The interview was focused on identifying plants that could create experiences and rooms in parks for all visitors to enjoy. This was an important objective to complete in order to properly design the green space with plants that will both grow and develop in the area, while also providing flood mitigation and aesthetic value. We used **field research, semi-structured interviews,** and **case studies** in order to accomplish this objective.

3.2.1 Method for Investigating Related Green Space Factors

We conducted **field research** in the surrounding neighborhoods in order to better understand what park features and plants are found in green spaces throughout Copenhagen. We visited ByOasen in Nørrebro and Sønder Boulevard in Vesterbro, in order to experience community parks in Copenhagen. The group photographed the areas to document the design and layout of both green spaces.

The last method used to complete this objective was **Case Study Research** on the Kallang River located in Bishan Park, Singapore. We analyzed this project's successful elements and related aspects of its planning and design that could be utilized in Copenhagen. An important distinction to make between these projects is the difference in climate, as Singapore is tropical while Copenhagen is temperate. Despite these differences, Bishan Park is an important model of ecosystem revitalization to emulate for the proposed green space in Nørrebro. The design of Arcadia Creek, Bishan Park, and the Saw Mill River will be considered during our designs.

3.3 Objective Three: Develop appropriate green space designs

For this objective, we furthered our understanding of how the development of similar daylighting projects were successful, specifically what factors were considered during each project's development phase. Key elements from the Arcadia Creek and Saw Mill River projects, defined as redevelopment goals, environmental benefits, and associated costs of daylighting, were identified and compared to understand their potential application within the scope of this project.

This objective was important to complete, as this was the main focus of the project. Providing green space design plans for Ågadeparken was the primary deliverable that Miljøpunkt Nørrebro wanted our team to produce. This objective was accomplished through **Case Study Research** and **Semi-Structured Interviews** with community members and PhD students at Copenhagen University, culminating in the application of the **Backcasting Approach.**

3.3.1 Method for Analysis of Similar Projects

The primary method for completing this objective was the analysis of selected case studies that are similar to Miljøpunkt Nørrebro's desired pilot project. **Case Studies** are used to investigate an event or a set of related events in order to describe and explain phenomena (Berg & Lune, 2011). This method was used to breakdown each of the aforementioned projects and we collected specific pieces from each daylighting example to use as building blocks for the creation of suitable designs for Ågadeparken.

Kalamazoo, Michigan and Yonkers, New York, as discussed in Chapter 2, were the primary case studies analyzed to complete this objective. We focused on the planning process, the creation of a healthy economic environment, and the integration of community support throughout the development of Arcadia Creek in Kalamazoo. The Saw Mill River Daylighting project relied heavily on public support and commitments from local businesses in order to move forward, and ignited an economic revitalization of downtown Yonkers. This interaction of trust within the economic and social components of various daylighting projects was compared and cross referenced to determine how these examples may be applied to the pilot project for Ågadeparken.

3.3.2 Interviews with Local Experts

To gain a better understanding of what considerations must be made when constructing a green space in Copenhagen, we conducted **Semi-Structured interviews**. This style of interview was

chosen to allow the interviewees to express their views through their own personal experiences, while also providing them with the ability to give more information outside of the prepared interview questions (Cohen & Crabtree, 2008). The semi-structured style helped provide a reliable and comparable set of qualitative data for use in the formation of a pilot project.

We interviewed Natalie Gulsrund and Louise Popowitz, PhD students at Copenhagen University, to further our understanding of green space development in Denmark. The focus of these interviews was to learn about their research and analysis in Urban Policy, and to gain insight on how local students view the proposed daylighting of the Ladegårdsåen River. Based on Natalie's recommendations, we gathered supplementary materials, such as reports illustrating designs and techniques to improve park quality and human health. We also went on a walk and distributed fliers about Ågadeparken to the group of project engineers working on the larger Ladegårdsåen daylighting project. From this walk we met and set up an interview with Anders Hansen, the Ladegårdsåen daylighting project manager. This interview focused around Anders' vision for the larger project and how he thinks Ågadeparken would be incorporated. Some of the questions included what major obstacles he has encountered while in charge of the project, and the approval process for the larger project. For complete interview questions for Natalie, Louise, and Anders, see Appendix A and C, respectively.

3.3.3 Backcasting Approach

Our sponsor, Anders Jensen, suggested we employ the **Backcasting Approach**, which involves identifying an end goal or vision and creating a method to achieve the identified goal (Quist & Vergragt, 2006). The backcasting method was developed as an alternative to traditional energy forecasting techniques used in the 1970s, and today is applied to sustainable development projects around the world (Apollonia, 2008). This method helps to identify future obstacles before they arise, instead of encountering problems as they appear. Backcasting the pilot project for Ågadeparken is intended to be supplementary to the official design process and was aimed at creating a feasible solution for Copenhagen to consider for Daylighting the Ladegårdsåen in Ågadeparken.

Our team first defined the larger problem of flood mitigation for the neighborhood of Nørrebro. Next, we identified potential obstacles to the project that needed to be considered during the planning process. Technical challenges, site constraints, and riverbed designs are a few of the

obstacles we addressed while completing the project. These obstacles led us to the creation of a future vision that the project should aim for in its development. After this vision was established, we began to collect and organize the information we had gathered and presented the findings to Miljøpunkt Nørrebro. Finally, we elaborated and defined the specific objectives and considerations for the design of the pilot project. This information was presented in our recommendations to Miljøpunkt Nørrebro.

By using the backcasting approach, important factors for success were identified and passed along to the architect, Simone Hochreiter, working with Miljøpunkt Nørrebro in order to turn ideas into designs. These designs take into account the most important factors identified through our research and are included in our recommendations for Ågadeparken.

3.4 Gantt Chart for Project Timeline

The following chart details the time of completion for tasks related to the design of the green space with Miljøpunkt Nørrebro.

TASK	**WEEK**							
	PQP	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Analyze similar case studies of daylighting								
Identify biological factors specific to the site								
Evaluate existing green spaces in Copenhagen								
Collect and analyze public feedback on knowledge and support of project								
Hold potential focus group discussions for further information								
Create potential design solutions								
Generate deliverables and design solutions, prepare final report and presentation								

Chapter 4: Findings

During our interviews, research, and surveys, we investigated public opinions of a pilot project located in Ågadeparken to daylight a portion of the Ladegårdsåen. From these data, we were able to formulate multiple designs for presentation to our sponsor, Anders Jensen. This chapter analyzes public support of the project and also identifies correlations between public approval and their demographics, in regards to the overarching project. In addition, we will go into detail about specific park designs, as well as the importance of stakeholder involvement. This chapter presents the findings that we discovered while carrying out this project.

Finding One: *A small pilot project would help push the project forward as public opinion is very influential in Copenhagen.*

The overall consensus from Copenhagen residents is that a pilot project in Ågadeparken would be beneficial to advancing the Ladegårdsåen project towards approval. One question in our survey asked the respondents if a small pilot project would change their opinion of the larger project. About 60% of the responses were positive in regards to the renovation of Ågadeparken, complete results are shown in Table 1 below. Some responses were double counted because respondents were given the opportunity to write in as many answers they desired, which led to a higher total than our 457 respondents.

If the pilot project were a success, would your opinion on the larger project change? Why or why not?		
Responses	**Number of Respondents**	**Percent**
No Response	153	31.16
In Support of Developing Ågadeparken	68	13.85
Yes, Increased Support	40	8.15
No, Would Not Change Opinion	77	15.68
Support Large Project Regardless	108	22.00
No Opinon on Developing Ågadeparken	14	2.85
Don't Understand Question	22	4.48
Against Development of Ågadeparken	9	1.83
Total:	**491**	**100**

Table 1: Survey analysis for whether the pilot project will change the resident support of the Ladegårdsåen Project

One particular answer that represented most of the respondents' opinion was, "I think unearthing part of the river is a great way to raise awareness of the project. If people are able to see the water with their own eyes, it'll be much more likely that they can get into the idea of unearthing the whole river." This showed us that the majority of respondents believed that demonstrating the feasibility of the Ladegårdsåen project through the Ågadeparken pilot project is a major stepping stone towards its realization.

Participant approval for a pilot project was reiterated in the focus group we conducted. Everyone in the focus group had the same opinion that there can never be enough green space in Copenhagen. One participant expressed concern over the state of the river after being buried but concluded by saying, “I don’t know how much you could create here, but it would still be better than nothing.” The most important message from the focus group was that people in Copenhagen want to see new and vibrant green spaces, even if the spaces are not very large.

During the focus group, we ensured the discussion focused on the participants own opinions and ideas. The input from the members of the focus group was very useful, as we found that they had a problem with visualizing physically what the space would look like and how it would function. When we discussed the small scale project it was clear that the smaller project’s success would be a great piece of evidence for people to support. They all agreed that if the smaller project is successful, people who are not confident in the larger project would have an example to look at which could change their opinion. By creating such a project, more residents of the area will hopefully become involved in the project, generating greater public support and influence that could potentially push the city to approve the implementation of the larger project.

The other common response to this question was concern that if this smaller project is created, the larger project will possibly not be pushed through and therefore, the pilot project will become a waste of municipal funds. These respondents were not against the pilot project, but instead were concerned about spending money on a small project when they believe the money should be spent on the larger Ladegårdsåen project. One notable quote from a respondent was, “I think it is ridiculous to spend a lot of money on such a small change. It's not long term thinking. Politicians need to think big, and spend more money on this project that could change Nørrebro and Copenhagen for the better in the long run.” The respondents were in favor of the pilot project, but expressed concerns in regards to spending money without approval of the larger Ladegårdsåen project.

We also interviewed Anders Hansen, the project manager of the Ladegårdsåen project, to get a better understanding of a more conservative view on the project. In the interview he highlighted the importance of public opinion and influence on projects in Copenhagen. One example he mentioned was Harbor Park in the center of Copenhagen, which was previously utilized for oil production and boating. Due to the high boat traffic, the harbor and surrounding area became

unappealing and polluted. The locals in the area were upset, so they fought the plans for more commercial buildings and companies, and now the area has been transformed into a signature green space in the center of Copenhagen. Harbor Park "was actually built due to local people who stood up against the plans for building the area with more traditional housing and companies." Anders also reiterated the idea of public involvement by saying, "Any local engagement can actually be adopted by our politicians, and change the way we actually approach the project." This showed us that the public influence, especially on city projects, is much stronger than we originally thought.

Through this data, it can be seen that a major portion of people would like to see a pilot project in Ågadeparken. The one major concern from the survey was the possible waste of municipal money. We feel this is a minor concern, especially with the overwhelming opinion that any new and improved green space in Copenhagen is desired. Ågadeparken will be designed to integrate into the larger Ladegårdsåen project in the future, if the larger project if adopted. This will help advance Ågadeparken's approval, which would show those who are undecided about the larger Ladegårdsåen project how Copenhagen could benefit from daylighting.

Finding Two: *Active and continued involvement of local stakeholders contributes to the success of daylighting projects and green spaces.*

Our case studies, interviews, and surveys show that one of the most important aspects of green spaces and daylighting projects is the active involvement of local stakeholders in the completion of the project. The daylighting projects in Kalamazoo and Yonkers were successful because of the involvement of local businesses who saw a great opportunity and chose to establish shops and restaurants along the newly exposed rivers. Yonkers obtained over three billion dollars of investment commitments from local realty groups and investors to offset the cost of the daylighting project. In downtown Kalamazoo businesses were given 30 year leases with the option to renew for a dollar in order to incentivize them to commit to the revitalization of Kalamazoo. This led to Kalamazoo generating an annual profit of 12 million dollars from the daylighted river. Ken Nacci, director of the Kalamazoo daylighting project stated that "If you're looking for a return on your investment that is tangible, then getting commitments from local businesses and institutions early is critical" in order for large daylighting projects to succeed. These two successful projects

highlight the benefits daylighting projects can have on a city, whether it's through construction investments or new streams of revenue.

In addition to business involvement in daylighting projects, the participation of local community leaders and members is vital in gaining support for the project. Of the three case studies we examined, only Bishan Park was completed and advanced solely by the government. The Kalamazoo and Yonkers projects were conceived by local environmental groups seeking to positively influence their community. These groups had to convince their local governments that the benefits of daylighting portions of their downtown areas outweighed the costs the projects would impose on their cities. Their efforts were successful as both Kalamazoo and Yonkers have benefited ecologically and economically from the creation of their two daylighted spaces.

We applied these processes of approval and commitment to the formulation of our project, as we sought to contact researchers in the fields of urban design, local government experts, and individuals who would directly experience the park. Throughout our project, we found strong support for the pilot project and the larger Ladegårdsåen project from interviews with researchers, who all believed that both projects are great ideas. The only flaw with the larger project, according to Natalie Gulsrund, is the belief that it is not politically feasible with the current political climate to advocate such a grand project as "[the politicians are] kind of dancing a line between keeping Copenhagen 'green' and economically vital." While it may seem daunting to convince politicians that Ågadeparken and the Ladegårdsåen should be pushed forward, Anders Hansen believes that "the local people have a big influence, here they are very positive," and their involvement in the project could convince the politicians to support the project. He also believes that "we [should] design the streets in a new way, [with what the] local wishes, thoughts, and ideas are," so that any solution proposed is acceptable for the locals and everyone else.

If there is a lack of a park space in a community, "any local engagement can actually be adopted by our politicians," according to Anders. This highlights the idea that local requests for city projects can be adopted by the politicians and moved towards approval. If this pilot project is approved, then it has the potential to showcase the methods identified in this report that could be applied to the larger Ladegårdsåen project. This successful display of daylighting methods in Ågadeparken would provide concrete evidence and bolster support for the development of the larger Ladegårdsåen project

The most important stakeholders in the discussions we had were the politicians of Frederiksberg and Nørrebro. Some will think the pilot project is “too much money” or a “waste of money” when the larger project funding could be used to finance five or six other parks in Copenhagen, according to Anders Hansen. While both the mayors of Copenhagen and Frederiksberg are interested in the project, they have different political beliefs. Anders believes that traffic is the greatest concern to the mayors, as “everyone wants high accessibility to the roads, and so on, but no one wants the others to have access,” to the others’ roadways because they feel they have enough traffic in their own city. While the local community may desire a park, it is important to design a space that can be used throughout the entire year.

While green spaces are great for the community and the city, they may not always be the most feasible solution when other factors, like traffic and technical details, are considered within the context of the larger project. Anders Hansen stated that Frederiksberg “exports a lot of traffic to Åboulevard,” and that the Danish government owns the beginning of the major highways Åboulevard and Ågade. In order to gain approval of the larger project, “we have to convince them in the finding that they don’t need that piece of highway,” according to Anders. He believes that “if we can handle the traffic issues, we are [a] big step further” to completion of the project, something we hope to facilitate with our report.

In order to best address these concerns, we discovered that involving local government officials and community leaders from the onset of any project is important for success. As Louise Popowitz stated, “Include the local communities and stakeholders in the planning [process]. By getting them to participate, it will create a sense of ownership and responsibility for the space, thus improving the success rate.” Taking this suggestion, we analyzed the feedback from the interviews, survey, and focus group, and incorporated it into our design of Ågadeparken.

After analyzing stakeholder involvement, we found the most successful method of presenting the proposed pilot project was to sit down with small groups of people, and discuss what they would like to get out of a small park. This method of communication proved insightful and effective in gathering local opinion data.

Finding Three: *Support of daylighting the Ladegårdsåen is not affected by resident's mode of transportation.*

We found that support for the daylighting of the Ladegårdsåen in Ågadeparken is not affected by respondent's mode of transportation in their everyday life. Of the 457 survey responses that we received, 450 (98.4%) expressed support for the project. Amongst all respondents, 76 percent indicated that they use bikes as their main mode of transportation and were in favor of daylighting the Ladegårdsåen, with over 90 percent (319 out of 348) of bike owners strongly in favor of the project. Figure 18 shows that most respondents rated the support of the project as a 5 out 5, with 409 out of 457 surveyed (89%) strongly in support of the project. Opposition to the project among those surveyed was low, with 7 out of 457 (1.5%) respondents indicating that they were neutral or opposed to daylighting the Ladegårdsåen.

All respondents who own and utilize cars as their primary mode of transportation support the larger project, with 82 percent (37 out of 45) strongly in favor of the project. None of those surveyed who owned cars indicated opposition to the project, suggesting that the primary users of the road may not be opposed to the creation of a green space and tunnel.

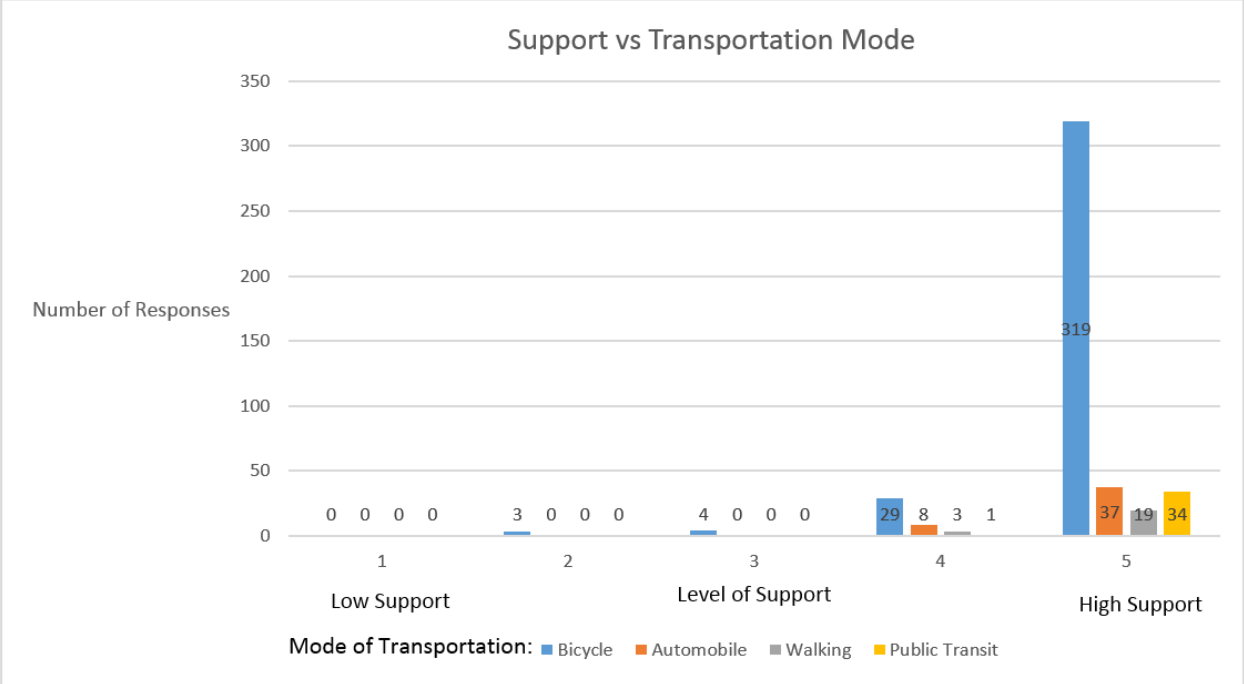


Figure 18: Survey analysis of the residents support vs. transportation mode

Finding Four: *Pollution reduction, flood management, recreation space, and beautification are the most important issues to be addressed in green space design.*

Green spaces offer physical and health benefits including reductions in air pollution, dampening noise pollution, and providing areas for relaxation and recreation. Our interviews, surveys, and focus group indicated that while support for green spaces is strong, they should address issues that the community believes are important. Those surveyed were asked to choose the top four issues they would like addressed in a new green space for Nørrebro, Figure 19 below. Of those surveyed, 322 out of 457 respondents (70%) indicated that reducing pollution in their environment was the most important aspect of green spaces to them. Flood management and mitigation was the second most important issue respondents would like addressed, with over 65% choosing this option. An increased amount of recreation space was an important issue of green spaces that 263 out of 457 surveyed (58%) identified they would like to see a solution for in Nørrebro. Beautification of the area was the fourth most chosen response, with 50% of those surveyed choosing it as a vital issue that should be addressed in any new green space or daylighting project.

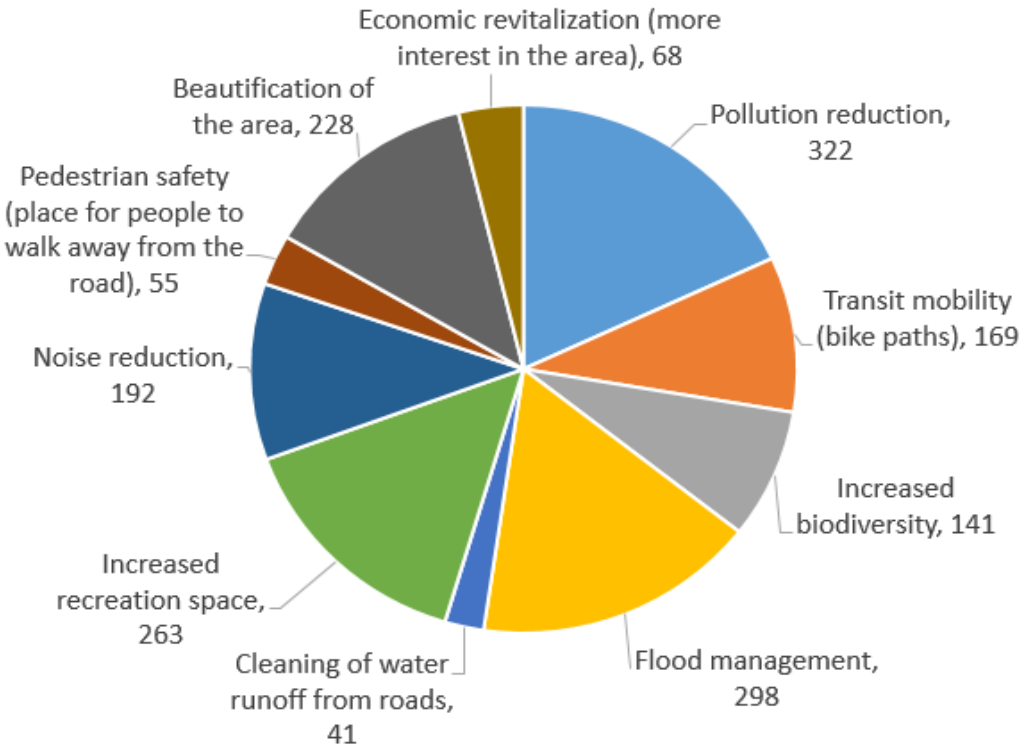


Figure 19: Survey analysis of issues parks should address

It is important to note that Figure 18 shows the four most important issues to general public, not experts in the field of green spaces. From our focus group and expert interviews, multifunctional spaces appear to satisfy the largest amount of respondents. All of the experts we interviewed agreed that green spaces should be capable of providing multiple benefits to a community.

While parks and green spaces should enable visitors a freedom to choose activities, safety and security should be taken into consideration when designing such spaces. One member of our focus group brought up the fact that walking through the park itself should be open and safe at all hours of the day. The same member of the focus group stated that "there's a line where trees can be a good thing, or it can be too much," as they can create places for individuals with malicious intent to hide, causing those passing through the park to feel unsafe at night. Any design for green spaces should seek to strike a balance between open space, privacy, and safety in order for the space to be successful.

Finding Five: *Green space design should be multifunctional and natural.*

Through the process of gathering information on park design, we found that Copenhagen residents have a preference toward parks that focus on a natural feel and are not meticulously designed. In order to analyze other parks in Copenhagen, we visited ByOasen in Nørrebro and Sønder Boulevard in Vesterbro, Figure 20 and Figure 21 respectively.

Figure 20: Multifunctional and natural ByOasen Park in Nørrebro

ByOasen is a community run park that was constructed by Miljøpunkt Nørrebro. The community helps care for the rabbits, roosters, and goats. There is also an open green space with benches where park visitors have the freedom to decide how they use the park. We felt this park was a good example of a natural park that had many varied uses integrated into its design.

Figure 21: Small and natural park in Sønder Boulevard in Vesterbro

Sønder Boulevard is a green strip which serves a variety of functions to local residents. Initially a row of elm trees, Sønder Boulevard was redesigned after all the elms were killed by disease. The park acts as a median between opposing traffic lanes, while providing space for recreation and relaxation. Sønder Boulevard is a good example of a small park space which was renovated to provide residents a natural space feel separated from the city.

From individual resident input, a common idea was that a park should be designed so that the people using the park could decide its purpose. In particular, the installation of park features that require a lot of space and cannot be used for different purposes should be avoided in the design process. Specific examples of these would be large playgrounds and skate parks. The phrase "multifunctional spaces" was brought up several times in the online survey, expert interviews, and the focus group, as seen in both Figure 22 and Table 2. In addition, both the focus group and survey responses showed that the inclusion of intrusive, unnatural features should be avoided, as the

respondents wanted a space that feels very natural. We believe that a sufficient number of these purpose built parks exist, and this park will not have one particular use.

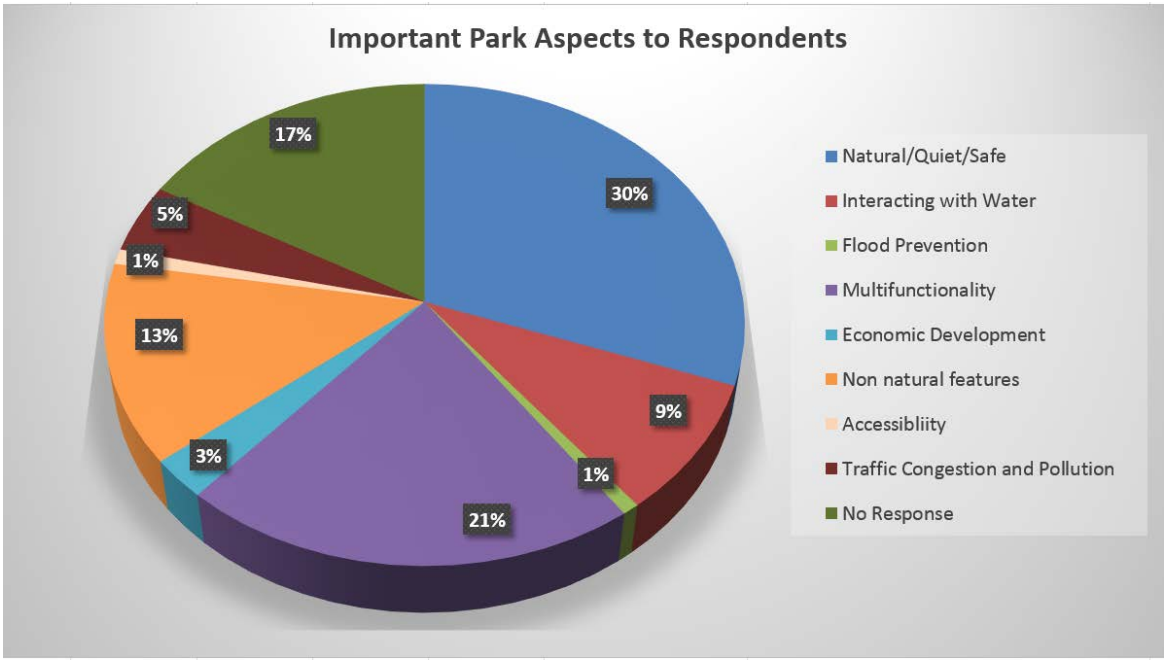


Figure 22: Important aspects of green space design to respondents

Important Park Aspects to Respondents	Number
Natural/Quiet/Safe	271
Interacting with Water	79
Flood Prevention	7
Multi-functionality	189
Economic Development	24
Non-natural features	119
Accessibility	9
Traffic Congestion and Pollution	41
No Response	149
Total	888

Table 2: Data values for important park aspects to respondents

In the interview with Peter Juhl, Owner and Director of Opland Architecture, we learned about the idea of “rooms” in park spaces. Different sections of a park that allow people to feel separation from the city and the rest of the park are called ‘rooms’. These rooms vary in size and shape, and enable the user to have different experiences throughout the park. For our design, we focused more on the creation of points of attraction, such as benches and hammocks that do not occupy a large area of space, to keep with the idea of an open space that can be multifunctional. Hedges will be

used in the creation of rooms which include benches and tables. This idea allows for the park space to remain open, while providing the possibility for exclusive space.

In order for parks to remain open, park designers do not have to create specific recreational spaces, according to Peter Juhl. Space can be designed so that parks are not reserved for one specific purpose. Peter stated that it's important to design the park so that "all users can use each area, in the way they are inspired" and that they have no limitations on what can be done in each area. He believes that "a big playground with no kids on it looks terrible" and is essentially a wasted space because the playground "is reserved for them and it doesn't inspire anybody else to go there and use it." The ideal green space would be a mix of recreational, green space, and flood management in the creation of Ågadeparken. It is important to not over emphasize any one aspect of a park and ensure that all users can use the park in the way they are inspired. This idea of multifunctional and natural spaces was consistently addressed in our research and data collection.

Limitation Acknowledgements

We acknowledge that there are potential limitations to all of these findings, but we believe our data is satisfactory and well-developed. We chose to use an electronic survey because this method of data collection gave us access to the most possible respondents. For the survey, respondents had an initial familiarity with Miljøpunkt Nørrebro and the daylighting of the Ladegårdsåen. This familiarity could potentially have resulted in biased responses to our survey. The demographics of the survey respondents and focus group were compared to the neighborhood of Nørrebro, and found to be very similar. These matching demographics allowed us to consider these responses as a representation of the population in the area. We attempted to gather varying opinions from Frederiksberg, but we were unable to obtain mailing lists for Frederiksberg to broaden our pool of respondents and acquire more data. We attempted to remedy this lack of diversity by conducting street interviews in Frederiksberg. However, this endeavor was unsuccessful as only two of the approximately 30 people we approached were willing to stop and answer our brief survey. These two results were excluded from the report as they were not statistically significant, because they were outside of our target area.

While our survey provided respondents the ability to select multiple issues that green spaces can address, the list was not comprehensive of all possible issues, and there was no option for people to write in their own opinions. Other issues may be of greater importance but were not accounted

for in our survey. The issues we decided on were based on our background research, discussions with our sponsor, and our experiences in Copenhagen and green spaces. We cannot claim with certainty that the four issues identified in finding four are the most important that a green space should address in Copenhagen, but from our research and data collection of public opinion, we are confident that they are vital issues a park should address.

The limitations in our data collection are minor and we believe most people would be in favor of Ågadeparken being renovated. The current green space is underdeveloped and does not adequately address the future flooding concerns of Copenhagen. Incorporating a body of water as a focal point in Ågadeparken would increase the appeal of this space and address the lack of green spaces with water features in Copenhagen, also known as blue-green spaces. We have compiled a set of recommendations for Miljøpunkt Nørrebro in order to help them increase support for both daylighting projects, as well as design proposals for the pilot project in Ågadeparken.

Chapter 5: Conclusion & Recommendations

This chapter includes recommendations that we have established through our focus group, interviews, research, and surveys on public opinion in Nørrebro, and includes our design proposal for the pilot project in Ågadeparken. It is our hope that these suggestions spark discussion on the larger Ladegårdsåen project with the various stakeholders involved.

5.1 Recommendations for Open Space Design

Ågadeparken should strike a balance between open space and seclusion, in order to provide a quiet and private park which is inviting to enter. To accomplish this, we suggest the creation of a boundary tree and hedge line to distance the park from the road. The interior of the park should be as open as possible to allow space for the river and any recreational activities visitors desire. This would be accomplished through the careful selection of trees that absorb noise and air pollution, but allow for sightlines into and out of the park. Adopting an open layout for Ågadeparken would give the sense that the park is larger than its actual size. We recommend the implementation of these features into Ågadeparken in order to strike a balance between open space and privacy.

5.2 Recommendations for Riverbed Construction

Our surveys and interviews indicated that the most important aspect of riverbed construction is the ability to make it appear natural. Numerous survey respondents and all seven members of our focus group expressed the desire to see a natural riverbed in Ågadeparken. Thus, we recommend constructing the riverbed in order to simulate a naturally flowing water way, instead of a concrete canal. By creating the riverbank and riverbed with soil and vegetation, the naturally flowing river could potentially provide ecosystem services to local species and create new habitats for animals. These habitats for plants and animals would offer people access to a natural setting in an urban environment. A detailed table of these approaches can be seen in Table 3 below.

Riverbed Stabilization Methods Pros - Cons

Method of Stabilization	Approach Type	Description	Pros	Cons
Rip-Rap	Hard	Rocks placed on a riverbank to absorb wave energy and prevent erosion of soft soil underneath	• Stable and protective • Appears semi-natural	• Susceptible to rock movement • Riverbank soil may, weakening Riprap
Engineered Revetments	Hard	Sloping structures used to absorb the energy of flowing water and reduce erosional forces	• Higher resistance to erosion than smaller riparian stone	• Unnatural look and feel to the riverbank
Retaining Walls	Hard	Vertical structures used to prevent erosion or bank failure	• Weight of wall contributes to stability • Relatively strong, hard to undermine	• Unnatural • does not dissipate water energy very well
Flow Control Structures	Hard	Structures are placed in the construction phase of the river to divert and change the flow of the water to decrease erosional forces	• More natural method of reducing the force of water • Can control the direction, velocity, or depth of water	• Structures are generally permeable • Susceptible to erosional forces themselves
Bioengineering	Soft	Utilizes live vegetation and plantings to provide stabilization to riverbanks	• Cheaper than most hard approaches • Provides natural environment for river bed and other species	• Requires more time than hard approaches to establish • May not provide immediate protection to riverbank • Labor intensive
Synthetic Engineering Solutions	Hard and soft	Creates durable and stable riverbanks through the use of hard approaches with space for vegetative growth to occur	• Provides good support to the riverbank • Aesthetically more pleasing than just hard approaches • Creates habitat for plants and animals	• More expensive to produce and maintain • Requires expertise in the interaction of natural and artificial features

Table 3: Detailed analysis for riverbank stabilization techniques (See Appendix F for more pictures)

There are two main categories of riverbank strengthening and stabilization: hard and soft. Hard approaches consist of rip-rap, stabilization walls, and other artificial techniques to provide support to the bank of a river, shown in Figure 23. While generally more expensive than softer approaches to riverbank stabilization, hard approaches are durable, highly stable, and can provide future habitat for vegetative growth. Hard approaches are also much easier and faster to repair, as long as those responsible for maintenance have access to the necessary materials.

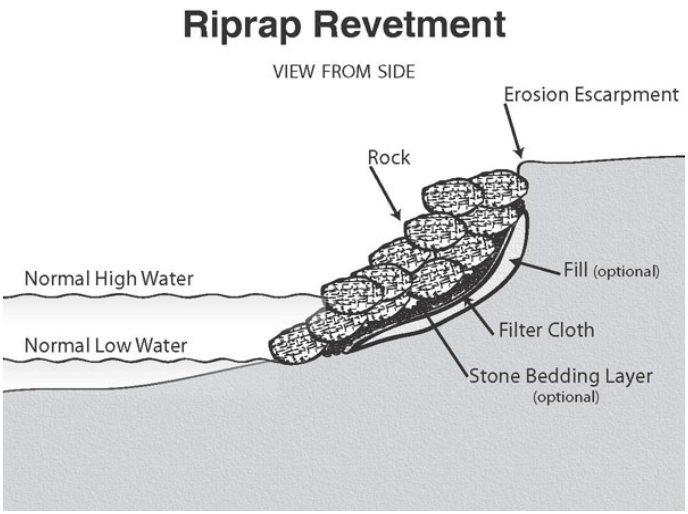


Figure 23: Sketch of rip rap stabilization wall (Northern Neck Marine Construction, 2015)

Soft approaches to riverbank stabilization involve various bioengineering techniques, including different types of vegetation that serve a variety of functions to the river, shown in Figure 24 below. Utilizing natural vegetation in stabilizing riverbanks costs less in comparison to hard techniques

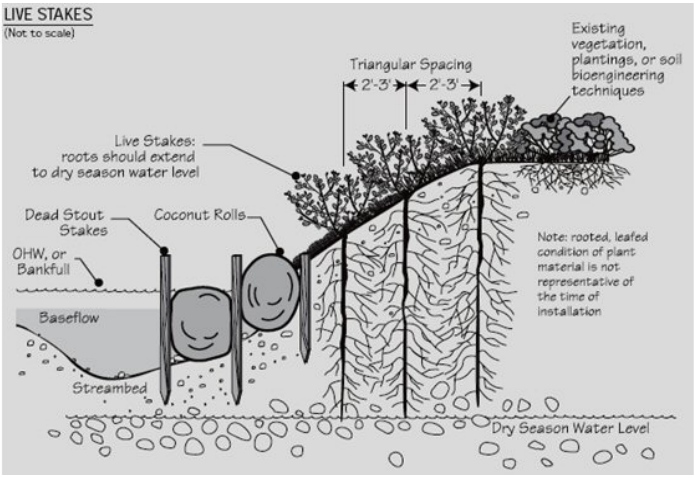


Figure 24: Sketch of live stake approach (Indiana General Assembly, 2006)

at the sacrifice of a quick repair. Soft approaches to bank stabilization provide regenerative protection and create better environmental outcomes for the future.

A further category of riverbank stabilization is the combination of hard and soft approaches into synthetic engineering solutions for riverbeds, as seen in Figure 25 below. These solutions create strong riverbanks that are durable and stable, while also providing areas for vegetative growth and increasing aesthetic value. These approaches require more expertise and money to produce, because the interactions of these artificial and natural surfaces are difficult to create and maintain.

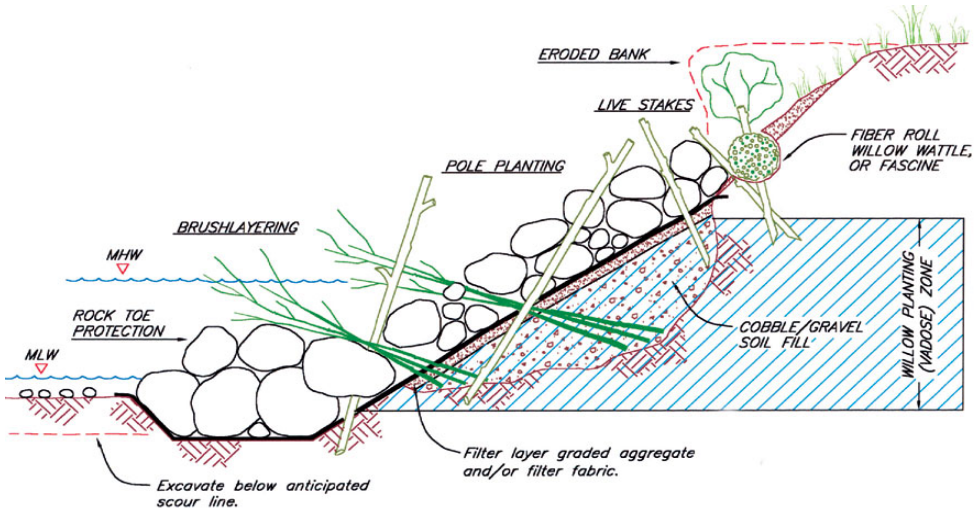


Figure 25: Sketch of synthetic riverbank stabilization technique (Ernst Conservation Seeds, 2014)

We recommend that Miljøpunkt Nørrebro explore the utilization of soft approaches for the creation of a natural riverbank, because they would best fit the vision that Miljøpunkt Nørrebro has proposed to Copenhagen. The natural landscape that would be created has the potential to continually grow and evolve into a space for all residents to enjoy.

Through our designs of Ågadeparken, we discovered that the best way to create the river is to make the riverbed capable of handling approximately 700 cubic meters of water during normal operation. We recommend this because we feel this is a balance between not enough and too much water, allowing visitors to Ågadeparken to enjoy the water without being fearful of its depth or width. To accomplish this, we recommend constructing a river through Ågadeparken that is one meter in depth, one and half meters wide. This river should be created with artificial bends in order to simulate the natural flow of water through a landscape, while also reducing the velocity of the

water, easing erosional forces. Illustrated below in Figure 26 is a cross-section example of what we believe the riverbed should look like after completion construction.

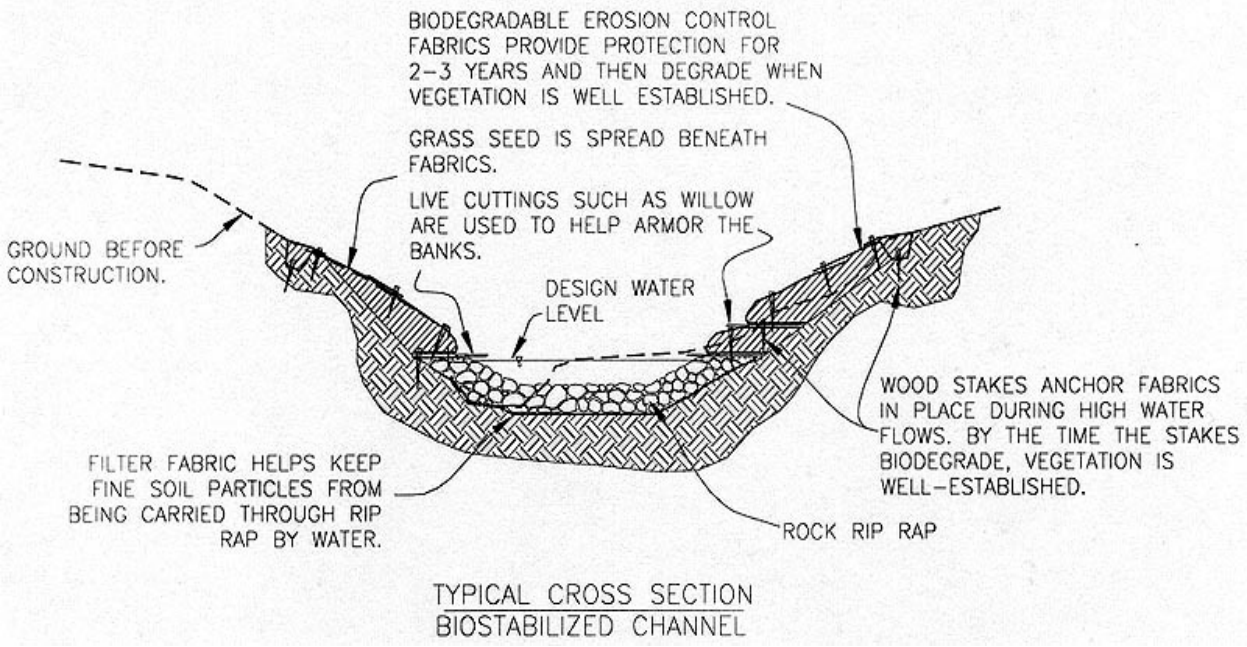


Figure 26: Example cross-section of a riverbed (City of Columbia Missouri, 2015)

5.3 Recommendations for Plants in Ågadeparken

By using the focus group, interviews with experts, and research on plant species we have come up with several recommendations for the plant choices for Ågadeparken. The first recommendation we have for Miljøpunkt Nørrebro is to use evergreen trees in the design of the park in order to provide color throughout the year. Peter Juhl, advised us that using these trees makes the space more inviting and beautiful during the months where there is less beauty in the park.

Another recommendation we have developed during this project is the use of trees that absorb and decrease air pollution from vehicles. Anders Jensen, our sponsor, brought this idea to our attention based on research by Arne Sæbø, an expert in plant propagation. Our research shows that the best species of these shrubs to use are the *S. incisa, P. mugo, S. japonica*, shown below in Figure 27. The best pollutant absorbing trees to use for this application were found to be *P. sylvestris* and *B. pendula*, shown below in Figure 28. Our recommendation is to use these trees on a narrow median between the busy street and the bike path in order to decrease the amount of pollution from the bicyclists and the park users.

Figure 27: Images of best pollutant absorbing shrubs (HGTV, 2015; Plant Points, 2015; United States Department of Agriculture, 2015)

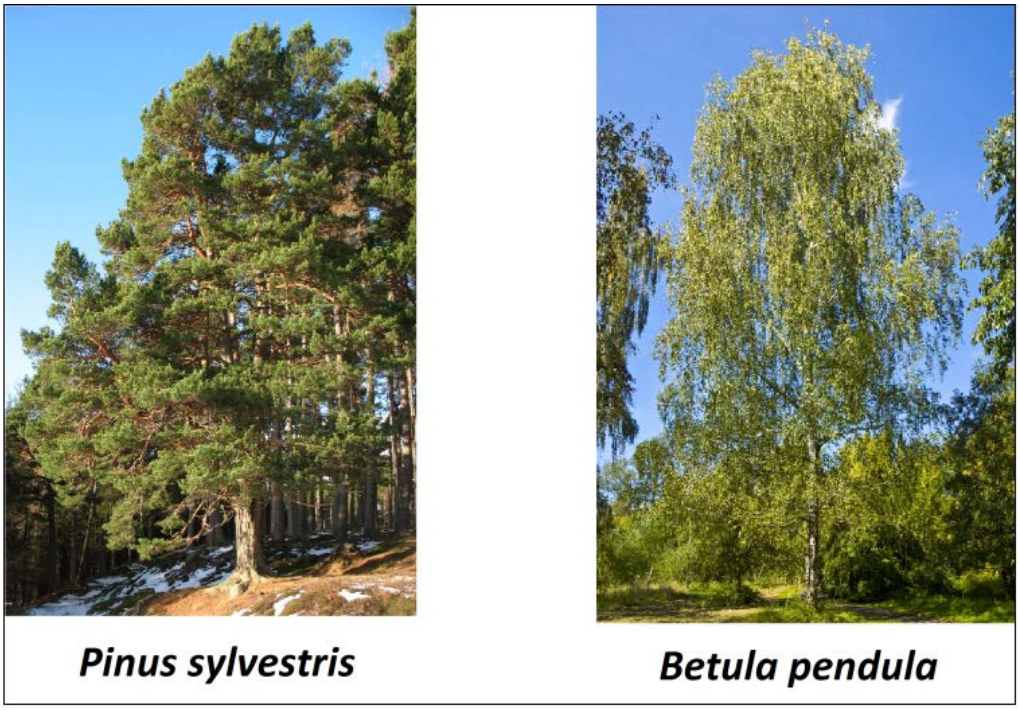


Figure 28: Images of best pollutant absorbing trees (Wikimedia Commons, 2015a, 2015b).

By researching the list of aquatic trees given to us by Peter Juhl and conducting background research on how to maintain natural riverbeds, we recommend that willow trees be used in the beginning and end of the river. Willow trees were on the list of plants that are able to thrive in aquatic settings. They are useful in managing the floodwater in the park because they are known to be good absorbents of water. Research also shows that trees and plants that have roots strongly set in the soil can help to stabilize the riverbed and prevent destructive erosion of the riverbed (Garanaik & Sholtes, 2013). For a more in depth list of different plants used in riverbank stabilization, see Appendix G.

People involved in the focus group mentioned they liked parks which include secluded and quiet areas where they can relax. In order to achieve this, we recommend that hedges be included in the design near the apartments on the Frederiksberg side of the Ågadeparken and also throughout the park in order to create 'rooms.' These rooms allow for both noise reduction and seclusion. Peter also mentioned that rooms invite people to stay in the park and entice them to explore the interior of the space. By putting rooms in the design of the park, visitors will want to stay and relax and use the green space.

5.4 Park Features and Design

The park features that we have included in our design for Ågadeparken are based on resident feedback from our online survey and focus group. The analysis of what components should be incorporated into our park design is also based on input from our expert interviews; working alongside Simone Hochreiter, Miljøpunkt Nørrebro's resident architect, and Anders Jensen, the project sponsor. From all of these sources, we have concluded that the general approach for Ågadeparken's design should be natural and non-disruptive, implementing features that will not distract visitors from the natural environment of the space. By incorporating as few artificial elements as possible, the design will addresses the most popular input from residents on park design, more natural space.

The following is a list of specific park features and design methodologies that should be included in the redesign of Ågadeparken:

1. We propose a relocation of the bike path, because this would allow for a row of trees to separate the park from the road and give more protection for the bikers. This row of trees would absorb some of the pollution particulates from the road.
2. Taking into account public feedback, we propose the creation of dedicated social space consisting of tables and a grilling area, as having a place to sit and relax with others was a common request during our research.
3. Due to overwhelming input for this feature from our online survey, hammocks are a proposed optional feature that could be implemented in between the pocket trees to provide additional relaxation spaces.
4. We propose that a loose stone path, shown below in Figure 29, known as a paver stone walkway, should replace the current asphalt path, because the asphalt path is the most intrusive structure of the park. This small change will make a difference in creating a more natural feel to the park, while still providing a functional walkway, accessible to all visitors.
5. Small wooden bridges should be constructed to connect the two sides of the park over the river, shown in Figure 29 above. These bridges will connect both side of the park and add aesthetic value, and should also be accessible to handicapped persons.

Figure 29: First person point of view perspective of redesigned Ågadeparken (Simone Hochreiter, 2015)

6. . The placement of the benches alongside the hedges also creates natural gathering points for people to relax, an example of the idea of “rooms”, shown in Figure 30 below.

   Lower hedges with accompanying benches will supplement the tree line on the Frederiksberg side of the park, in order to provide a feeling of inclusion for the apartments that are connected to the space. Safety was a concern expressed by many during our research. It is addressed in the design by providing easier access and creating a sense of security for visitors to the park

Figure 30: Example of a ‘room' with a bench (rgbstock free stock photos, 2015).

7. An overall aerial design of Ågadeparken can be found in Figure 31 on the following page. This design has our proposed details for each aspect of the redesigned green space.

Figure 31: Aerial design of Ågadeparken green space (Simone Hochreiter, 2015)

5.5 Influence of Public Opinion

Our results showed us that public opinion and ideas are very important in the development of city projects. The interview with Anders Hansen informed us how previous major city projects, such as Harbor Park, were expedited by the public pressuring the government of Copenhagen to act. The focus group and survey respondents also reiterated this idea, stating that building a small pilot project could garner more public support for the larger project, leading to possible city approval. However, some problems we encountered included limited knowledge of Ågadeparken and its accompanied daylighting aspect, as well as a lack of public support for the Ladegårdsåen project outside of Nørrebro. In order to address these problems, we recommend that Miljøpunkt Nørrebro begin a public outreach campaign for the Ågadeparken daylighting project. This campaign could utilize billboards in areas of high pedestrian traffic, or a newsletter. The goal of this campaign would be to inform the public about the pilot park project in Ågadeparken, and in turn generate more support for the project.

The neighborhood of Nørrebro has strong local support for the Ladegårdsåen project, but many residents are not aware of the possible improvements to Ågadeparken. This level of understanding of both daylighting projects decreases as you go further from the proposed site, especially in Frederiksberg. The public outreach campaign should focus almost exclusively in the area near Ågadeparken, on both the Nørrebro and Frederiksberg sides of the park. This is because the people surrounding the park are the ones that are going to be using the park most often. The campaign could help persuade Ladegårdsåen skeptics to support Ågadeparken as a pilot project. The scope of this project is much smaller than that of the Ladegårdsåen, leading to a higher possibility of approval and therefore advancing the Ågadeparken pilot project development.

Another broader public outreach campaign could be planned for other parts of the city focusing on the Ladegårdsåen project because it would be more impactful on these people than the smaller Ågadeparken project. Even though the focus of this new campaign would be on the Ladegårdsåen, there would still be a connection to Ågadeparken to help inform people about the testing of the daylighting process and garner their support. The intended outcome of this campaign would be to gain enough public support so that Copenhagen's government would be forced to make a decision for the Ladegårdsåen project. We have created designs for the park in conjunction with Miljøpunkt

Nørrebro, but the next step is to gain support for the implementation of these designs, while using Ågadeparken as a stepping stone for the larger Ladegårdsåen project.

5.6 Stakeholder Involvement

The results showed that active involvement of local stakeholders is vital to the success of any park. In order to address this issue, we recommend that Miljøpunkt Nørrebro consult with local community organizations in Frederiksberg and Nørrebro, as well as the municipality of Copenhagen, in order to ensure the success of Ågadeparken and the larger Ladegårdsåen project. Through our research, we discovered that information is best conveyed when it can be easily explained and understood. Therefore, we recommend that Miljøpunkt Nørrebro use our report and pamphlet, or develop a presentation which explains the complexities of our report.

Our interviews with Anders Hansen, Louise Popowitz, Natalie Gulsrund, and Peter Juhl all touched upon the idea of active and continual community involvement, coupled with governmental oversight, in the creation and maintenance of green spaces. Maintenance and gardening costs affect the success of a park, because organizations and governments are not always willing to support spaces which are expensive and difficult to maintain. Therefore, we recommend that any proposed design for Ågadeparken consist of as few maintenance intensive features as possible in order to reduce annual operating costs. Reducing the annual cost of the park will make the proposal more acceptable to local stakeholders who will ultimately be supporting it financially.

This discussion led to many insights for us, and we realized that if there is any chance of this project succeeding, that information will have to be disseminated to local leaders, businesses, and individuals, in a manner that they can all understand and support. In order to accomplish this, we recommend the creation of flyers and other ancillary documents for distribution to key stakeholders in the community and local government to better inform others of Miljøpunkt Nørrebro's goal for Ågadeparken.

5.7 Recommendations for Future Projects

We have a set of recommendations for future studies to further the project and provide assistance to Miljøpunkt Nørrebro. While our project focused on the public opinion analysis of those living and working along Åboulevard, we did not gather large amounts of data from residents of Frederiksberg. A future project for Miljøpunkt Nørrebro could focus on gathering and analyzing

the opinions of stakeholders and residents of Frederiksberg in regards to the daylighting of the Ladegårdsåen. This is an understudied segment of the population who would be directly affected by the proposed green space.

At this point in time, there are a couple of possibilities for what future projects may do, depending on the status of this project. The first situation is that our Ågadeparken renovation proposal is accepted and is in the process of being completed. In this situation, a future project team can assist in the development process by researching additional techniques and park designs. This project could also be directly partnered in a sponsor fashion with the company completing the renovation. The second situation is that the project is proposed to the municipality for consideration and the project is not yet approved. A project team could conduct interviews with members of the municipality to attempt to understand why the project is not being looked at with more urgency, or what can be done to further the advancement of the project toward approval. By looking for ways to create more community involvement for the project, a project team could continue the social aspect of the project, as our research has concluded that city projects in Copenhagen are much more likely to be accepted if there is significant support from residents. The third option is that the project is proposed to the municipality, considered, and rejected. The accompanying project to this situation would be an analysis of why the project was rejected, consisting of interviews with members of the municipality who considered it and review of what work needs to be done to get the project to where the City of Copenhagen will consider the project again.

5.8 Deliverables

Along with our recommendations for park designs and increasing public support, our deliverables consisted of a pamphlet, a park design, and two heat maps, shown below in Figure 32 and Figure 33, illustrating where those who support the project live and work. A choropleth map was not created because there was no significant opposition to the larger project in our survey responses. The pamphlet of recommendations we prepared is located in, Appendix H, for our sponsor, Anders Jensen. Anders, along with Miljøpunkt Nørrebro, will be using this project summary to bolster support for the daylighting of the Ladegårdsåen with the various stakeholders we have identified.

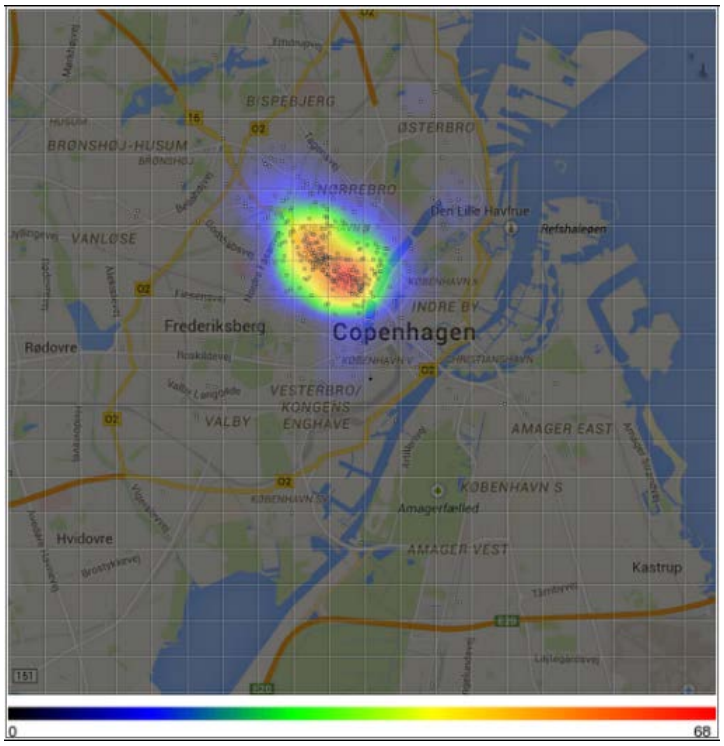


Figure 32: Heat map of where survey respondents live

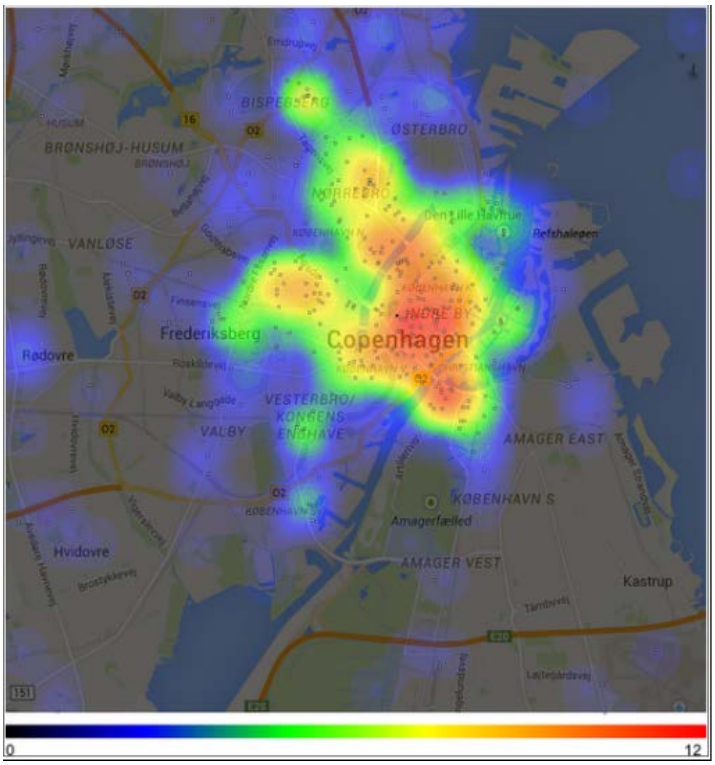


Figure 33: Heat map of where survey respondents work

5.9 Conclusion

There is no way to prevent a natural disaster such as the Cloudburst of 2011 that Copenhagen experienced. Copenhagen is consistently expanding due to its growing population, causing an increase in the use of impervious materials for construction purposes. Miljøpunkt Nørrebro is attempting to mitigate the possibility of another disastrous storm by proposing the creation of green spaces throughout the city capable of providing floodwater solutions. This organization is providing politicians with environmentally friendly solutions to flooding concerns and lack of green spaces in Copenhagen. Miljøpunkt Nørrebro believes daylighting the Ladegårdsåen and moving Åboulevard and Ågade into a tunnel underground is the best solution to address environmental concerns such as flooding and pollution. In order to properly test the daylighting methods and gather more support for the larger Ladegårdsåen project, Miljøpunkt Nørrebro wants to create a pilot project in the currently underdeveloped small park: Ågadeparken. We hope that through our research and recommendations we provided Miljøpunkt Nørrebro, they will accomplish their goal of designing a pilot project in Ågadeparken, and advance the larger goal of daylighting the Ladegårdsåen.

References

Adderly, S. (2013). The Boston Big Dig and the Problems with Complex Projects. Retrieved from https://shawnadderly.wordpress.com/2013/02/09/the-boston-big-dig-and-the-problem-with-complex-projects/

Apollonia, M. (2008). Backcasting approach for sustainable mobility. *JRC Scientific and Technical Reports*, 74. Retrieved from Official Website for the European Union website: http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/7659/1/backcasting%20final%20report.pdf

Berg, B. L., & Lune, H. (2011). *Qualitative Research Methods for the Social Sciences* (8th Edition ed.): Pearson.

Brenner, E. (2012). Restored River a Boon to Yonkers. *The New York Times*. Retrieved from http://www.nytimes.com/2012/08/12/realestate/westchester-in-the-region-restored-river-a-boon-to-yonkers.html

Buley, J. (2011). Drenched. *The Copenhagen Post*. Retrieved from http://cphpost.dk/news/drenched.1893.html

CH2M Hill. (2012). Bishan - Ang Mo Kio Park and Kallang River. Singapore: Public Utilities Board of Singapore.

Chauhan, A. J., & Johnston, S. L. (2003). Air pollution and infection in respiratory illness. *British Medical Bulletin, 68*(1), 95-112.

City of Columbia Missouri. (2015). Parks and Recreation. Retrieved April 26, 2015, from https://www.gocolumbiamo.com/ParksandRec/Images/Parks/cosmocrosssecb.jpg

City of Copenhagen. (2015). Københavns Kommune. Retrieved March 26, 2015, from http://kbhkort.kk.dk/spatialmap?

Cohen, D., & Crabtree, B. (2008). Qualitative Research Guidelines Project. Retrieved February 16, 2015, from http://www.qualres.org/index.html

Copenhagen, C. o. (2007). Eco-Metropolis: Our Vision for Copenhagen 2015. Retrieved from City of Copenhagen website

Copenhagen, C. o. (2013). Noise from traffic is still a major challenge. Retrieved February 6th, 2015, from http://subsite.kk.dk/sitecore/content/Subsites/CityOfCopenhagen/SubsiteFrontpage/LivingInCopenhagen/ClimateAndEnvironment/CopenhagensGreenAccounts/Noise.aspx

County, H. (2011). Community Revitalization Resulting from Stormwater Management Strategies. Hamilton County, Cincinnati Ohio.

Duke University. (2005). Guidelines for Conducting a Focus Group. Retrieved April 10, 2015, from https://assessment.trinity.duke.edu/documents/How_to_Conduct_a_Focus_Group.pdf

Environmental Protection Agency. (April 2011). Uncovering a Long-Buried Prize in Downtown Yonkers. *Brownfields Success Story*. EPA-560-F-11-028. Retrieved January 31, 2015, from http://epa.gov/brownfields/success/success_adpss.htm

Ernst Conservation Seeds. (2014). Riverbank Stabilization Techniques. Retrieved April 26, 2015, from http://www.ernstseed.com/files/general_images/biomass/bioengineering/0004_intro-picture-4_caption-stream-bank-diagram-lg.jpg

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (2008).

Garanaik, A., & Sholtes, J. (2013). River Bank Protection: Colorado State University.

Groundwork Hudson Valley. (2015). Groundwork Changing Places Changing Lives. Retrieved February 6, 2015, from www.groundworkhv.org

Helders, S. (2007). Malaysia:Metropolitan areas.

HGTV. (2015). Stephanandra Incisa. Retrieved April 27, 2015, from http://cdn.hgtvgardens.com/dims4/GRDN/20a05f4/2147483647/resize/616x/quality/90/?url=http%3A%2F%2Fcdn.hgtvgardens.com%2Fea%2F0b%2F30ae2d8c431eae60fc72abc1e749%2F4011_034.jpg

Indiana General Assembly. (2006). Live Stakes. Retrieved April 26, 2015, from http://www.in.gov.ezproxy.wpi.edu/legislative/iac/indocs/irdocs/ir2006/images/312120154NRA08.jpg

Jensen, A. (January 2015). Daylighting Ladegårds Creek Integrated traffic and storm water solution: Miljøpunkt Nørrebro.

Kable. (2012). SMART (Stormwater Management And Road Tunnel), Kuala Lumpur, Malaysia. from http://www.roadtraffic-technology.com/projects/smart/

Kaufman, R. (2013). Daylighting Takes Off as Cities Expose Long-Buried Rivers. *National Geographic*.

Kiat. (2006). Riding the rails. from www.kiat.net/malaysia/KL/transit.html

Kramer, M. (2014). Hidden Gems- How Daylighting Rivers are Revitalizing Cities. Retrieved from http://citiesforpeople.ca/en/blogroll/hidden-gems-how-daylighting-rivers-are-revitalizing-cities-2

MassDOT. (2014). The Central Artery/Tunnel Project - The Big Dig. Retrieved February 4, 2015, from http://www.massdot.state.ma.us/highway/thebigdig.aspx

Mufti, S. (2012). Half fear home flooding. *The Copenhagen Post*. Retrieved from http://cphpost.dk/news/half-fear-home-flooding.2106.html

National Parks. (2014). Your Guide to Bishan-Ang Mo Kia Park. Retrieved March 20, 2015, from https://www.nparks.gov.sg/~/media/nparks-real-content/gardens-parks-and-nature/diy-walk/diy-walk-pdf-files/bishan-amk-park.ashx

Northern Neck Marine Construction. (2015). Riprap Revetment. Retrieved April 26, 2015, from http://nnmarineconstruction.com/

Plant Points. (2015). Spiraea japonica. Retrieved April 27, 2015, from http://www.plantpoints.com/images/plants/Spiraea%20japonica%20Dart%20s%20Red.jpg

Public Utilities Board of Singapore. (2010). Kallang River-Bishan Park ABC Waters Project. Retrieved February 15, 2015, from http://www.pub.gov.sg/abcwaters/Publications/Pages/KallangRiver.aspx

Quist, J., & Vergragt, P. (2006). Past and future of backcasting: The shift to stakeholder participation and a proposal for a methodological framework. *38*(9), 1027-1045.

Rasmussen, J., & Hauber, G. (2013). Climate Adaption.

rgbstock free stock photos. (2015). Bench with Hedge. Retrieved April 27, 2015, from http://www.rgbstock.com/images/bench%20with%20hedge

Saw Mill River Coalition. (2015). Daylighting the Saw Mill River in Yonkers. Retrieved February 6, 2015, from www.sawmillrivercoalition.org/whats-happening/daylighting-the-saw-mill-river-in-yonkers

Service, N. P. (2002a). Daylighting and Restoring Streams in Rural Community City Centers: Case Studies.

Service, N. P. (2002b). Giving New Life To Streams in Rural City Centers.

Silberstein, J., & Maser, C. (2014). *Land-Use Planning for Sustainable Development* (2nd ed.). Boca Raton, Florida: CRC Press.

Sinclair, C. (2012). An exploration of stream daylighting and urban attitudes towards the environment. *6*.

SMART Motorway Tunnel. (2015). Stormwater Management and Road Tunnel. Retrieved April 26, 2015, from http://smarttunnel.com.my/

Takano, T., Nakamura, K., & Watanabe, M. (2002). Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. *Journal of Epidemiology and Community Health, 56*(12), 913-918.

Trice, A. (2013). Daylighting Streams: Breathing Life Into Urban Streams and Communities. Washington DC: American Rivers.

United States Department of Agriculture. (2015). Pinus Mugo. Retrieved April 27, 2015, from http://plants.usda.gov/gallery/standard/pimu80_001_shp.jpg

Wikimedia Commons. (2015a). Betula pendula. Retrieved April 27, 2015, from http://upload.wikimedia.org/wikipedia/commons/4/46/Betula_pendula_001.jpg

Wikimedia Commons. (2015b). Pinus sylvestris. Retrieved April 27, 2015, from http://upload.wikimedia.org/wikipedia/commons/5/5f/Pinus_sylvestris_Glenmuick.jpg

World Health Organization, & European Union. (2007). Night Noise Guidelines (NNGL) For Europe (pp. 319): World Health Organization.

World Weather Online. (2015). Kuala Lumpur Monthly Climate Average, Malaysia. Retrieved April 13, 2015, from http://www.worldweatheronline.com/Kuala-Lumpur-weather-averages/Kuala-Lumpur/MY.aspx

Appendix A: Semi-Structured Interview Questions for Natalie Gulsrund and Louise Popowitz

1. What made you interested in urban green space?

2. Why are these spaces important to a community?

3. What is the most important part of an urban space? Recreational? Green space? Flood management?

4. We saw you've conducted case studies in Singapore, have you heard of Bishan Park in Singapore?

5. Have you heard of the daylighting of the Lade River?

6. What is your opinion on the proposed daylighting of the Lade River?

7. What features do you think would be important to include in a test green space?

8. What makes a green space successful? Do you have any recommendations for us to make our project successful?

9. Can you recommend anyone else we should talk to?

10. Do you have any questions for us?

Appendix B: Semi-Structured Interview Questions for Peter Juhl

1. What considerations need to be taken into account when deciding what plant species should be used in a green space?
2. Do you have any prior techniques that you have used for spaces similar to Ågadeparken?
3. Have you had any successes with plants that are useful for flood prevention/mitigation and/or riverbed erosion prevention? If so which plants?
4. Looking at the area of Ågadeparken, what are your thoughts on the best approach to create a new green space that incorporates recreation while also being used as a method of flood mitigation?
5. How can we make sure biodiversity is integrated into our design so that the park is successful?

Appendix C: Semi-Structured Interview Questions for Anders Hansen

1. What are you visions for the Lade river project?
    a. Where do you see the project in 10 years?
2. What techniques would you plan to use in order to utilize the river?
    a. Natural Flowing?
    b. Canal?
    c. Plants?
3. How would you see the Ågadeparken being incorporated into the larger project?
4. What are some of the major obstacles that are preventing the approval for this project?
    a. What obstacles are you currently trying to overcome in regards to the development of the daylighting project?
    b. In your opinion what do you think is the biggest setback that comes along with this project?
5. Do you believe this smaller project, if found successful, would help to push the larger project to approval?
6. What considerations should be taken to ensure that the project fits into the city's vision, so that the project can be approved?
7. Are you trying to gather any sort of public input on what the project should consist of or is it purely being done using ideas that have been done before?
    a. Any development plans of your own? Or is Miljøpunkt plans the only one?
8. Have you had any conversations with the municipality of Frederiksberg?
    a. Would they support a project of this scale?
    b. Would that push the project forward?

Appendix D: Electronic Survey Questions for Public Opinion

Hello, we are a group of students from Worcester Polytechnic Institute in Massachusetts, USA, working in conjunction with Miljøpunkt Nørrebro. We are conducting surveys with residents of Copenhagen and Frederiksberg for the purpose of assessing current knowledge and public support for the Daylighting of the Ladegårdsåen. Our ultimate goal is to offer an analysis of public opinion to Miljøpunkt Nørrebro and your input will be extremely useful.

The buried Ladegårdsåen, located under Ågade and Åboulevard, may potentially be brought back to the surface, in a process known as "daylighting." The existing roads may be replaced by a tunnel, with the river being surrounded and built into a new city park space. Our project is focusing on the surface design of the city space.

Your participation in this interview is voluntary and you may withdraw at any time. Names are optional but location data will be asked for in order to understand geographically where the opinions are located. Thank you for your time.

1. What is your main mode of transportation?
    - Bicycle - Car
    - Walking - Public Transportation (Bus, metro, S-tog)
2. What are some aspects of parks and recreation spaces that you would like to be included in the design of a proposed city space?
3. Please click on the map below where you live. This is important data to understand the distribution of support for the project across the city. If you do not live in this area, you will be able to enter your address in the next question.
4. Please enter your residential address in the space below.
5. Please indicate on the map below where you work. This is important data to understand the distribution of opinion for the project across the city. If you do not work in this area, you will be able to enter your address in the next question. (Uses same picture as above)
6. Please enter your work address in the space below.
7. On the following scale, please indicate your level of awareness of the Ladegårdsåen project, 1 being no knowledge of the project and 5 being full understanding of the project.
8. Please list any specific ideas about the Ladegårdsåen project that you are aware of (what it consists of).

9. On the following scale, please indicate your opinion of the Ladegårdsåen project, 1 being completely opposed and 5 being completely in support.
10. Please indicate in the space below why you have reached this opinion.
11. The project team is currently proposing a small portion of the river to be brought to the surface in a park next to the Ågade. If this project is a success, would your opinion change on the larger daylighting project? Please explain why or why not in the space below.
12. What issues would you like the proposed space next to the Ågade to address? Please choose up to four options.

Pollution reduction	Increased recreation space
Transit mobility (bike paths)	Noise reduction
Increased biodiversity	Beautification of the area
Flood management	Economic revitalization (more interest in the area)
Cleaning of water runoff from roads	Pedestrian safety (place for people to walk away from the road)

13. Please list any additional comments or concerns you have about this project in the space below.

14. Please select your age range.

<18 18 to 24 25 to 35 36 to 45 46 to 55 56 to 65 65 or older

15. Please select your gender.

- Male - Female - Other

16. A more in-depth interview will be of great help in understanding community concern and priorities for the city space. If you are interested in providing more feedback on the project, please enter a contact name and phone number or email address that we may use to contact you.

Thank you very much for your time, all of your responses are greatly appreciated.

Appendix E: Focus Group Questions

FOCUS GROUP INTRODUCTION WELCOME

Thanks for agreeing to be part of the focus group. We appreciate your willingness to participate.

INTRODUCTIONS: Moderator

PURPOSE OF FOCUS GROUPS

We have been asked by Miljøpunkt Nørrebro to conduct the focus groups. The reason we are having these focus groups is to find out the public's opinion on green spaces and what they would like to see implemented in green spaces. We need your input and want you to share your honest and open thoughts with us.

GROUND RULES

1. WE WANT YOU TO DO THE TALKING

We would like everyone to participate. I may call on you if I haven't heard from you in a while.

2. THERE ARE NO RIGHT OR WRONG ANSWERS

Every person's experiences and opinions are important. Speak up whether you agree or disagree. We want to hear a wide range of opinions.

3. WHAT IS SAID IN THIS ROOM STAYS HERE.

We want folks to feel comfortable sharing when sensitive issues come up.

4. WE WILL BE TAPE RECORDING THE GROUP

We want to capture everything you have to say. We do not identify anyone by name in our report. You will remain anonymous.

Focus Group Questions:

Engagement Questions:

What are your experiences of the Cloudburst of 2011?

Exploration Questions:

What parks do you all visit regularly?

What aspects of parks do you typically look for to visit a park regularly?

Are there any aspects of parks that cause you to not want to go to them again?

Have you heard of parks being used for flood management?

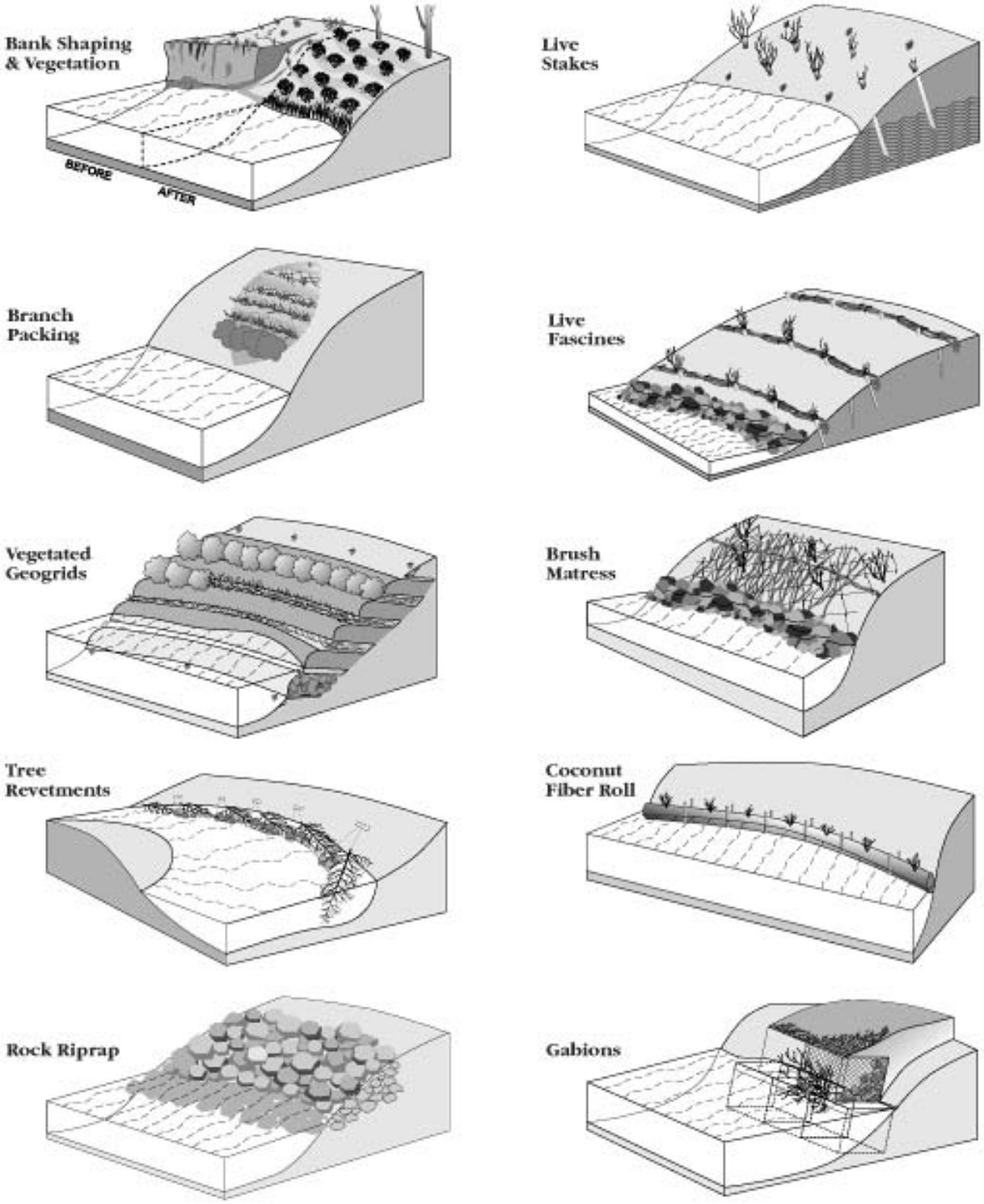
- How successful do you think they are at reducing flood damages?
- What their opinions for the idea? Support or against? If supportive, suggestions for making it successful.

Exit Questions:

Is there anything else you would like to say about the proposed project we are conducting research for?

Has your opinion of the project changed after this focus group?

Appendix F: Pictures of Various Riverbank Stabilization Techniques



Appendix G: Plant Species for Park Design

Latin Name	**English Name**
Shrubs	
Kolkwitzia amabilis	Beauty Bush
Rosa multiflora	Japanese Rose
Rosa rubuginosa	Sweet briar
Syringa vulgaris	Common lilac
Syringa vulgaris 'Michel Buchner'	French lilac
Buddleja davidii 'Nanhoe Blue'	Common butterfly bush
Buddleja davidii 'Ile de France'	French Butterfly Bush
Sambucus nigra 'Korsør'	European Elderberry
Viburnum opulus 'Roseum'	European Cranberry bush
Philadelphus virginalis 'Schneesturm'	'Mock orange'
Cornus alba	Siberian Dogwood
Cornus mas	European Dogwood
Cornus Kousa	Korean Dogwood
cornus controversa	Chinese Dogwood
Rain Garden	
Alchemilla mollis	Lady's Mantle
Iris pseudoacorus	Yellow Iris
Eupatorium fistulosum	Purple thoroughwort
Lythrum salicaria 'Blush'	Purple Loosestrife
Lysimachia ciliata 'Fire cracker'	Fringed Loosestrife
Filipendula palmata	Meadowsweet
Ligularia hybrid 'Weihenstaphan'	Leopard plant
Achillea ptarmica	Sneezewort/European pellitory
Lychnis flos-cuculi	Ragged Robin
Molinia caerula 'Dauerstrahl'	Moor grass
Trees	
Salix alba	White willow
Alnus glutinosa	Common Alder

Appendix H: Pamphlet of Project Summary and Recommendations

ÅGADEPARKEN

Recommendations

Open Space Design

The design should be quiet, inviting, appealing and private. Opening up the park will make it more inviting.

Public Opinion

A public outreach campaign, consisting of billboards or a newsletter, is important to help send out the message about both the pilot project and the large-scale Ladegårdsåen project. It would be helpful to clarify that the pilot project is a stepping stone towards the larger project.

Stakeholder Involvement

In order to have a successful project, it is important to get local stakeholders in support of the project. To gain further support of the project, we recommend that the green space be easy to maintain so that the city does not have to spend excessive time and money on the park.

Park Features

The features in the park should be multifunctional. Large amounts of space should not be designed for one single purpose. We recommend features such as a barbecue and picnic area, toilet facilities, and a paver stone walkway for the final design.

Natural Riverbed

A soft riverbed approach constructed with soil and vegetation should be considered while making a natural riverbed for Ågadeparken.

Plant Selection

Water absorbent plants and evergreen trees are some plants that we recommend to use in the proposal of the park. 'Rooms' should be created using low hedges. Unique trees capable of absorbing air pollution should be used between the bike path and road.