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Title

THE LANDING PARK OF THE MID AMERICAN STEEL: BRIDGING THE PAST AND FUTURE THROUGH SOUNDSCAPE ANALYSIS

By

Muhammad Ashifur Rahman

The Supervisory Committee certifies that this ***thesis*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF LANDSCAPE ARCHITECTURE

SUPERVISORY COMMITTEE:

Jason Kost — DocuSigned by: Jason Kost 028272F1D32542D...

Thesis Coordinator

Dominic Fischer — DocuSigned by: Dominic Fischer 93D0F7EC1B714AF...

Primary Advisor

Approved:

05/10/2024 — DocuSigned by: [redacted] 93D0F7EC1B714AF...

Date — Department Chair

THE LANDING PARK OF THE MID AMERICAN STEEL: BRIDGING THE PAST AND FUTURE THROUGH SOUNDSCAPE ANALYSIS

A Thesis
Submitted to the Graduate Faculty
of the
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By

Muhammad Ashifur Rahman

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for the Degree of
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ABSTRACT

Good soundscape quality in parks can only be provided with a thorough understanding of the complex relationships among sound, environment, and individuals. This study explores visitors' perceptions of the urban park soundscape to relieve stress. The study employed a mixed-methods approach consisting of an objective sound walk survey, a questionnaire survey, and a landscape design approach to improve sound quality in urban parks. Approximately 234 park visitor responses were obtained from online questionnaire surveys administered in the Fargo, North Dakota, region. Objective sound measurements were conducted at 53 survey spots on four different days, two days in the morning and the other two in the afternoon, corresponding to the questionnaire. The findings unveil that acoustic comfort evaluation, besides visual comfort evaluation of landscape, also plays a vital role in users' acceptability of the urban park environment. The soundwalk survey collected visitors' perceptions and evaluation of the urban park soundscape. At the same time, the qualitative questionnaire survey explored visitors' experiences and preferences regarding the soundscape for stress relief and preferred locations to visit inside the park. The literature review and study results showed that visitors perceived the urban park soundscape as essential for promoting stress relief and relaxation. Visitors preferred natural sounds, such as bird songs and water sounds, over human-made sounds, such as traffic and construction noise, as they were more calming and pleasant. The study also found that visitors had varying preferences for the intensity and complexity of the soundscape, with some preferring a quiet and straightforward soundscape.

In contrast, others enjoyed a more diverse and complex soundscape, where an above-average decibel range of anthropogenic sounds did not deter the park users' willingness to stay. The results suggest that urban park designers should consider the soundscape as a crucial element in promoting stress relief and well-being for park visitors. Furthermore, these results are applied to the Mid-American Steel site in Fargo, North Dakota, a post-industrial site with a strong historical background. This site has potential features for urban park development and civic facilities to make a good connection between downtown Fargo and the bank of Red River. The major challenge of this location is the rail track, which has passed through the site and, in this design, reduces decibel levels of rail track using a gradient of priorities based on park programming.

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I must acknowledge the role of my family and friends for their understanding and endless love throughout the duration of my studies. I must also give a special mention to my wife, Ummay Muslima, whose support and encouragement have been a constant source of strength.

Finally, I would like to thank the Klai Library Computer Lab staff for helping me access the resources necessary for my research.

Completing this thesis was made possible only through the support of many people and institutions, and I am incredibly grateful for that.

DEDICATION

This thesis is dedicated to my father, Rafiqur Rahman, who has always stood by me and provided me with the moral support and constant encouragement that carried me through hardship. I also dedicate this work to Uncle Dr. Mukhlesur Rahman, whose influence has been a cornerstone in my personal and academic development.

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1. INTRODUCTION

Nestled along the banks of the Red River, downtown Fargo, North Dakota, stands as a dynamic testament to the evolution of riparian urban landscapes in the Upper Great Plains. In this thriving city, where history intersects with innovation, a bold vision has taken root on the historic grounds of the Mid-American Steel site. The Mid-American Steel Site Landing Park Project is poised to breathe new life into this historically significant location, fostering a harmonious blend of serenity gardens with flowering and ornamental trees, a meadow vista for picnic and relaxation, an echo pond for rainwater retention, a tranquility fountain for social gatherings, a summit amphitheater for performance and community events, a riverside terrace offering scenic views and heritage plaza along with preservation and integration of key historical artifacts from the Mid-American Steel site to provide educational and cultural opportunities for visitors. The park will incorporate sustainable design elements, including rain gardens, energy-efficient lighting, and water conservation measures. In addition to the urban park design, the urban infill structure will consist of a mixed-use building featuring retail and commercial spaces.

Fargo, North Dakota, carries within its streets and structures a storied past rooted in the pioneering spirit of the American Midwest. The city's beginnings trace back to the late 19th century when it was founded as a pivotal railroad town, and its cultural heritage is steeped in the traditions of agriculture, industry, and community resilience. Downtown Fargo bears witness to this rich history, with its architectural landmarks and historical narratives etched into its urban fabric.

1.1. Problem Statement

The Mid-American Steel site, once a cornerstone of Fargo's industrial sector, stands at the threshold of a transformative era. This research delves into the redevelopment of this historic site into a vibrant and sustainable landing park with a focus on the transformative potential of soundscape analysis. This space resonates with both history and modernity. At the heart of this study is exploring how sound influences our perception of space and memory. By employing soundscape analysis techniques, this research aims to capture the auditory essence of the site and integrate it into a contemporary park setting. This approach is about preserving historical soundscapes and understanding and creating a sonic environment that enhances the visitor experience.

1.2. Objective

Methodologically, the study comprehensively assesses ambient sounds, historical sound marks, and potential acoustic interventions. The objective is to create a harmonious blend of natural and mechanical sounds that reflect the site's transformation from a steel manufacturing hub to an urban retreat.

The attempt of this investigation is to reveal if there is any effect of urban park soundscape on visitor stress relief and how different acoustic environment of the urban park helps visitors to relieve stress. The sound environment of urban parks consists of different sources of sound, and their level of intensity has some correlation with individual perceptions of sound source types. This study mostly focused on developing questionnaires to understand visitors' experience in different soundscape zones of urban parks and to compare their awareness of natural, human, and mechanical sound effects for releasing stress. This study used Lindenwood Park, Fargo, North Dakota, as a study site, representing an urban park environment with typical features. The gradation of soundscape perception of the sample site is accessed with the help of the soundscape perception evaluation questionnaire.

The anticipated outcomes of this research extend beyond the realm of urban redevelopment. Landing Park is a testament to Fargo's commitment to innovative, inclusive, and sustainable urban planning by improving the present acoustic situation. It will be a place of recreation and a sensorial link to the city's industrial roots, enriching the cultural tapestry of Fargo for generations to come.

1.3. Historical Events

1.3.1. Mid-American Steel

The Fargo Foundry, established in 1905, is located near the Red River at 92 N.P. Avenue. The firm was started by Kalmen and Parsons as a machine shop at the corner of N.P. Avenue and 1st Avenue North. The main thrust of the business was the manufacture and repair of farm equipment. One of the firm's first products was a press that that compacted flax straw into briquettes to be used instead of coal for heating. Other well-known products have included the Dakota Burner in the 1920's, irrigation sprinkling systems in the 1930s, and the Fargo Sprayer in the 1940s. About 1973-74, the Foundry changed its name to Mid America Steel to reflect its own change from a foundry (which it closed in 1978) to a steel fabrication company.

Figure 1. Aerial over Mid America Steel and Fargo Foundry Company, 92 N.P. Avenue, 1911.

1.3.2. Fargo-Moorhead Steamboat Landings

In the 1870s and 1880s steamboats plying the Red River tied up just two blocks south of today's Hjemkomst Center. The waterfront was located between today's Center Avenue and 1st Avenue North bridges. It was a very busy place 130 years ago.

Initially, in the 1860s, steamers hauled furs from Canada to Georgetown, thirteen miles north of Moorhead, where they were transferred to Red River ox carts destined for St. Paul. Trade goods went north along the same route.

Railroads reached the Red River in 1871 and Fargo-Moorhead popped up. The faster and more efficient trains put the carts out of business but gave steamboats a boost. Lots more stuff was shipped to and from Canada.

Figure 2. The Fargo-Moorhead waterfront today and Grandin Line's Operations, about 1880.

2. LITERATURE REVIEW

Urban parks provide significant benefits to the ecological environment and public community but due to rapid socioeconomic growth and urbanization taking urban citizens away from nature. High-intensity work, stressful lives, and changes in the living environment have indirectly affected the physical and mental health of urban residents (Karasek et al., n.d.; Park et al., 2012; Tyssen et al., 2000). Compared with other urban spaces, urban parks have a higher number of green spaces and plant landscapes, which can reduce air pollution on a local scale (Laurent et al., 2019), block some urban noise (Ow & Ghosh, 2017). Ulrich's (*7*, n.d.; Ulrich et al., 1991) stress recovery theory also suggests that exposure to nature or urban greenery can provide mental stress relief and that this relief is an "immediate, subconscious stress response". The visual aesthetic quality of landscape, particularly the beauty and exuberance of vegetation, has always been one of the primaries focuses in a majority of park designs (Smardon, n.d.). Recently, there is a growing body of evidence suggesting that soundscape quality also helps define quality of visitor experiences in parks (Nilsson, 2006a). Natural sounds like twittering of birds and falling water were more preferred, while mechanical sounds from road traffic were not welcomed in parks (Nilsson, 2006b; Yu & Kang, 2010). It is well known that natural environments are more effective in promoting stress recovery than urban environments (Herzog et al., n.d.; Karmanov & Hamel, 2008). Soundscapes are one of the main elements of restorative landscape design and have an important recreational value, and from a health perspective sound perception can be used as an enhancement tool for human experience (Aletta et al., 2018). Annerstedtet al. only demonstrated better stress relieving effects of birdsong and water flow sound exposure than no sound exposure (Annerstedt et al., 2013).

The term “soundscape” has been used by a variety of disciplines to describe the relationship between a landscape and the composition of its sounds. Sound in outdoor environments has traditionally been considered in negative terms as both intrusive and undesirable (Jennings & Cain, 2013). However, sound may provide positive effects, such as enhancing a person’s mood, triggering a pleasant memory of a prior experience, or encouraging a person to relax and recover (Payne, 2013). Thus, the soundscape framework proposes a positive approach, which claims not only to reduce sound exposure but also to preserve, conserve, or even encourage certain sounds that may be of great interest to the population.

The function of urban parks to improve the soundscape of the urban environment through noise reduction may be limited by their size and location (Watts et al., 2010). However, recent studies have shown that soundscape perception is not specifically associated with decibel levels, but rather with the type of soundscape, individual preference, individual sensitivity, and soundscape related demographics (Hong et al., 2020; Van Renterghem et al., 2020). Age and gender have been shown to influence the perception of soundscapes (Alves et al., 2015; KANG, 2017; Ode Sang et al., 2016; Van Kempen et al., 2014), cultural background can also influence perceptions and assessments of the environment (Hunter, 2001; Muratet et al., 2015; Van Kempen et al., 2014). Moreover, sound, space, people, and environment are considered to be four vital elements and the interrelationships among them have been highly concerned in the soundscape studies of urban parks and other urban open spaces (Coles & Bussey, n.d.; Zhang & Kang, 2007).

3. RESEARCH METHODS

3.1. Questionnaire Survey

Questionnaire surveys were designed to obtain park users' perception of soundscape and to examine how acoustic comfort evaluation relates to acceptability of the environment and preference to stay within a park due to soundscape quality. Lindenwood Park and Fargo, North Dakota, are selected as study sites. It was selected because traffic noise was expected to be the major sound source within the park areas. Also, they were expected to possess similar landscape features and to be equipped with sports and recreational facilities (see Table 1). Park users were asked to answer questions on an online survey about the sound quality of this park and suggestions to improve it. A sound walk survey was administered in both mornings and afternoons during weekends and holidays to capture the sound intensity. Sound recordings and the measurements of the sound levels were carried out at 53 designated spots within the park. These physical sound measurements were carried out using a sound analyzer app as close to the target road segment as realistic and in a direction facing the nearest road. The sound analyzer app gave the equivalent sound pressure levels. The sound measurement and the questionnaire survey enabled an analysis of the visitors' perceptions of the park's soundscape.

Area (m^2)	92 acres
Location	A residential district near a busy highway
Sports facilities	
Swimming pool	No
Football fields	No
Multipurpose field	Yes
Playground (age 2 - 5)	Yes
Playground (age 5 - 12)	Yes
Basketball courts	No
Jogging path	Yes
Extreme games	Yes
Tennis	No
Bicycle tracks	Yes
Landscape features	
Square	No
Campground	Yes
Shelter	Yes
Restroom	Yes
Garden	No
Recreational trails	Yes
Pond	No
River	Yes
No. of measurement spots	53

Table 1. Summary of the characteristics of the study park.

3.2. Sound Measurement Data Collection

To understand the sound intensity of Lindenwood Park, 53 points were selected to measure the sound level of the park, including Gooseberry Park (see Figure 3). The data were collected from four (04) different days, two days in the morning and the rest two in the afternoon. All the days were weekends because this park is more active on weekends than on weekdays. A sound level measurement app with a 30–130 dB(A) measurement range was used. The current sound pressure level of the park was collected from 8:00–11:30 a.m. in the morning and between 4:00–6:00 p.m. in the afternoon, and the height of the measuring point was 1.5 m from the ground. The duration of sound level measurement of each point was 45 seconds to 2 minutes, depending on the location and its activity.

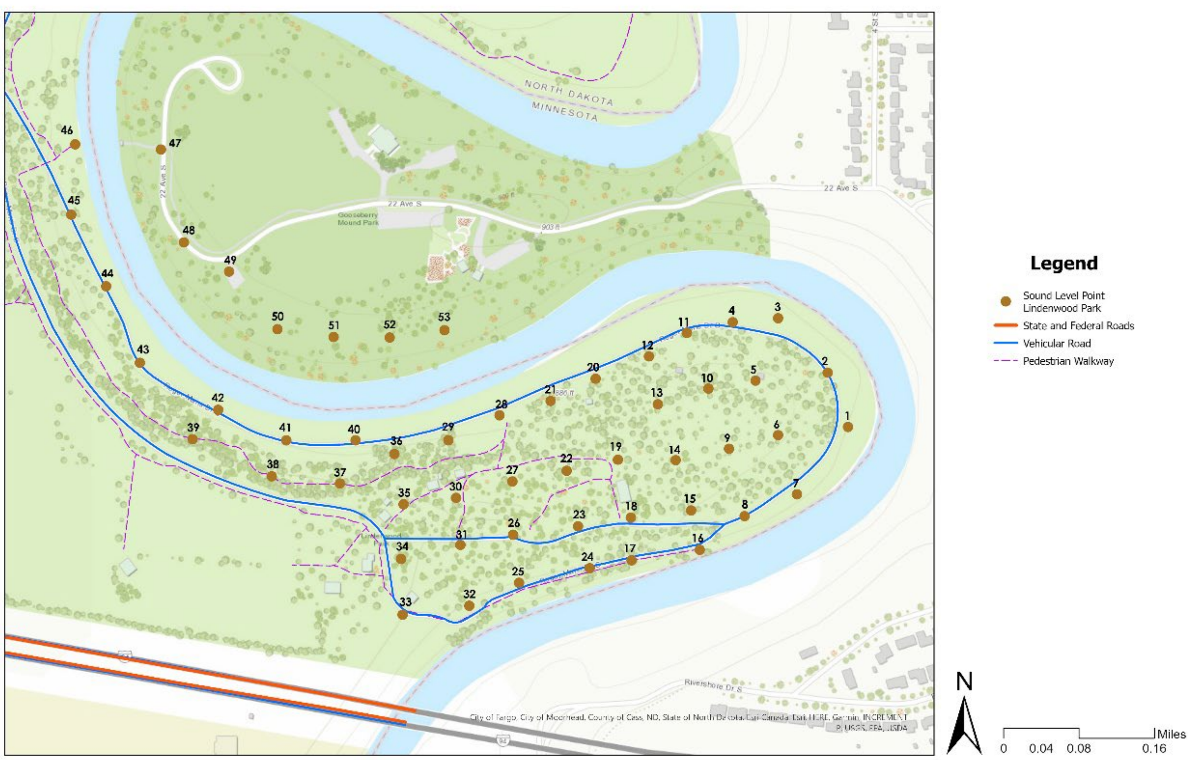

Figure 3. Sound measurement points in Lindenwood Park.

3.3. Sound Measurement Data Sheet

The sound pressure level research measurement point data information is shown in Table 2, where we compared the morning and afternoon sound level intensity and get a firm understanding of the overall sound quality of Lindenwood Park. This table represents continuous data, and the unit of this measurement is decibels. The data was extracted from the sound measurement app and transformed into a table form to get a generalized idea of which point of the park has a more intense sound level and which time of the day reflects more noise. The data table reflects that afternoon time is more intense than morning, and the points closer to the highway and parking have higher decibels. There are some points that are near highways but show lower sound levels because those locations are enclosed by trees. The data was imported into Arc GIS Pro, and morning and afternoon maximum, minimum, and average sound level maps were prepared to understand the park's sound level.

	Morning (8.00-11.30) am			Evening (4.00-6.00) pm		
Location	Min	Max	Avg/Leq	Min	Max	Avg/Leq
1	46.1	56.7	49.35	44.55	55.75	47.475
2	45.45	65.55	52.55	44.875	63.275	52.825
3	44.25	53.65	46.4	43.475	55.725	45.95
4	45.35	50.45	47.35	44.725	49.475	46.625
5	47	61.2	54.15	45.15	63.15	54.175
6	47.15	58.3	51.4	46.175	58.65	50.25
7	50.1	61.55	53.65	49.15	62.225	52.325
8	47.6	61.9	54	47.45	63.6	54.95
9	47.45	71.5	54.6	47.425	70.65	54.05
10	45.55	57.2	48.8	44.925	57.6	48.5
11	45.1	65.3	50.25	43.65	63.4	48.175
12	46.4	59.05	51.2	45.1	61.025	51.25
13	47.95	55.6	50.6	47.475	55.95	50.35
14	50.25	64.55	54.15	50.175	63.875	54.425
15	49.95	57.7	52.4	48.675	56.4	51.35
16	51.65	68	55.9	51.625	69.5	55.95
17	51	63.65	54.55	50.4	62.525	53.875
18	59.35	67.95	62.95	62.275	70.225	65.725
19	46.95	64.1	52.3	46.275	63.95	51.7
20	44.55	61.4	49.8	44.075	60.3	49.3
21	45.5	56.25	49.35	44.65	57.475	49.075
22	48.2	68.4	55.75	47.35	69.65	56.375
23	52.45	67.05	59.7	52.075	71.575	61.85
24	51.3	70.1	56.95	50.65	68.85	56.525
25	50.75	72.5	59.9	49.325	66.4	56.35
26	49.6	58.5	53.15	48.8	59.65	53.075
27	47.05	60.55	50.8	46.875	60.825	51.2
28	43.95	57.1	46.95	43.275	55.45	45.925
29	44.8	65.9	50.8	44.25	69.05	51.8
30	50.35	67.2	58.4	49.675	63.45	55.2
31	50.45	56.95	52.85	50.525	58.475	53.425
32	52	63	56	51.8	62.7	55.3
33	53.4	62.15	56	53.5	62.025	56.25
34	52.8	67.6	60.15	51.95	64.65	57.825
35	49.1	55.9	51.55	48.5	55.1	50.675
36	46.1	54.9	48.2	45.8	53.1	47.8
37	48.05	54.45	50.1	47.675	53.925	50
38	46.95	61.15	52.3	46.575	65.125	53.5
39	47.4	51.2	49.35	46.6	50.55	47.45
40	46.75	56.45	49.75	46.575	56.125	49.925
41	45.2	57.55	47.65	44.75	57.625	47.175
42	46.05	54.45	48.5	45.275	54.825	48.1
43	47.25	56.15	51.25	47.025	56.775	51.925
44	43.35	61.35	49.95	42.225	61.325	49.325
45	45.8	64.05	54.95	44.1	69.175	56.675
46	33.45	65.7	54.3	37.875	66.75	54.3
47	44.95	58.35	48.5	43.275	57.625	46.9
48	45.6	55.3	48.6	44	53.75	46.85
49	49.1	69.2	60	47.75	73.2	62.95
50	46.2	62.3	51.7	44.5	61.95	50.9
51	46.55	54.7	49.3	43.775	52.55	46.3
52	44.7	56.55	48.1	43.5	57.175	47.25
53	44.2	62.9	50.25	42.8	66.9	50.675

Table 2. Sound intensity level research measurement point data.

4. RESULTS

4.1. Data Analysis from Questionnaire Survey and Sound Measurement Data

234 respondents were successfully administered online from December 6th, 2023, to December 30th, 2023. The average duration for completing an interview was around 10 to 15 minutes. Table 3 shows a statistical summary of the sound pressure levels (Leq) of the surveyed spots in the park. The park's average noise levels (Leq) lie in a range between 50.43 and 52.40 dB(A). The sound pressure level of the park was collected from 8:00–11:30 a.m. in the morning and between 4:00–6:00 p.m., and the height of the measuring point was 1.5m from the ground. Table 4 shows a summary of statistics on the respondents' personal characteristics.

Number of sound measurement spots taken in the park area	53	
Total no. of sound measurements taken	212	
Time	8:00–11:30 am	4:00–6:00 pm
Leq (dB(A))		
Maximum	56.05	60.96
Minimum	46.43	47.52

Table 3. A statistical summary of the sound pressure levels (Leq) for the surveyed spots in the park.

Gender		%
Male		35.27
Female		62.95
An identity not listed		1.79
Age (yr)		
18–25		19.64
26–30		12.95
31–40		20.09
41–65		42.86
Over 65		4.02
Do not want to answer		0.45
Highest level of education		
None		0.45
Primary school (elementary)		0.00
Secondary Education		8.52
Higher Education (University)		49.33
Master's Degree		31.84
PhD		9.42
I do not want to answer		0.45
Frequency of visiting the park		
Daily		3.57
Weekly		23.21
Monthly		45.54
Rarely		27.68
Purpose of visiting the park		
Walking or jogging		34.23

Exercising		4.56
Picnicking		12.24
Relaxing		28.01
Playing with children		14.11
Others		6.85
Duration of stay (min)		
Less than 30		17.04
30–59		54.26
60–89		20.18
90–119		5.38
More than 120		3.14
Place of residents		
Metropolis (More than 1 million inhabitants)		0.90
Big City (between 300.000-1.000.000 inhabitants)		4.04
Medium City (Between 100.000-300.000 inhabitants)		71.30
Large Town (between 10.000-100.000 inhabitants)		15.70
Town (less than 10.000 inhabitants)		4.93
Village/Rural Area (less than 2.500 inhabitants)		3.14
Self-rated auditory capability		
Very poor		1.44
Poor		1.92
Average		20.19

Good		39.42
Very good		37.02

Table 4. A summary statistic of the personal characteristics of the respondents.

4.2. Acoustic Comfort Assessment

The objectives are to identify the overall acoustic perception and factors that affect visitors of urban parks and their preference for staying there. The acoustic comfort assessment was rated on a five-point verbal scale with "low acoustic comfort assessment" or "high acoustic comfort assessment" in Table 5. This assessment's question was how respondents wanted to describe any unpleasant sound during their activity in an urban park. High acoustic comfort assessment refers to a rated response of acceptable or very acceptable but excludes a neutral response. Low acoustic comfort assessment refers to a rated response of very unacceptable, unacceptable, or neutral. As a result, the total numbers of responses falling into two groups are comparable (11.89% for high acoustic comfort evaluation and 88.12% for low acoustic comfort evaluation).

Acoustic perception		%
Very negative		0.00
Negative		6.80
Neutral		33.98
Positive		50.97
Very positive		8.25
Acceptability of the environment		
Very unacceptable		10.89
Unacceptable		30.20
Neutral		47.03
Acceptable		10.40
Very acceptable		1.49
Preference to stay due to soundscape quality		
Leave right away		8.87
Consider leaving		57.14
Neutral		25.62
Consider staying		5.91
Continue to stay		2.46

Table 5. A summary statistic of responses about acoustic perception, acceptability to the environment, and preference to stay.

4.3. Park Sound and Preferences

Table 6 shows a breakdown of the number of respondents who had heard different types of natural sounds. Most of the respondents in the park heard wind rustling through trees, and bird song was the second most frequently heard sound. Sound from flowing water-related sources was heard by only a few respondents. The breakdown also shows different types of anthropogenic and mechanical sounds heard by the respondents. Conversely, sounds from children playing were the most frequently heard sound attributed to human activities. Sounds from heavy vehicles were also heard by most respondents, and a few respondents heard music playing and other sounds.

Natural Sound		**%**
Birdsong		20.75
Flowing water (fountains, steams)		8.91
Wind rusting through trees		25.77
Anthropogenic and mechanical sound		
Traffic noise		18.80
Children playing		21.72
Music playing		1.94
Others		2.11

Table 6. The most common sound heard in the park.

5. DISCUSSION

5.1. Analysis of Findings

This study looked closely at the sounds in Lindenwood Park, Fargo, and what visitors think about them. We found a mix of nature sounds, like birds chirping, wind in the trees, and city noises. This mix shows that urban parks are places where the city and nature come together.

People visiting the park mostly enjoyed the sounds of nature and wanted less city noise. This shows parks' challenge in keeping a good mix of sounds that lean more towards nature. There are some places where most of the park activity occurs, and the sound level of those areas shows high intensity, but visitors prefer to stay there because the sound source is not mechanical.

5.2. Future Studies

Our research opens up new paths for more studies. We could look over time to see how the park's sounds change and what visitors think about those changes. Trying different ways to bring out more natural sounds or lessen city noise can show us what works best in managing park sounds. Also, looking at different city parks can help us understand how different settings influence people's thoughts about the sounds they hear. This can give us more insight into how to manage sounds in parks.

6. RESEARCH CONCLUSION AND APPLICATION

6.1. Conclusion

Our investigation into the soundscape of Lindenwood Park, Fargo, and the preferences of its visitors sheds light on the critical role of auditory environments in urban green spaces. The sound analysis revealed a vibrant blend of natural and urban sounds, reflecting the complex interaction between the park's natural beauty and urban surroundings.

This preference highlights the importance of considering soundscapes in planning and managing urban parks. It points to a broader understanding that the quality of a park's soundscape can significantly affect visitor satisfaction and overall park experience. The challenge lies in balancing the preservation of natural soundscapes with the inevitable encroachment of urban noise.

6.2. Application

The findings from this study have practical implications for urban park management and design strategies aimed at improving soundscape quality. To enhance the auditory experience in Lindenwood Park and similar urban green spaces, several measures can be recommended:

Noise Mitigation: Implementing physical barriers, such as vegetation buffers or sound walls, to reduce the infiltration of urban noise into the park.

Enhancing Natural Sounds: Encouraging biodiversity through the planting of native flora and the creation of habitats to attract wildlife, thereby enriching the park's natural sounds.

Design and Planning: Considering the soundscape in the park's design and maintenance plans, such as placing noisy activities away from areas designated for relaxation and contemplation.

Community Engagement: Involving local communities in soundscape improvement projects can help ensure that changes align with visitor preferences and enhance the overall park experience.

7. SITE

7.1. Site Context

This project, located along the banks of the Red River in downtown Fargo, North Dakota, stands as a dynamic testament to the evolution of urban landscapes. Fargo is a city where history intersects with innovation; a bold vision has taken root on the historic grounds of the Mid-American Steel site, which is considered a mixed-use development site in downtown Fargo.

The project is bounded on the north side by NP Avenue, on the east Red River, on the south side by Main Avenue, Veteran Memorial Bridge, and the west side by 2nd Street North, and a rail track passed through the site from the east-west direction. Figure 4 is the context map of Mid-American Steel site.

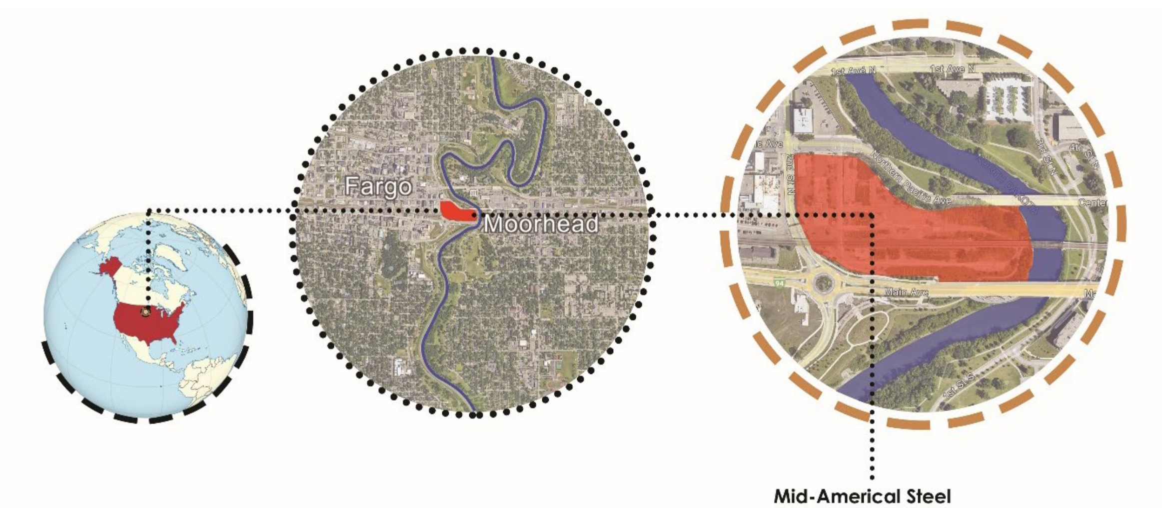

Figure 4. Context map of Mid-American Steel.

7.2. Vision Plan and DOCA Analysis

A vision is to create a postindustrial landscape where industry transforms into nature, historical value becomes ecological value, and production logic drives life logic, focusing on emotion, health, recreation, and equity. See Figure 5 for the vision plan. At the beginning of the site analysis, a Data, Opportunity, Challenges, and Anecdote (DOCA) analysis to identify intangible points for DOCA and the measurements needed to make a feasible program element for the sustainable urban park. This research has three points: Key attributes, Intangibles, and Measurements. See Figure 6 for the DOCA chart.

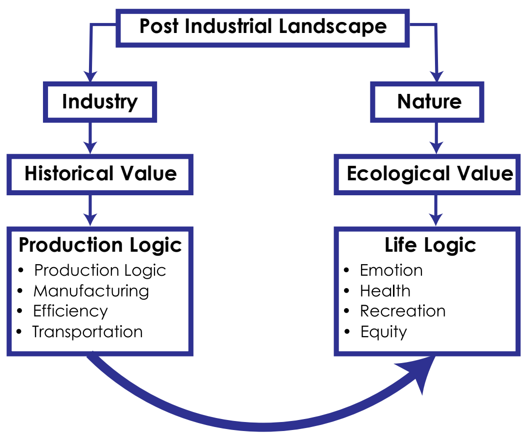

Figure 5. Vision plan.

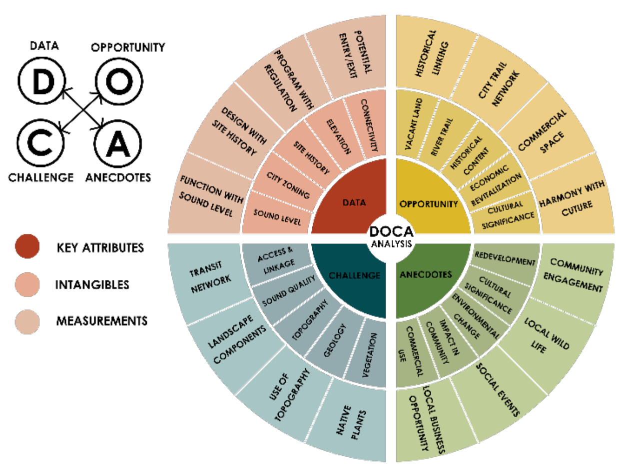

Figure 6. DOCA analysis chart.

7.3. Inventory and Analysis Cultural History

In my research and analysis of Landing Park of the Mid-American Steel, I started by inventorying and analyzing the culture and history of this historical location, along with its current physical components. The Mid-American Steel was established in 1905 with the name of Fargo Foundry, and it became Mid-Amrican in 1973. It is the 1st steel fabrication company in Fargo. Another major event occurred in Frago in 1870, when the first steamboat landed in the Fargo-Moorhead area.

To understand this significant site's history, I researched Mid-American Steel's growth and tried to locate its early footprint. See Figure 7.

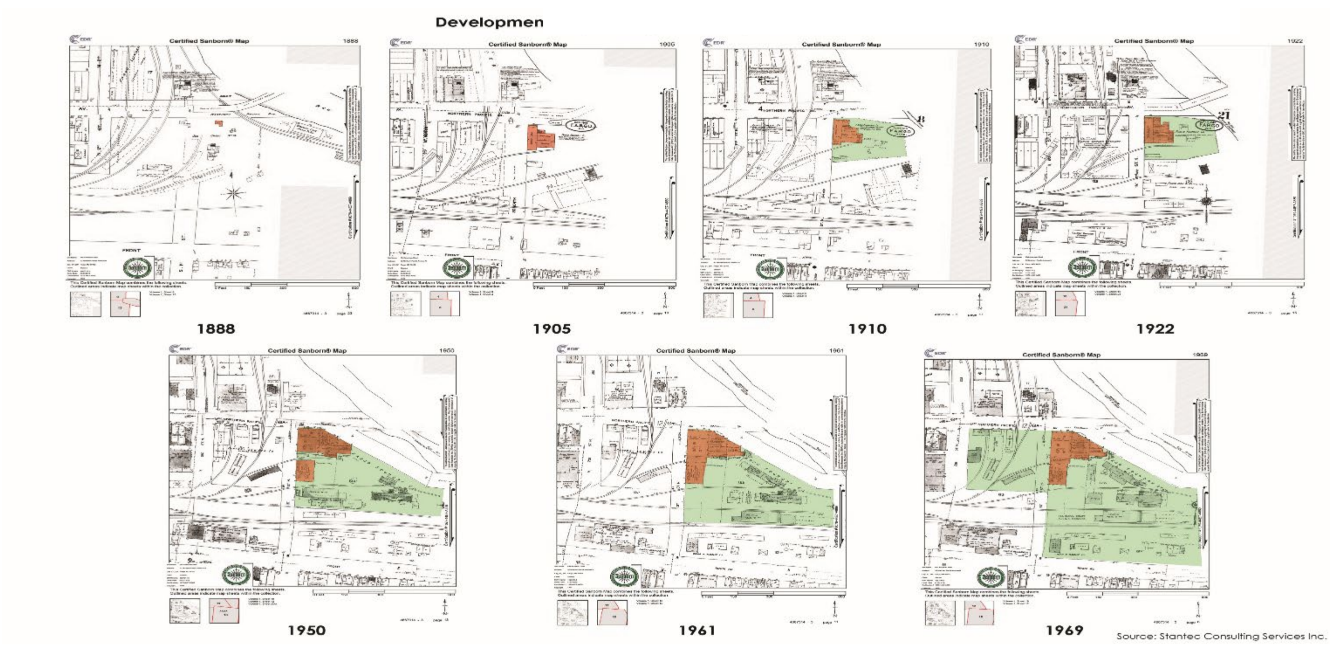

Figure 7. Development map of Fargo Foundry Steel and MEG. CO.

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The Cultural History Inventory map reflects Mid-American Steel's old footprint and production chain, along with the first steamboat landing point and existing pedestrian and vehicular circulation. The inventory also reflects the production chain of Mid-American Steel and the old rail track location. See Figure 8.

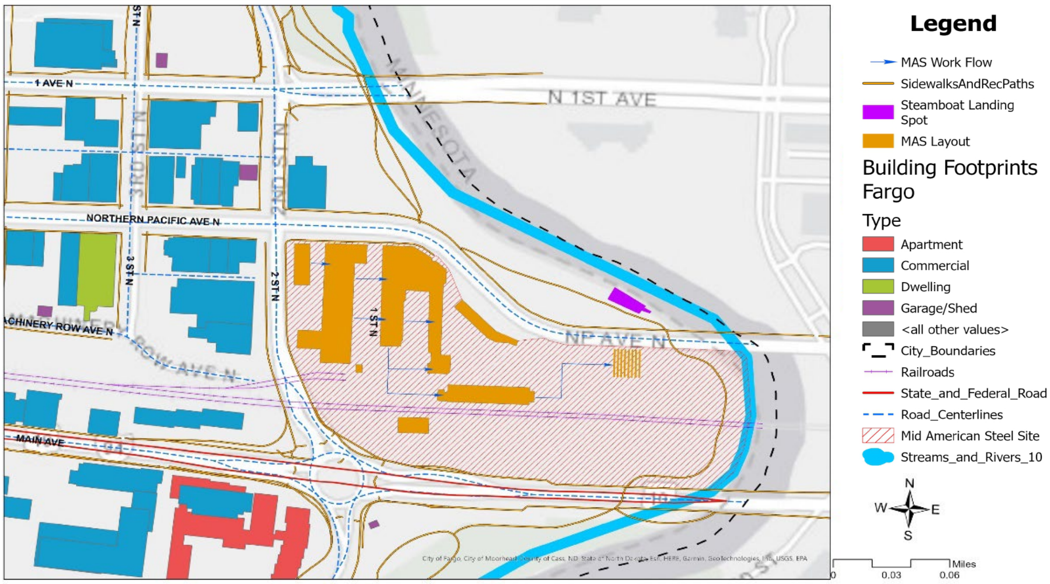

Figure 8. Cultural history inventory.

From the inventory, I tried to analyze the potential entry and exit points for vehicular and pedestrian access to the design area and how old footprints of the Mid-American Steel and Steamboat landing can be integrated with landscape design components.

In analyzing the circulation pattern, I focused on where pedestrians and vehicles will not cross each other. The blue circle is a good access point for pedestrian and vehicular circulation. See Figure 9.

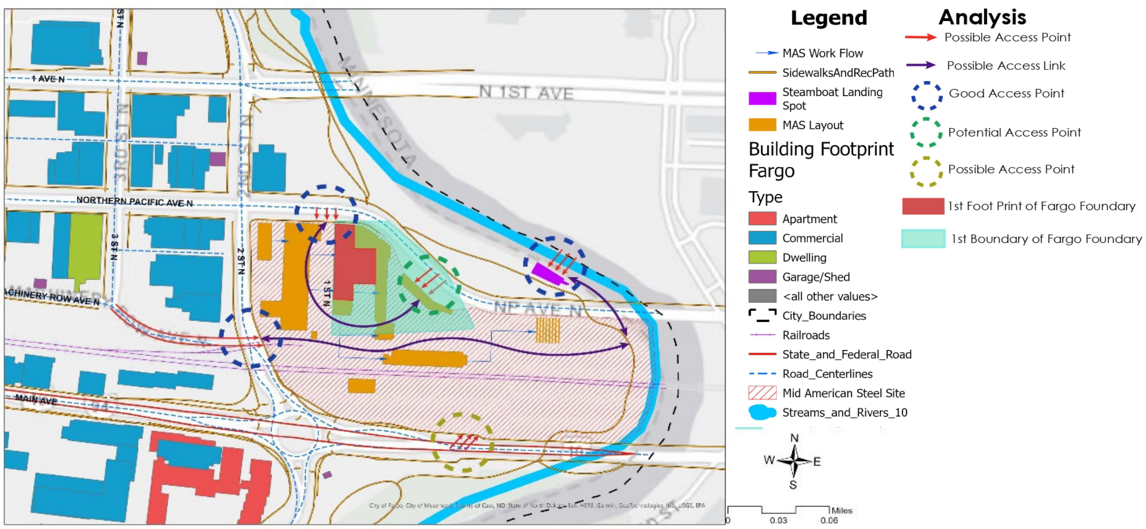

Figure 9. Cultural history analysis.

7.4. Inventory and Analysis of Soundscape Quality

The next research step was identifying this project area's current sound intensity level and testing possible solutions to improve sound quality using landscape components. Physical sound level data was collected at 04 points parallel to the rail track at 02 separate times. One was with train movement, and the other was without train movement using the mobile app from 5'-0" above the ground. See Figures 10 and 11.

02 section was developed from the collected data to understand the intensity of the sound at this site. During train movement, the intensity is high and contained within 74'-0" of the rain track; in contrast, the sound level is flexible without train movement. See Figures 12 and 13.

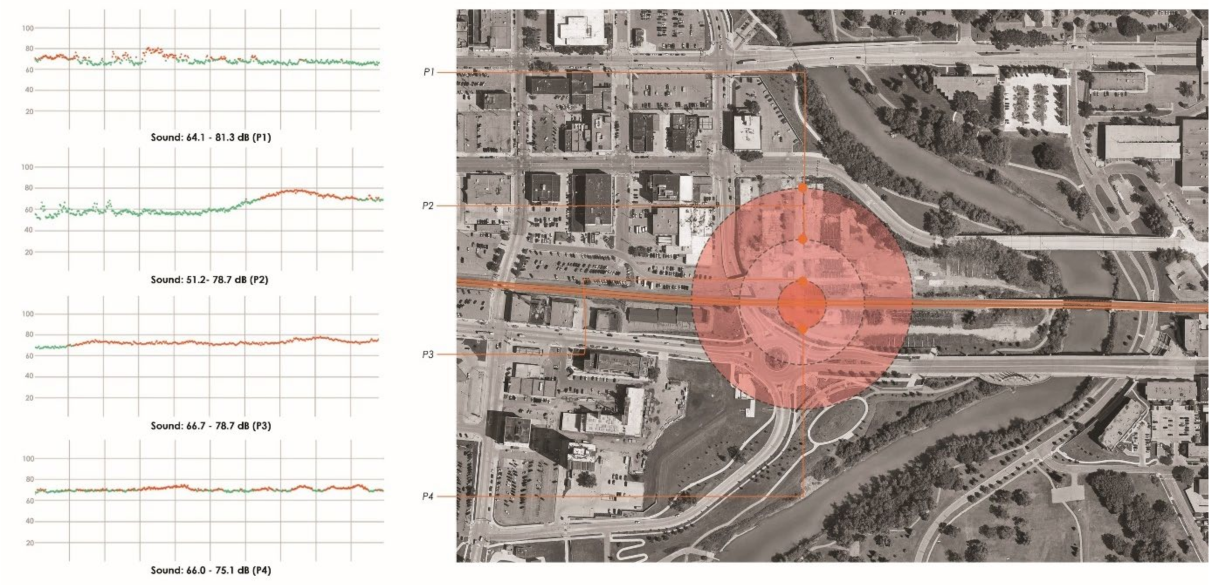

Figure 10. Sound level data with train movement.

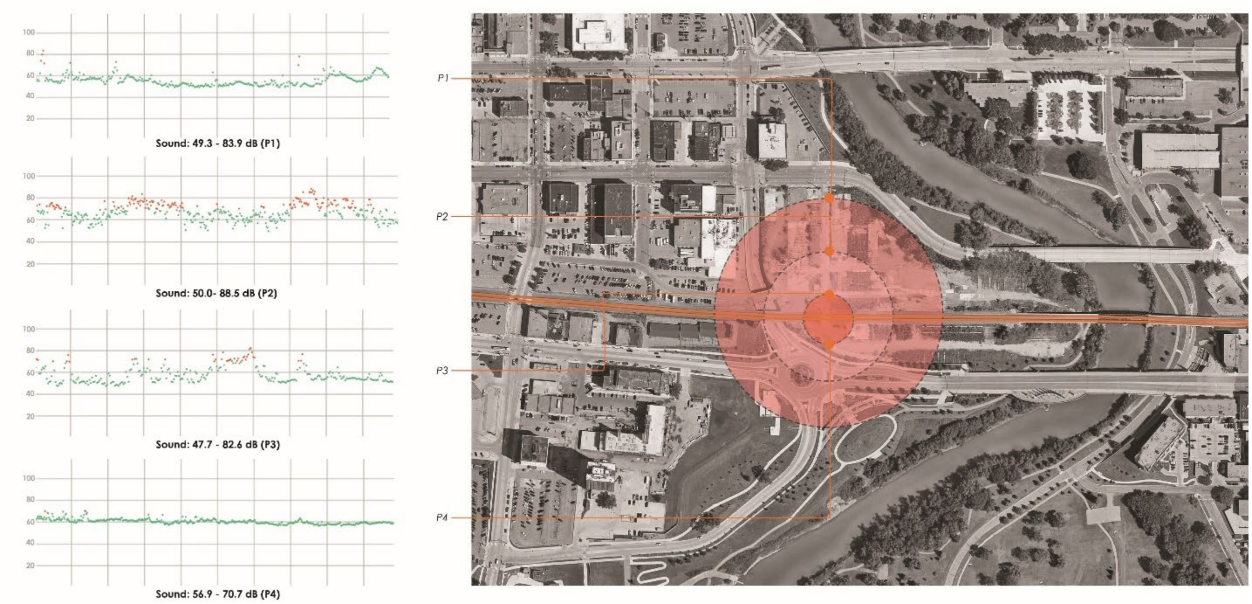

Figure 11. Sound level data without train movement.

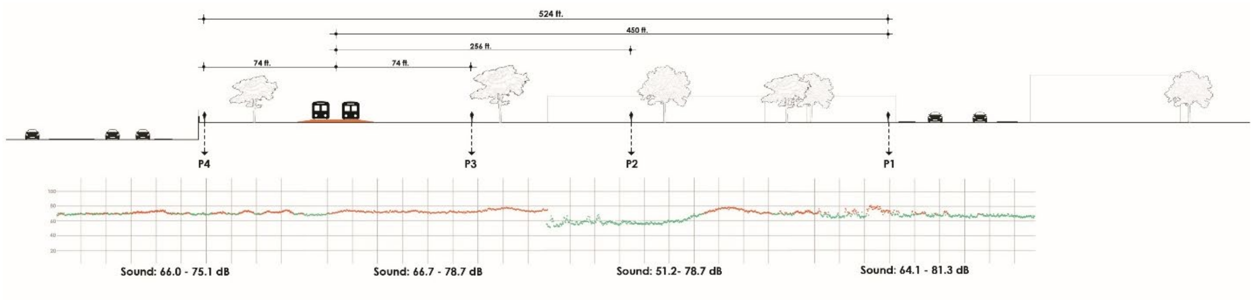

Figure 12. Sound level section with train movement.

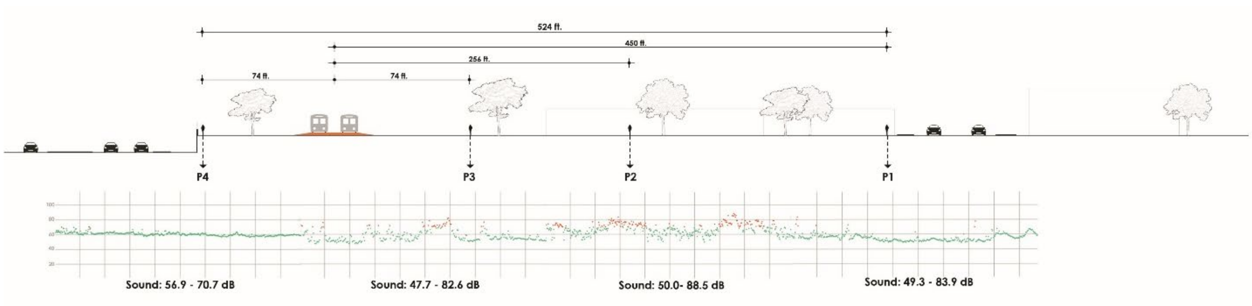

Figure 13. Sound level section without train movement.

Based on sections, a sound intensity map was developed to identify this historical site's high, medium, and low sound intensity areas. This rain track area is a whistle-free zone, and sound mostly comes from rail tracks and vehicular movement on surrounding roads. See Figure 14.

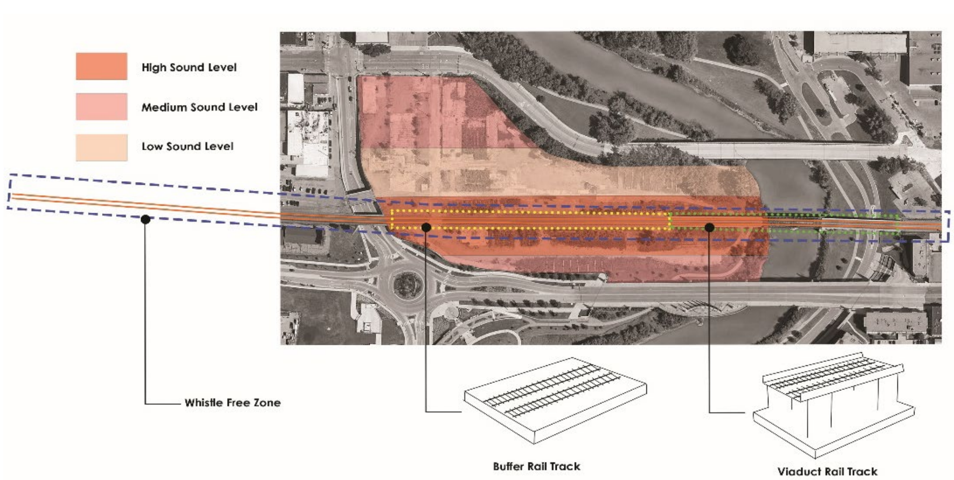

Figure 14. Sound intensity map.

This sound analysis identified that the sound mostly comes from rail tracks and surrounding roads, and the maximum sound intensity is within 5’-0” from the ground. Soil berm, vegetation, and a smooth sound wall to mitigate the sound intensity are possible solutions. Those components could be the elements of this project's landscape design. See Figure 15.

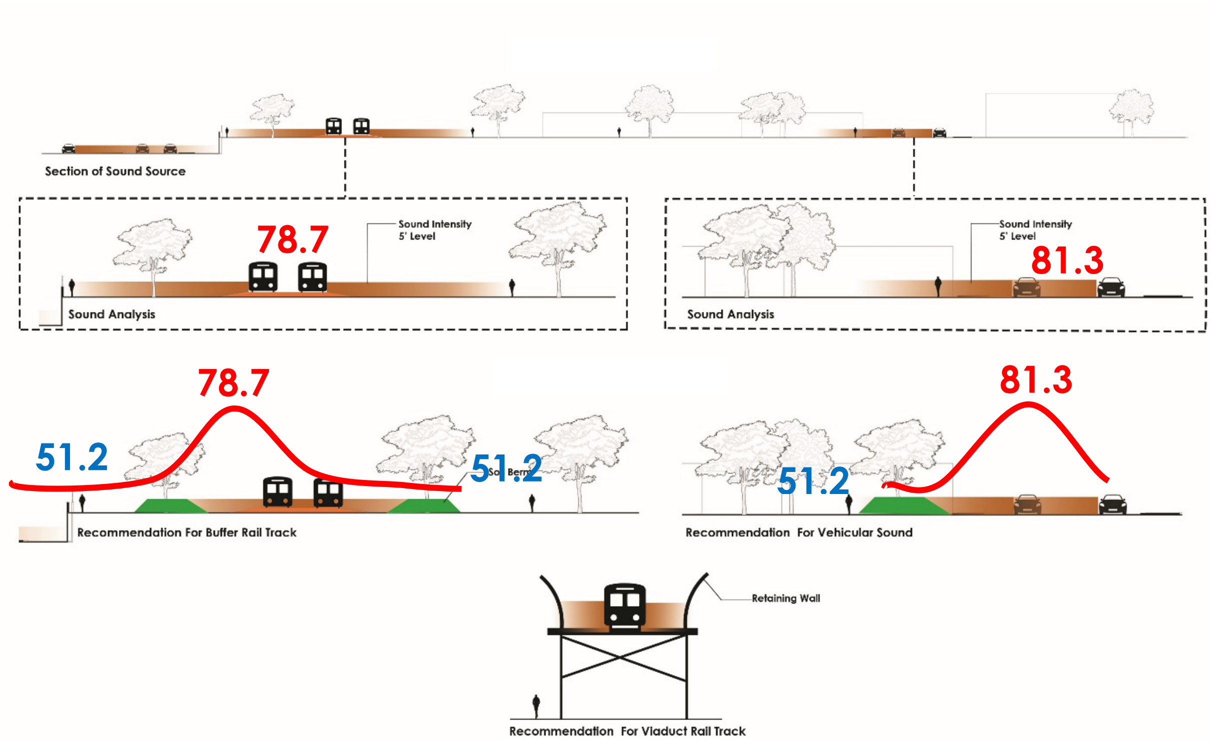

Figure 15. Sound analysis and recommendation.

7.5. Inventory and Analysis of Ecological Process

The last section of the research concerns this project's ecological inventory and analysis. This is a post-industrial project site. The ground is mainly covered by the footprint of an old factory building, hardscape, graveled paths, and very few green surfaces. Without removing the whole ground surface, to use the current hardscape and old structural foundation for the new development, such as pedestrian surface agreement, riparian restoration, and Pavel beach development. This approach will help to reduce the transportation of vast amounts of rubbish for new development. See Figure 16.

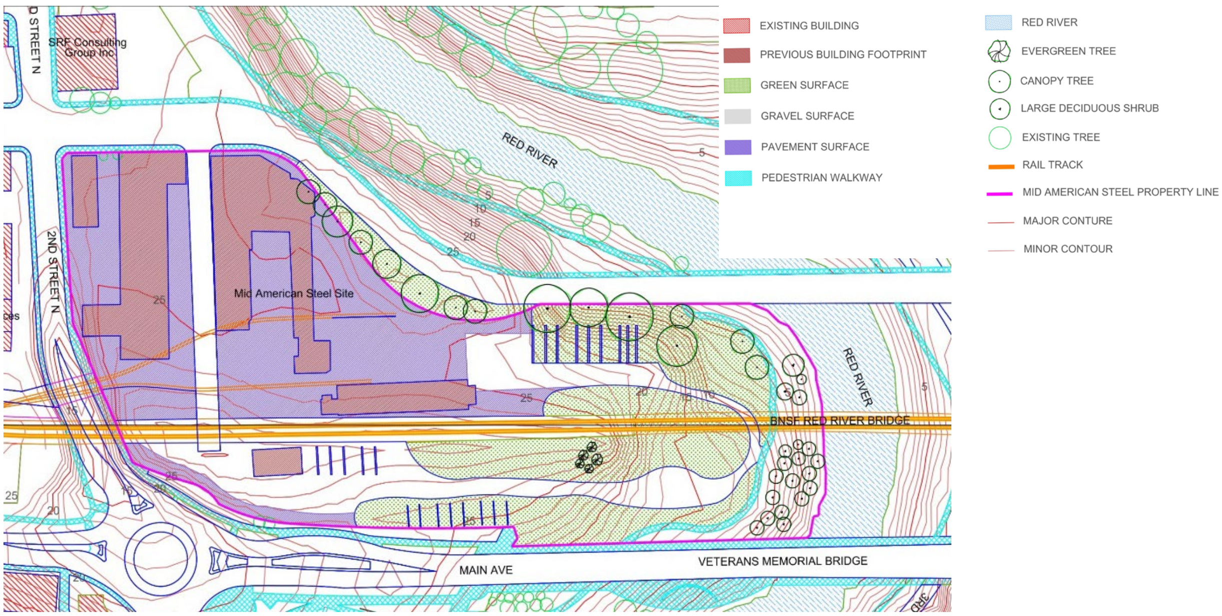

Figure 16. Ecological inventory map.

The project is located on the bank of the Red River, and Frago experiences flood events every spring. Considering this, the flood level analysis up to Stage 37 to identify the area of this project site where a flood event could occur. See Figure 17 for the flood level map. The project area is mostly flat land except the east side towards the bank of the Red River, where different slopes are identified, and most of the slopes are stiff enough to access. See Figure 18 for slope analysis. The project site is also vacant land, and there is little vegetation in the present situation. Most of the plants are shrubs, and there are a few ornamental trees. See Figure 19 for vegetation analysis.

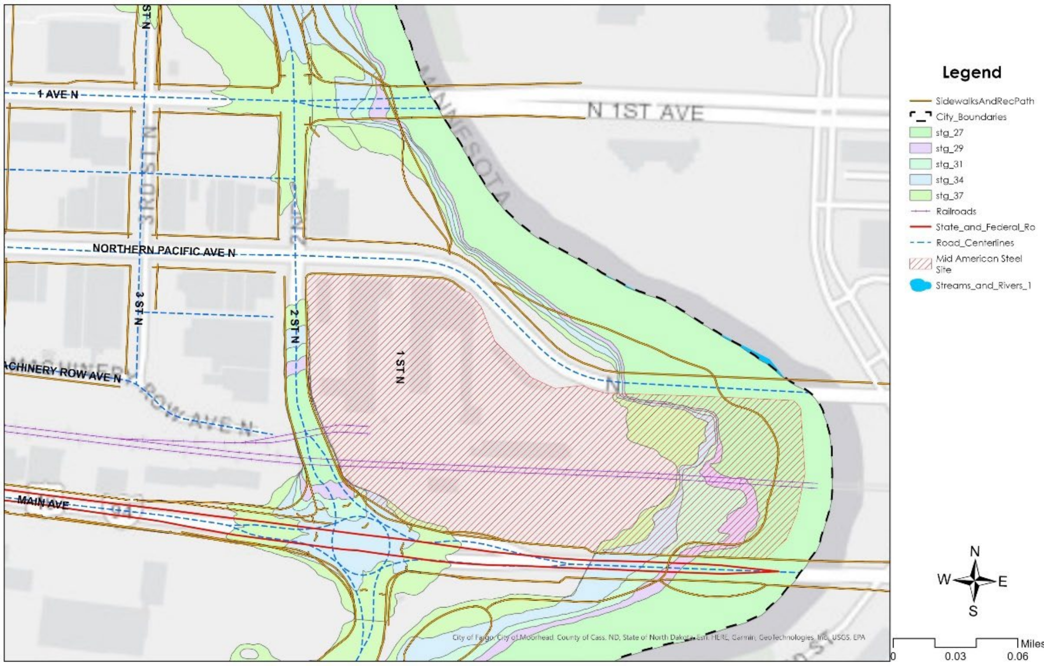

Figure 17. Flood map.

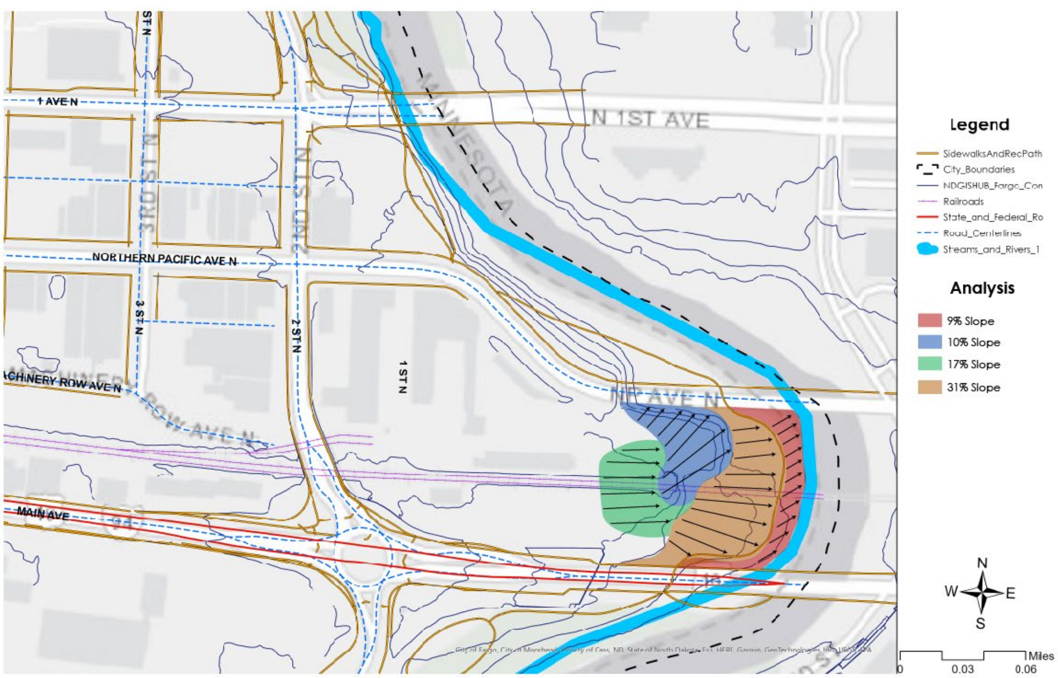

Figure 18. Slope analysis.

Figure 19. Vegetation analysis.

From the ecological analysis of the Mid-American Steel site, some recommendations have been proposed for better ecological components for future development, such as riparian development, a possible location for a rainwater retention pond and rain garden, land development for better accessibility, and a possible location for ornamental tree and botanical garden. See Figure 20 for ecological process recommendations.

Figure 20. Ecological process recommendations.

8. PRE-DESIGN PROGRAMMING AND DESIGN PRECEDENTS

8.1. Zoning Map

Based on on-site analysis, the project area was divided into 5 zones for the master plan development, and a schematic program was developed based on 03 objectives. Master plan programs were distributed within 5 zones based on objectives. See Figure 21 for master plan zoning. Table 7 shows the program list and zone of the different programs. Based on that initial master plan, a concept was developed and how it could complement the rest of the design.

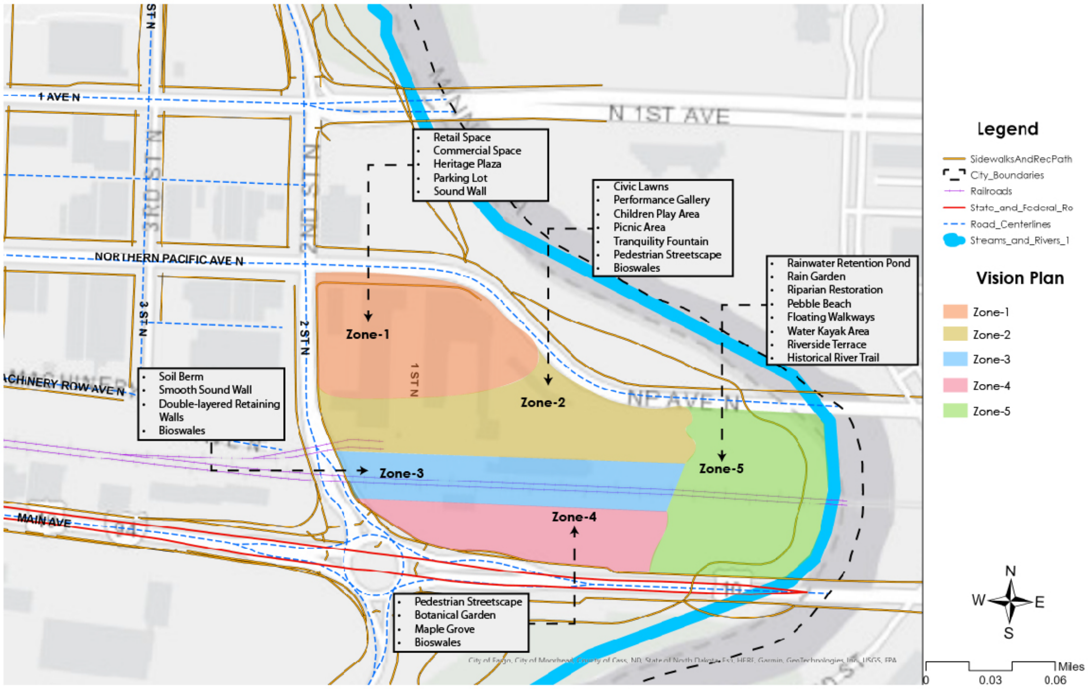

Figure 21. Master plan zoning.

Sl. No.	Objective-1	Zone-1	Zone-2	Zone-3	Zone-4	Zone-5
1	Cultural History					
1.1	Retail Space	X				
1.2	Commercial Space	X				
1.3	Heritage Plaza	X				
1.4	Performance Gallery		X			
1.5	Children Play Area		X			
1.6	Picnic Area		X			
1.7	Historical River Trail					X
1.8	Civic Lawns		X			
1.9	Water Kayak Area					X
1.10	Parking Lot	X				
	Objective-2					
2	Soundscape Quality					
2.1	Pedestrian Streetscape		X		X	
2.2	Botanical Garden				X	
2.3	Soil Berm	X		X		
2.4	Smooth Sound Wall	X		X		
2.5	Double-layered Retaining Walls			X		
2.6	Tranquility Fountain (White noise effect)		X			
	Objective-3					
3	Ecological Process					
3.1	Rainwater Retention Pond					X
3.2	Rain Garden					X
3.3	Pebble Beach					X
3.4	Riparian Restoration					X
3.5	Maple Grove				X	
3.6	Floating Walkways					X
3.7	Riverside Terrace					X
3.8	Bioswales		X	X	X	

Table 7. Program list.

8.2. Design Precedents

8.2.1. The Brooklyn Bridge Park, New York

The Brooklyn Bridge Park 2005 Master Plan describes a set of design principles to guide the transformation of this former industrial waterfront into a park landscape, one that will serve surrounding neighborhoods as well as all of New York. Governor Pataki and Mayor Bloomberg initiated the design and construction phase of Brooklyn Bridge Park in 2002. These commitments culminated many years of community efforts to make the Brooklyn waterfront a park. Grassroots initiatives characterize this generation of park-making and will continue to in the future. Brooklyn has not undertaken a park project of this scale and complexity since 1865. We are determined that with the participation of residents, officials, artists, and everyone else involved, the final design of service—updated for a new kind of site and a new kind of public—that Prospect Park embodies. Brooklyn Bridge Park is also one of a number of projects that mark the transition of the East River from a commercial shipping channel to an ecological waterway and greenway. Brooklyn Bridge Park will serve the recreational needs of the public and will also be a critical component of the continued revival of the biological health of the river and its related ecosystems. See Figure 22.

Figure 22. Brooklyn Bridge Park.

8.2.2. Klyde Warren Park, Dallas, Texas

The Woodall Rodgers Freeway had severed the city's two largest cultural districts for many years. Restoring the connection has transformed the city by bridging the gap and creating a new heart of Downtown. Acting as a common ground for the surrounding museums and businesses, Klyde Warren Park is a vibrant and well-programmed urban park. Bisected by the existing Olive Street bridge, the park is organized by a sweeping pedestrian promenade that features a continuous canopy of trident maples. The promenade draws visitors through the park past a botanical garden, a children's garden with an interactive water feature, a reading room, and an event lawn. A large public plaza adjacent to Olive Street connects the restaurant terrace, the performance pavilion, and the casual take-out pavilion to the street and features an interactive fountain. The park has measurably decreased noise and air pollution in the area and increased activity for businesses and cultural institutions. Real estate and property values surrounding the park have seen a steady increase since the start of construction. Klyde Warren Park has gracefully reconnected the city and has become an integral and endeared open space in downtown Dallas. See Figure 23.

Figure 23. Klyde Warren Park, Dallas.

8.2.3. Raised Gardens in Sants, Barcelona

The path of the train and metro tracks through the Sants neighborhood (Barcelona) has been an open wound in the urban fabric for the past century. With an average width of 30 m. and a platform for 8 tracks, it has divided the neighborhood into two practically unconnected parts, along 800 meters from Place de Sants to career Riera Blanca, which has led to urban defects, in terms of noise pollution and a deterioration of the surrounding areas.

In 2002, the city government decided to launch an urban renewal project for the Sants railway land, which marked the beginning of a complex process that has implicated three public administrations and civic organizations in the Sants neighborhood. See Figure 24.

Figure 24. Raised Gardens in Sants.

9. SCHEMATIC DESIGN

9.1. Concept of Master Plan

The main idea for the concept of the master plan was to avoid pedestrian and vehicular crossing and create a connection with the existing river trail. The very strong horizontal line exists in the project area, and breaking this strong rail track horizontal line through a smooth sound wall was considered another component of the master plan concept. Major program elements were distributed within the master plan area based on on-site analysis. See Figure 25 for the schematic design of the master plan.

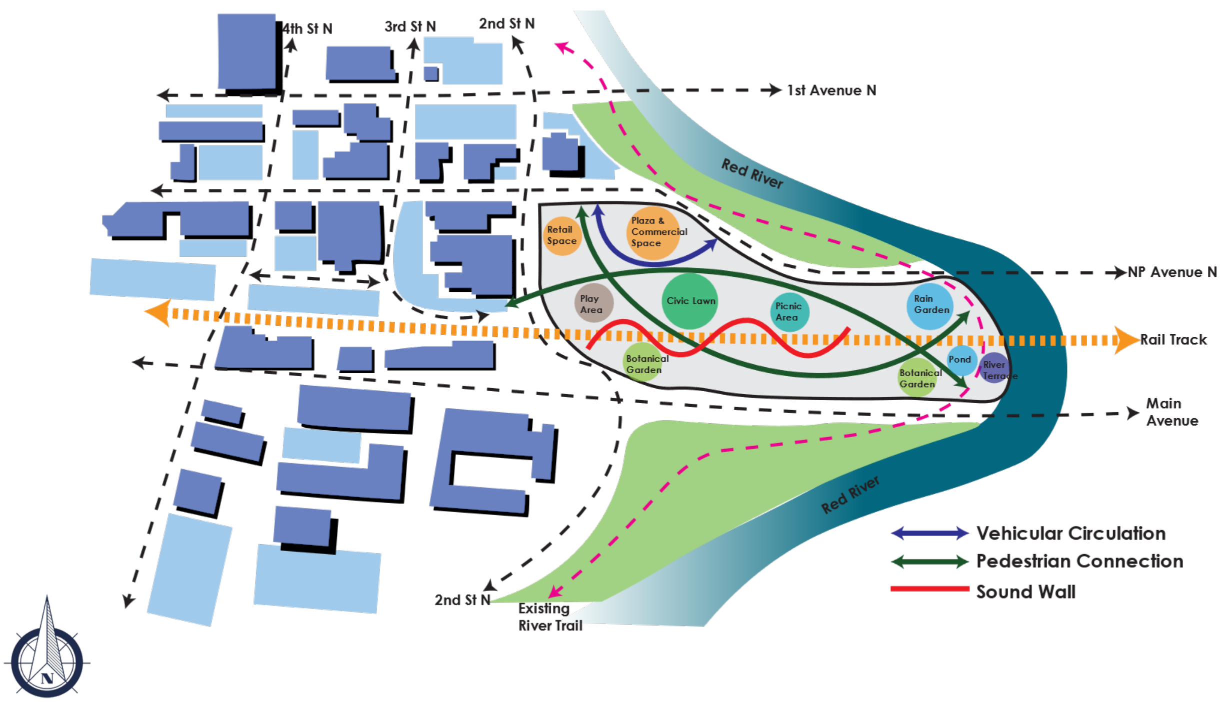

Figure 25. Schematic design of the master plan.

10. DESIGN DEVELOPMENT

10.1. Master Plan

The research on the cultural history of Mid-American steel identified the following critical areas for pedestrian and vehicular entry and exit.

- New exit point on NP Avenue
- Pedestrian connection from the west side using the bridge over 2nd St.
- Curvilinear line to integrate different parts of the park.
- Distinguish the separation of infill structures and park setting.
- Establish a historical steamboat landing by river Kayak deck.
- Based on existing topography, tried to establish an ecological process for sustainable urban parks.
- Tried to make an old rail track as part of the landscape components and established historical events. See Figure 26 for the master plan.

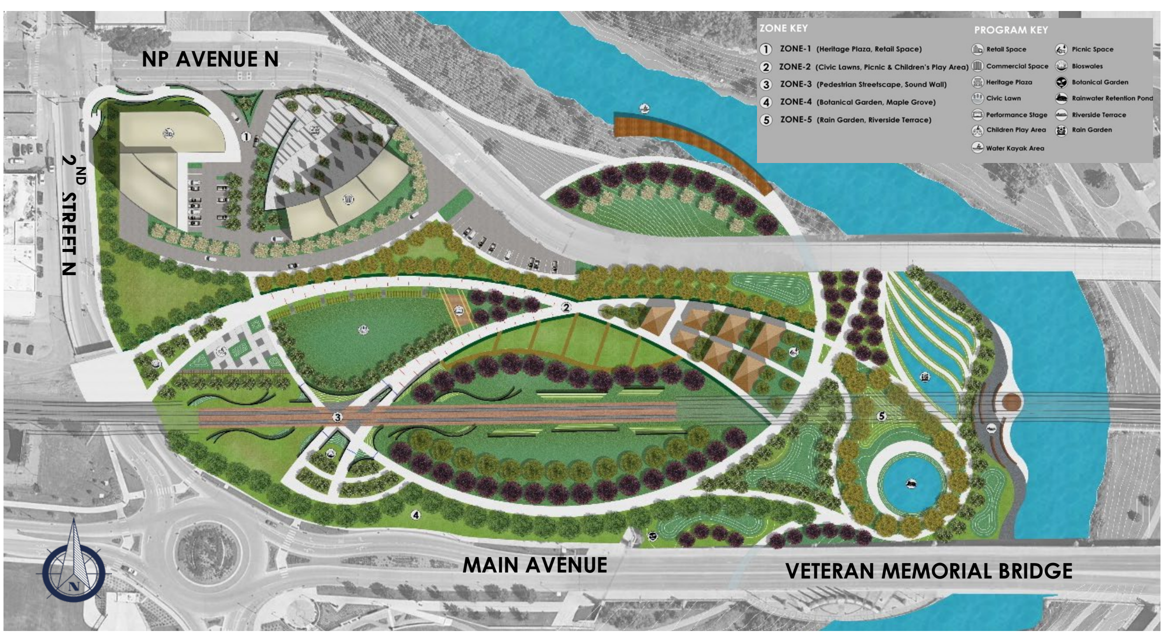

Figure 26. The master plan.

10.2. Description of the Master Plan Zone-1

The location of the old footprint of Frago Foundry was incorporated into zone-1 of the master plan as a Heritage Plaza to make a historical representation of this design. Heritage is one of the significant components of this design, and metal was used for the ground cover of this plaza. Black stripes are the metal components that represent the old ground area of Frago Foundry. The form of the plaza is the reflection of the flexible characteristics of steel. The idea for this plaza design is to create an open space where visitors can enjoy the forms of the surrounding infill structure. The sound walls are along the roadside of the Northwest corner because the retail space is adjacent to the road, and from sound data analysis, sound is also higher in this area.

The ornamental trees with shade tolerance were selected for the plaza area, which is located on the north side. All were selected because they are tolerable for acidic, alkaline, clay, loamy, moist, sandy, well-drained, and wet soil and adaptable to Hardy Zone -3. This kind of soil condition is mainly found in post-industrial sites. See Figure 27 and 28 for heritage plaza plan and perspective respectively.

Figure 27. Plan of Heritage Plaza.

Figure 28. Perspective of Heritage Plaza.

The section of the heritage plaza illustrates infill structures and heritage plaza components, including the smooth sound wall. It also gives an impression of the plaza's scale. See Figure 29 for the section of the heritage plaza.

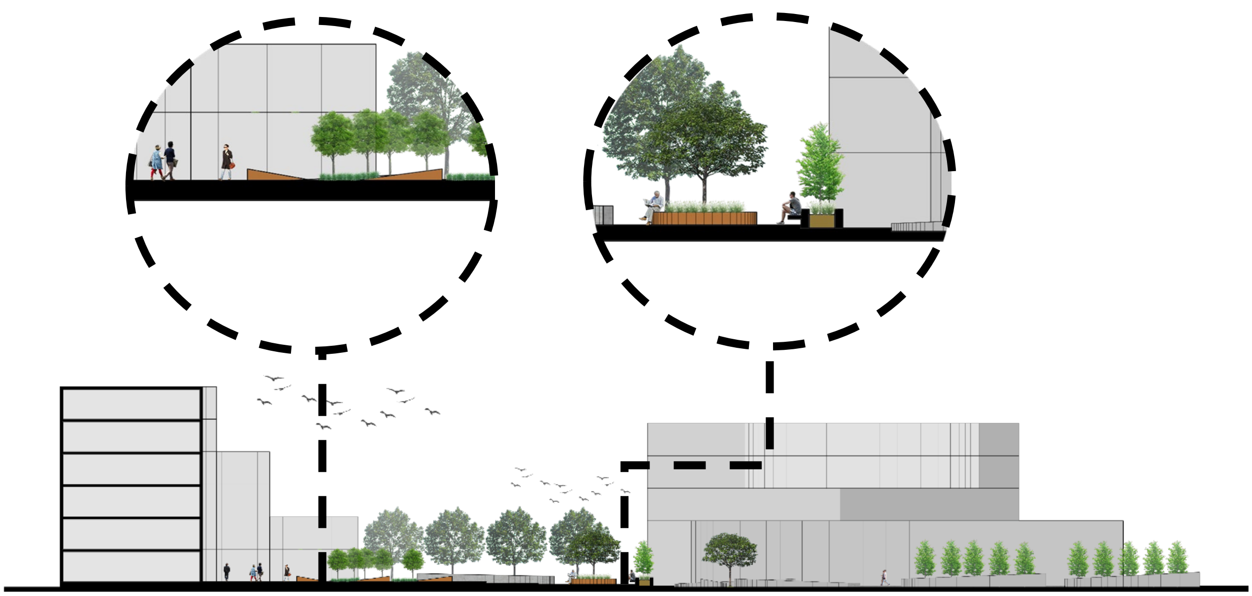

Figure 29. Section of Heritage Plaza.

10.3. Description of the Master Plan Zone-2

The pedestrian streetscape's detail aims to blend historical reflection and ecological components to create a better harmony for the park experience. The streetlight and furniture reflect the steel industry, and the permeable pavement, rail water collection pond along the side of the walkway, and plant species are the ecological components of the streetscape. The selection of canopy trees for this park setting is based on the soil conditions of the post-industrial site and is tolerable to Zone 3. See Figure 30 for the streetscape design.

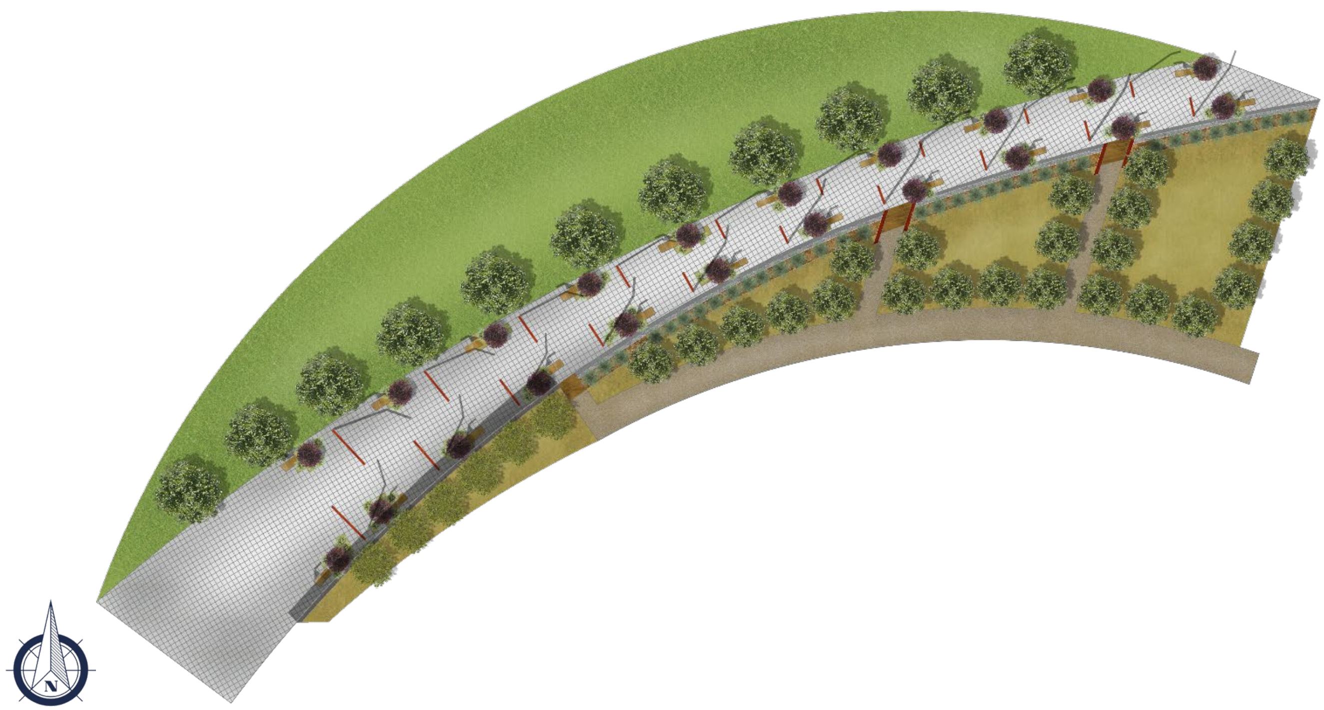

Figure 30. Plan of Streetscape Design.

This detail of the street components (See Figure 31) with rain and surface water collection methods to make a sustainable park environment gives an impression of the streetscape experience for park visitors and how it could be tied up with surrounding environments. The permeable pavement and rainwater collection pond are the main components of the streetscape design, where water will be collected from the surroundings, driven through the collection pipe below the pedestrian walkway, and sent to the rain garden and retention pond.

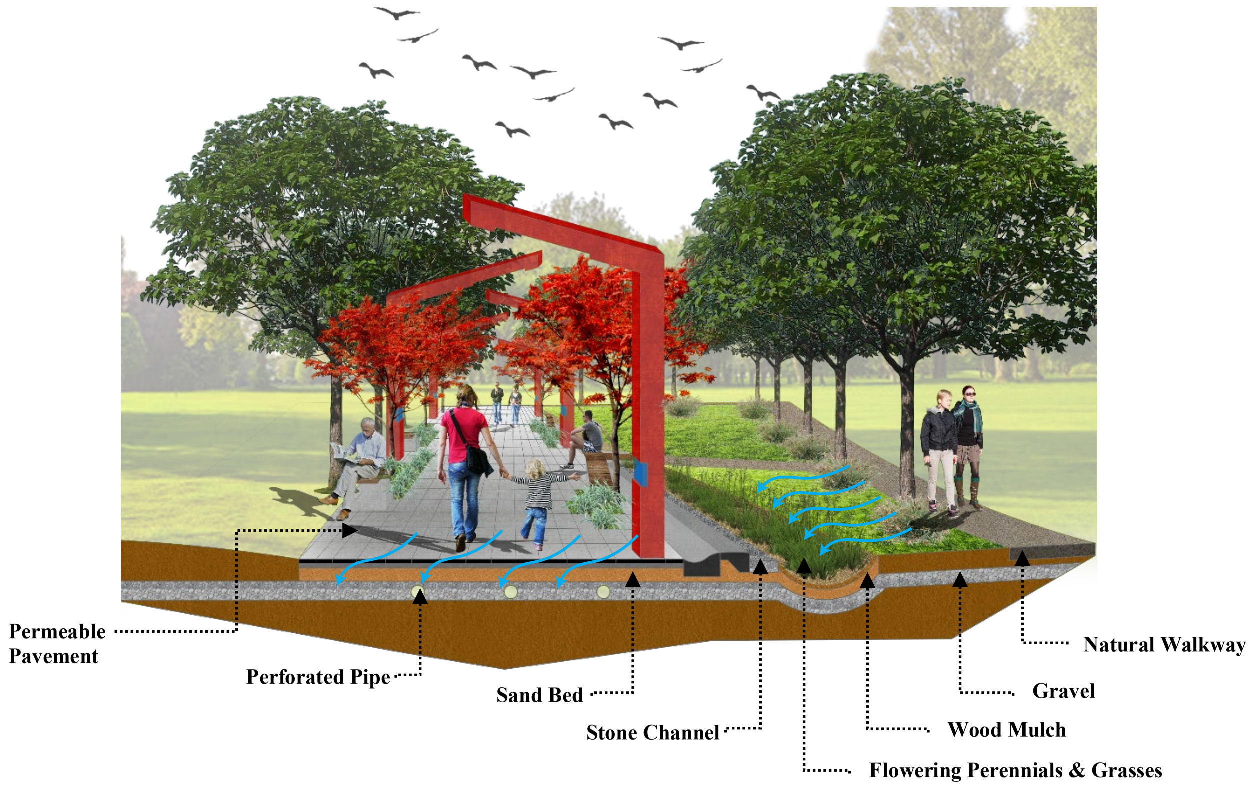

Figure 31. Section of Streetscape Design.

The inspiration for the street light design came from the industrial structure, and this design was incorporated to make an enclosure of the industrial environment. The light post with red coated paint will be the contrast components with surrounding green environments. Street furniture is also a street component and incorporates the composition of rusted metal and wooden planks to create an impression of the industrial past. See Figures 32 and 33 for the streetlight and street furniture design.

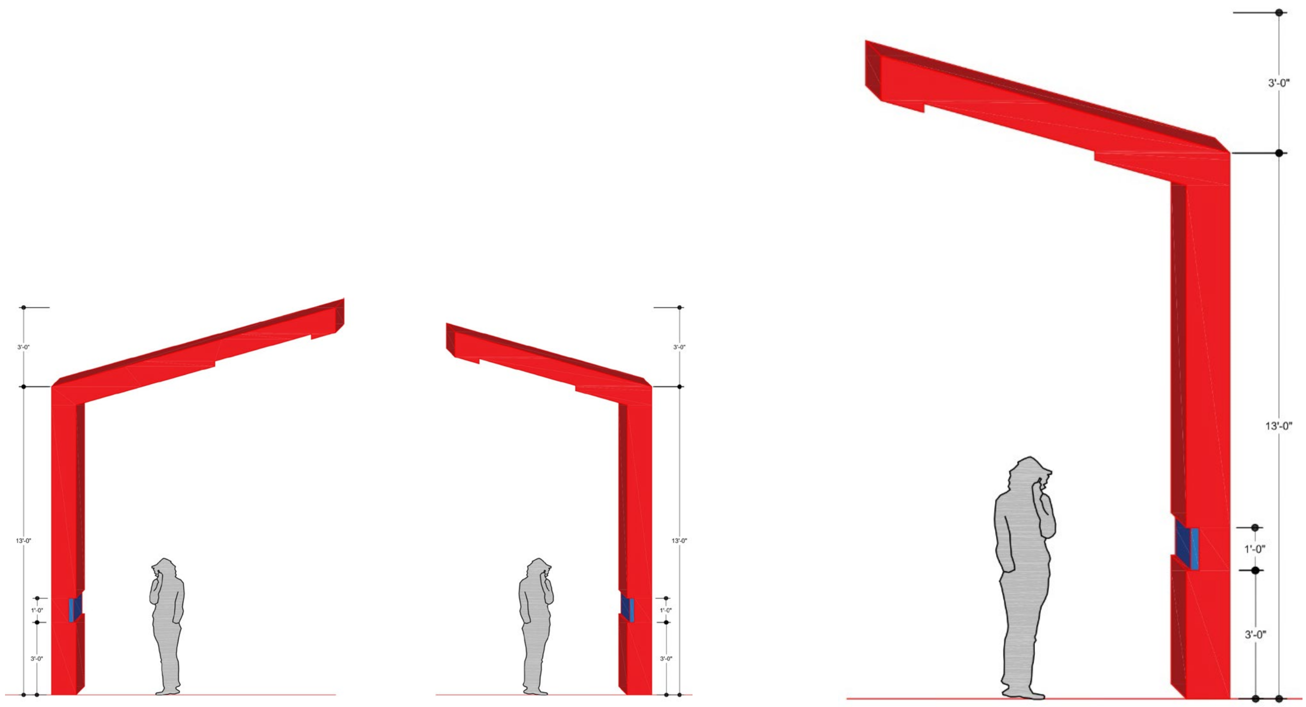

Figure 32. Design of Streetscape Light.

Figure 33. Design of Streetscape Furniture.

An old rail track in the project incorporated this historical component in design to make a footprint of Mid-American Steel (see Figure 34). The perspective shows the old rail line transformed into a landscape that allows walking in planting beds on exposed rail tracks (see Figure 35). The performing gallery structure, a vital component of the steel industry, incorporates a gondola form (see Figure 36).

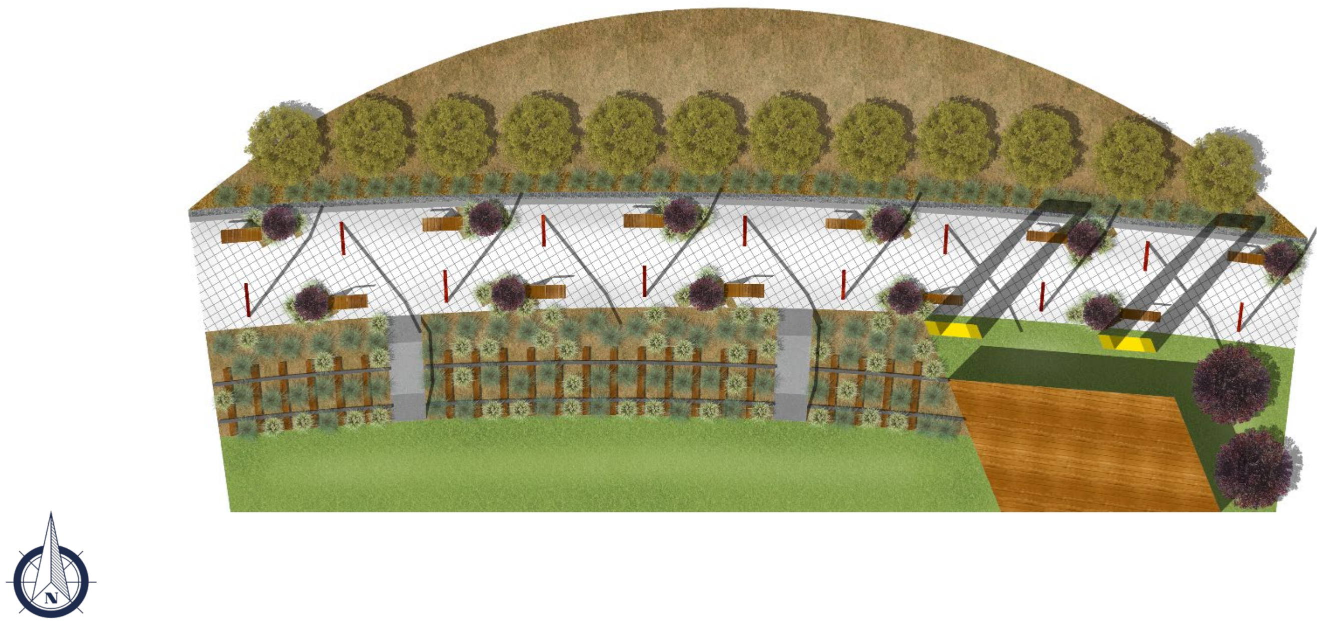

Figure 34. Design of Old Rail Track.

Figure 35. Perspective of Old Rail Track.

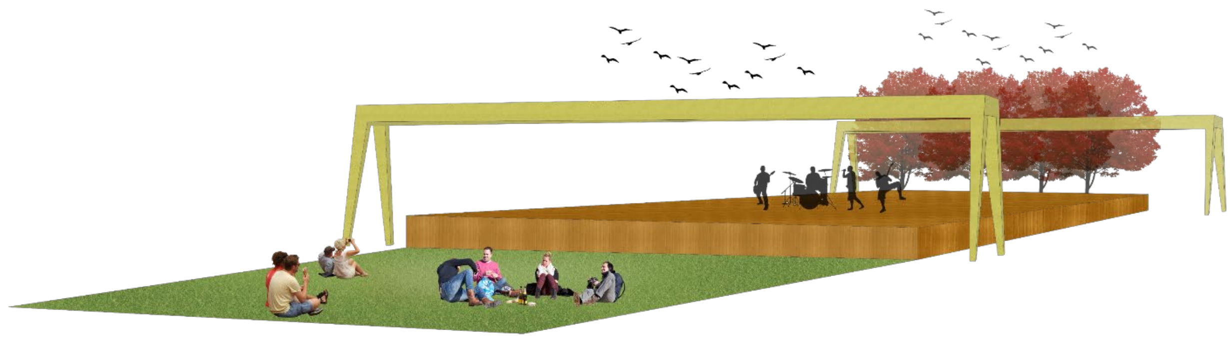

Figure 36. The perspective of Performance Gallery.

10.4. Description of the Master Plan Zone-3 & 4

One of the significant challenges of my design was reducing the sound from the rail track and ensuring pedestrians could cross it efficiently. Breaking the strong horizontal rail track to integrate this design with the other design components, different shapes of sound walls alongside the rail track, and making better pedestrian access paths that could be controlled during train movement. An auto-retractable barrier at different junctions to facilitate safe movement within the park. The texture of the rail track is another vital issue, and different materials, such as brick paving and gravel, are used to take extra precautions for pedestrians crossing over it. From ecological process analysis, a large canopy tree was used, and the botanical garden location along the south side parallel to the main avenue to reduce the sound impact from this busy road. See Figure 37 & 38 for the plan and perspective of the pedestrian crossing.

There are different bioswals and collection pond locations within the park area to collect rain and surface water. The water is collected through those points and driven to the retention pond and rail garden. After sedimentation, it is sent to the Red River.

Through my analysis of cultural history, the production flow of Mid-American Steel, collection—production—storage. This strategy should be applied to this proposal's design vision of the ecological process. See Figure 39 for water collection flow.

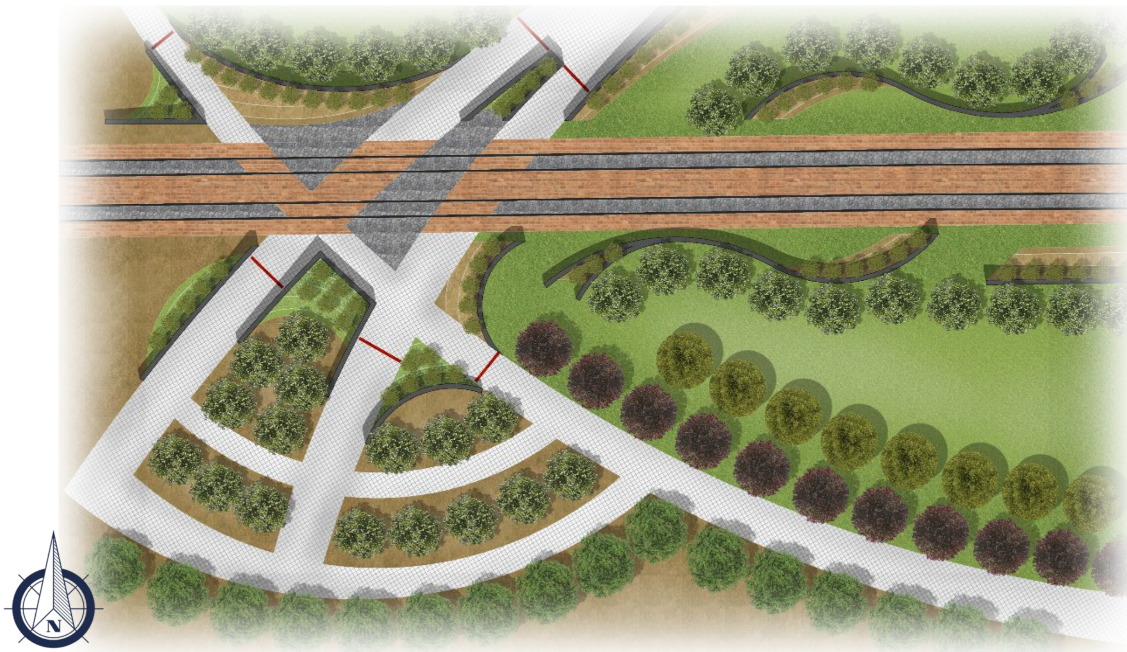

Figure 37. The Plan for Pedestrian Crossing.

Figure 38. The Perspective for Pedestrian Crossing.

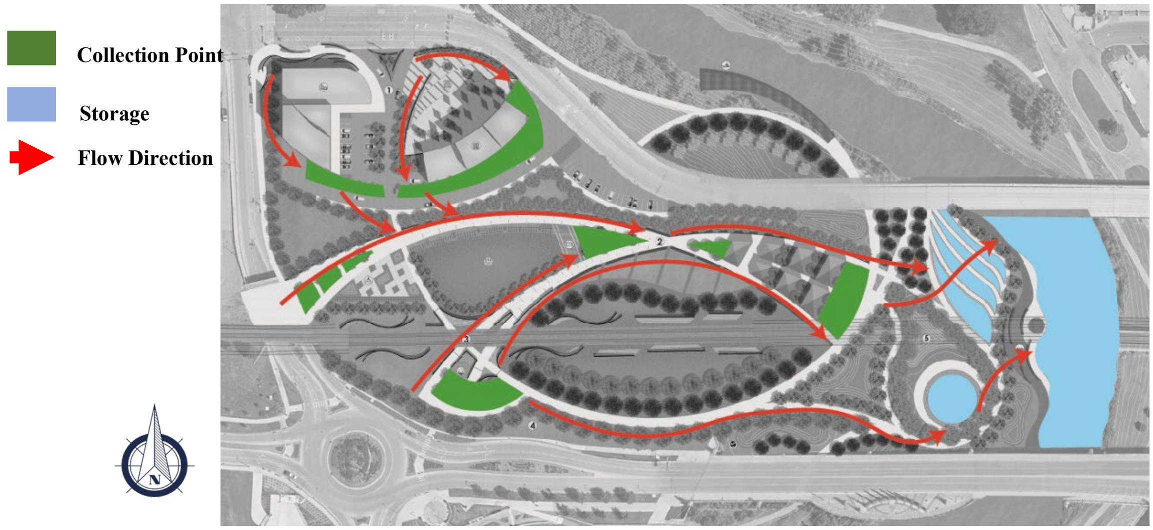

Figure 39. The Plan for Rain and Surface Water Collection and Flow.

In the soundscape quality analysis for this project area, the maximum sound level was found parallel to the rail track, and the distance at which a sound wall could effectively reduce rail track noise was determined. The form and material of the sound wall and soil berm are used to absorb the sound, and the Upright Ironwood tree is the buffer element to reduce wind impact during train movement (see Figure 40 for sound wall design). A double sound wall is another component to reduce sound impact from the rail track bridge, and different height walls to mitigate the sound from the bridge. See Figure 41 for a layered sound wall design.

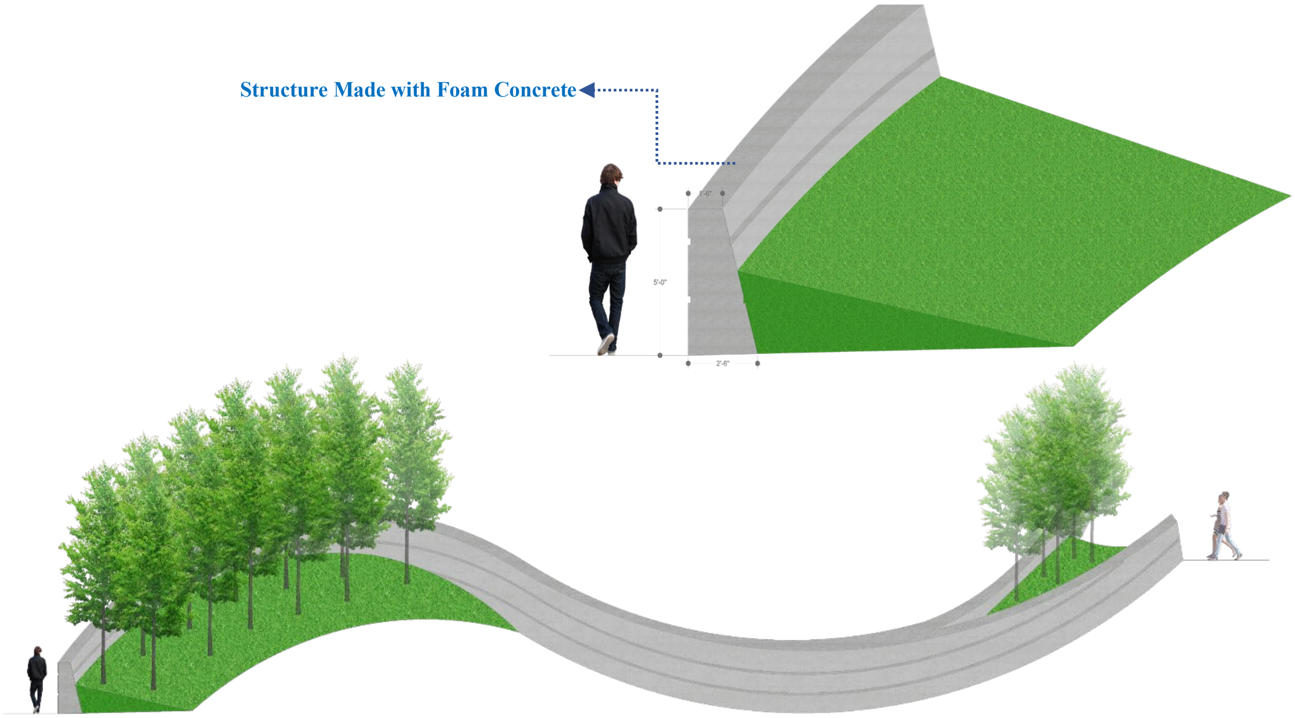

Figure 40. The Detail of Sound Wall Design.

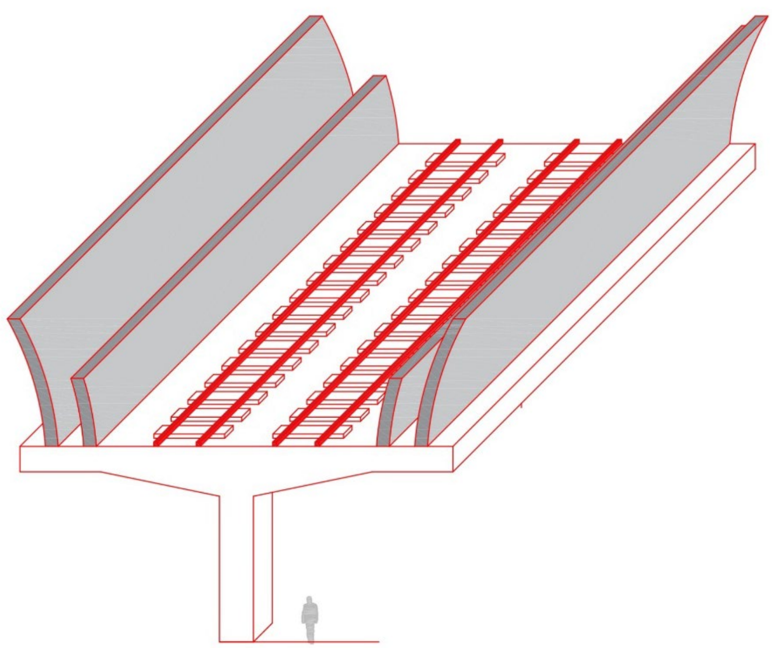

Figure 41. The Detail of Double Layer Sound Wall Design.

10.5. Description of the Master Plan Zone-5

This part of my design focused on the riverbank, where the key components are the rain garden and water retention pond. From flood and slope analysis, their location was determined. During flood events, that pond will be covered with water, but after the flood, it will retail water, and surface water will come from the park area. The process will help to sediment the different particles from the water and transfer them to the river. This will help to germinate new species from the seeds, which will be driven by surface water. See Figure 42 for the plan of the retention pond and riparian area.

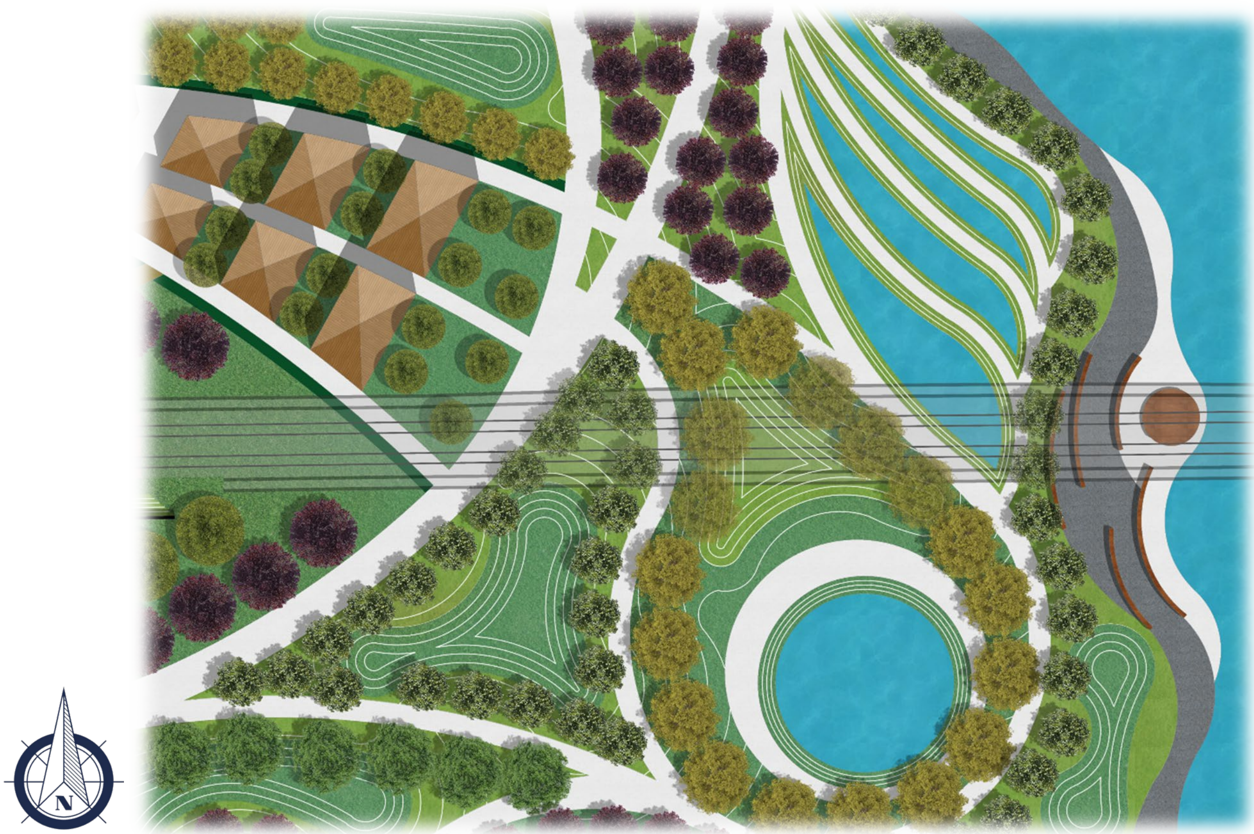

Figure 42. The plan of the retention pond and riparian area.

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The selection of native grasses and shrubs is adaptable to rich, average, poor, clay, sand, and post-industrial soil stations. It is also adaptable to Zone 3. These plants also produce seeds for new germination. The ecological analysis of current plant species in the riverbank is not significant enough for riparian restoration. Considering this, proposed different trees and shrubs adaptable to moist soil conditions. See Figure 43 for the rain garden section.

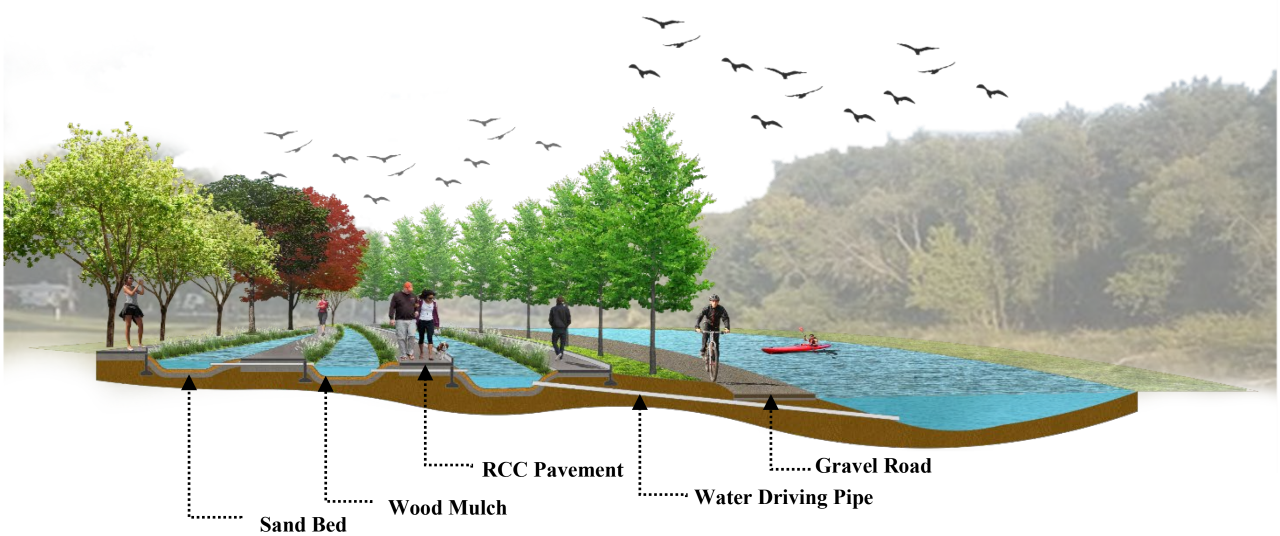

Figure 43. The rain garden section.

11. DESIGN DISCUSSION & CONCLUSION

11.1. Discussion

"THE LANDING PARK OF THE MID-AMERICAN STEEL: BRIDGING THE PAST AND FUTURE THROUGH NOVEL SOUNDSCAPE ANALYSIS" presents a comprehensive exploration of how soundscapes can enhance urban park experiences. This innovative approach, which measured the acoustic environment and the visitors' perceptions and preferences regarding the soundscape, offers a fresh perspective on urban park design.

The findings highlight a significant, often overlooked aspect of urban planning—the acoustic environment's impact on the quality of life in urban spaces. This research underscores the transformative potential of integrating soundscape analysis into urban park design, proposing that such integration can significantly enhance visitor satisfaction and engagement.

The application of soundscape analysis was effective in the context of the Mid-American Steel site and served as a model for other post-industrial sites. This research suggests that understanding a site's evolution and integrating its historical elements into the new design can preserve the area's heritage and enrich the contemporary urban experience, demonstrating the broader potential of historical awareness in urban redevelopment.

Additionally, using ecological and landscape design elements—like native vegetation, bioswales, and sound walls—illustrates a thoughtful approach to sustainable urban design. These elements are strategically used to mitigate environmental issues such as noise pollution and water runoff, showcasing how design can address ecological challenges while enhancing the urban fabric.

11.2. Conclusion

This thesis is a compelling example of how interdisciplinary approaches can address complex issues in urban environments. Integrating soundscape analysis with historical preservation and ecological design addresses urban dwellers' sensory and aesthetic needs and tackles environmental sustainability. Projects like The Landing Park of the Mid-American Steel are essential case studies in pursuing more livable, engaging, and sustainable urban spaces as urban areas grow and evolve. This work contributes significantly to urban design, offering insights that could shape future developments in understanding and crafting urban environments.

REFERENCES

Journal article - Karasek, R.; Baker, D.; Marxer, F.; Ahlbom, A.; Theorell, T. Job decision latitude, job demands, and cardiovascular disease: A prospective study of Swedish men. Am. J. Public Health 1981, 71, 694–705.

Journal article - Tyssen, R.; Vaglum, P.; Gronvold, N.T.; Ekeberg, O. The impact of job stress and working conditions on mental health problems among junior house officers. A nationwide Norwegian prospective cohort study. Med. Educ. 2000, 34, 374–384.

Journal article - Park, J.; Chung, S.; An, H. A structural model of stress, motivation, and academic performance in medical students. Psychiatry Investig. 2012, 9, 143–149.

Journal article - Laurent, O.; Benmarhnia, T.; Milesi, C.; Hu, J.; Kleeman, M.J.; Cockburn, M.; Wu, J. Relationships between greenness and low birth weight: Investigating the interaction and mediation effects of air pollution. Environ. Res. 2019, 175, 124–132.

Journal article - Ow, L.F.; Ghosh, S. Urban cities and road traffic noise: Reduction through vegetation. Appl. Acoust. 2017, 120, 15–20.

Journal article - Ulrich, R.S.; Simons, R.F.; Losito, B.D.; Fiorito, E.; Miles, M.A.; Zelson, M. Stress recovery during exposure to natural and urban environments. J. Environ. Psychol. 1991, 11, 201–230.

Journal article - Ulrich, R.S.; Parsons, R. Influences of passive experiences with plants on individual well-being and health. Role Hortic. Hum. Well-Being Soc. Dev. 1992, 15, 93–105.

Journal article - R. C. Smardon, "Perception and aesthetics of the urban environment: Review of the role of vegetation," Landsc. Urban Plann. 15, 85–106 (1988).

Journal article - J. Downing and E. Stunsick, "Measurement of the natural soundscape in national parks," J. Acoust. Soc. Am. 108, 2497 (2000).

Journal article - M. E. Nilsson and B. Berglund, "Soundscape quality in suburban green areas and city parks," Acta Acust. Acust. 92, 903–911 (2006).

Journal article - L. Yu and J. Kang, "Factors influencing the sound preference in urban open spaces," Appl. Acoust. 71, 622–633 (2010).

Journal article - Herzog, T.R.; Chen, H.C.; Primeau, J.S. Perception of the restorative potential of natural and other settings. J. Environ. Psychol. 2002, 22, 295–306.

Journal article - Karmanov, D.; Hamel, R. Assessing the restorative potential of contemporary urban environment(s): Beyond the nature versus urban dichotomy. Landsc. Urban Plan. 2008, 86, 115–125.

Journal article - Aletta, F.; Oberman, T.; Kang, J. Associations between positive health-related effects and soundscapes perceptual constructs: A systematic review. Int. J. Environ. Res. Public Health 2018, 15, 2392.

Journal article - Annerstedt, M.; Jönsson, P.; Wallergård, M.; Johansson, G.; Karlson, B.; Grahn, P.; Hansen, Å.M.; Währborg, P. Inducing physiological stress recovery with sounds of nature in a virtual reality forest—Results from a pilot study. Physiol. Behav. 2013, 118, 240–250.

Journal article - Jennings P, Cain R. A framework for improving urban soundscapes. Appl Acoust 2013;74: 293–9.

Journal article - Payne SR. The production of a perceived restorativeness soundscape scale. Appl Acoust 2013;74:255–63.

Journal article - Watts, G.; Pheasant, R.; Horoshenkov, K. Tranquil spaces in a metropolitan area. In Proceedings of the 20th International Congress on Acoustics, Sydney, Australia, 23–27 August 2010.

Journal article - Van Renterghem, T.; Vanhecke, K.; Filipan, K.; Sun, K.; De Pessemier, T.; De Coensel, B.; Joseph, W.; Botteldooren, D. Interactive soundscape augmentation by natural sounds in a noise polluted urban park. Landsc. Urban Plan. 2020, 194, 103705.

Journal article - Hong, J.Y.; Ong, Z.-T.; Lam, B.; Ooi, K.; Gan, W.-S.; Kang, J.; Feng, J.; Tan, S.-T. Effects of adding natural sounds to urban noises on the perceived loudness of noise and soundscape quality. Sci. Total Environ. 2020, 711, 134571.

Journal article - Kang, J. From dBA to soundscape indices: Managing our sound environment. Front. Eng. Manag. 2017, 4, 184–192.

Journal article - Sang, Å.O.; Knez, I.; Gunnarsson, B.; Hedblom, M. The effects of naturalness, gender, and age on how urban green space is perceived and used. Urban For. Urban Green. 2016, 18, 268–276.

Journal article - Alves, S.; Estévez-Mauriz, L.; Aletta, F.; Echevarria-Sanchez, G.M.; Romero, V.P. Towards the integration of urban sound planning in urban development processes: The study of four test sites within the SONORUS project. Noise Mapp. 2015, 2.

Journal article - Van Kempen, E.; Devilee, J.; Swart, W.; Van Kamp, I. Characterizing urban areas with good sound quality: Development of a research protocol. Noise Health 2014, 16, 380–387.

Journal article - Muratet, A.; Pellegrini, P.; Dufour, A.-B.; Arrif, T.; Chiron, F. Perception and knowledge of plant diversity among urban park users. Landsc. Urban Plan. 2015, 137, 95–106.

Journal article - Hunter, I. What do people want from urban forestry?—The European experience. Urban Ecosyst. 2001, 5, 277–284,

Journal article - Coles, R.; Bussey, S. Urban forest landscapes in the UK—Progressing the social agenda. Landsc. Urban Plan. 2000, 52, 181–188.

Journal article - Zhang M, Kang J. Towards the evaluation, description, and creation of soundscapes in urban open spaces. Environ Plan B Plan Des 2007;34:68–86.