INDUSTRIAL AGRISCAPE

revitalization of red hook grain terminal

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REVITALIZATION OF RED HOOK GRAIN TERMINAL, NYC, USA

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Figure 1. Gotham Green Farm, Brooklyn, NYC © Victoria Morris

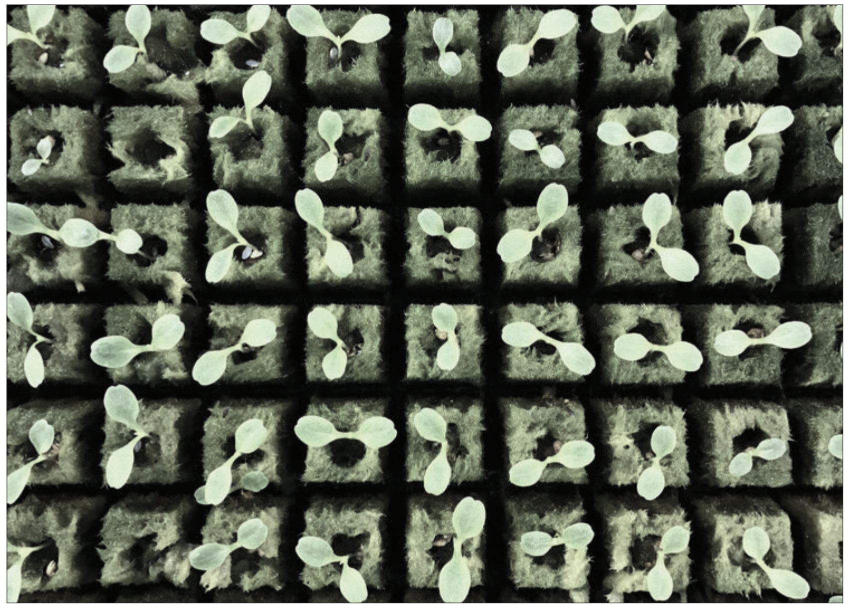


Figure 2. Gotham Green Farm, Brooklyn, NYC © Victoria Morris

ABSTRACT

This thesis will argue the possible integration of the CSA model (community-supported agriculture) within a dense urban scheme. It also tries to tackle unemployment as a common threat among contemporary societies by proposing exemplary solutions. The thesis attempts to create a bond between the application of the CSA platform and relative architectural theories through the revitalization of industrial abandoned structures.

The progressive intensification and mechanization of agricultural production have significantly changed the character of food production over the last few decades. Regional supply structures have increasingly been replaced by globalized value chains and networks. However, from a consumer's point of view, global supply chains are opaque, and current production practices are regarded as ethically and morally doubtful. There are increasing societal concerns about the impact of modern food production on human health and the environment. These aspects have encouraged a group of consumers to find an alternative form of high-quality food supply.

In recent years Community Supported Agriculture (CSA), an innovative grassroots movement connecting consumers with a local farm have rapidly spread across most of the industrialized countries. An increasing number of consumers who are dissatisfied with conventional food supply chains have signed up to receive fresh produce, support a local community and protect the environment. On the other hand, the idea of food miles, the distance that food must be shipped, has entered debates in both popular and academic circles about local eating. An oft-cited figure claims that the average item of food travels almost 1000 kilometers before it reaches your plate.

The strategy of urban farming on small and medium scales have been executed in different mediums like roof gardens, terraces and public lands (prominently during the last two decades) but further steps should be taken if we want more complex communities to benefit from this proposed model. A few examples of such innovation are serving the communities in different parts of the world, by following the standard greenhouse schemes, yet disregarding the speculative role of architecture. Metropolitan cities around the world currently host hundreds of abandoned industrial structures that have a great potentiality to act as proper mediums for more sophisticated urban agriculture paradigm.

REVITALIZATION

HYDROPONIC HORTICULTURE

INDUSTRIAL AGRISCAPE

COMMUNITY-BUILDING

UNEMPLOYMENT

COMMUNITY-SUPPORTED AGRICULTURE

PEDESTRIAN CIRCULATION

STRATEGICAL APPROACH

SPACE-TIME RELATIONSHIP

LANDSCAPE ICONOGRAPHY

INDEX

BACKGROUND

This dissertation tries to execute a multi-criteria strategical design process, yet maintaining the aesthetical values by integrating architectural and landscape theories. The first chapter explains the history of urbanization and agriculture on three different scales. It starts with New York City and then the borough of Brooklyn and finally the district of Redhook where the site of development is located. The analysis of the site is done in two phases; the social, environmental, and economic aspects of the site is evaluated in the first part of the second chapter and the latter section talks more about morphological and contextual characteristics of the site. Urban agriculture and its related technologies are explicated in the third chapter along with sustainable development goals that have been considered in this project. The last chapter conflates the consequent strategies derived from the aforementioned topics and demonstrated the concept development. Then the ideas are explained through drafted architectural drawings and three-dimensional representations.

Site Selection & Program

As for a building to propose for this paper, the aim was to find an icon, a powerful statement, a monumental, yet not a too overwhelming building. The building is called "Redhook Grain Terminal" which is an abandoned grain elevator adjacent to the mouth of the Gowanus Canal in New York City. It is 12 stories tall, 21 meters wide, and 130 meters long, containing fifty-four 36-meter-tall cement silos. It is located on the northwestern edge of the borough of Brooklyn The site has a lot of potential since it is surrounded by spaces and structures which are dedicated to local communities. The "Redhook Recreation Center," "Redhook Community Farm," and the world-famous "IKEA Furniture Store" (their only branch

Figure 3. Redhook Grain Terminal © Points Prox Inc.

in NYC) are all within walking distance. Aside from the spaces dedicated to food production, the program contains social and community-oriented activities as well. A flexibale space to host regular events, classrooms for educational purposes and market halls to sell the products. In addition to the mentioned spaces, the building contains spaces dedicated to agriculture-related projects, offices, meeting rooms, a canteen for staff, and building services.

QUESTIONS AND OBJECTIVES

1- Large Disciplinary Questions

Cities are comprised of various elements: buildings, streets, parks, etc. However, their most important element is people. This is because people - whether commuters, residents, or visitors - create the demand for programs within the city. Therefore, any public structure added to this network can create the possibility for ultimate integration within the social context of the community.

The mechanical lifestyle and the electronic representation of reality made humans' life disconnected from nature especially when someone lives in a big city. Former rural settlements are now extended suburbs of metropolitan areas or replaced by shopping malls, hospitals, and highways. Megacities pushed farmlands away, therefore our food is coming from increasingly greater distances which helps air pollution and increases the amount of waste during transportation [1]. But what are the solutions that can be proposed to tackle such issues? if cities take responsibility instead of pushing the green belt further away, then the food production can be brought back to the city even on a very big scale. But how can we consolidate the implementation of such ideas? How do we convince stakeholders and the local population to adopt innovative patterns? How does this combination intensify the forgotten bond between city dwellers and nature?

The disappearance of nature within cities happened in a gradual pattern and therefore we can not expect the rebirth process to have immediate results. Local stakeholders need to be fully aware of the current situation and then we can expect them to fully participate.

2- Specific Research Questions

In the further stages, we would expect different kinds of questions to arise while planning for the implementation of urban agriculture on bigger scales compared to existing practices. How do we integrate Architecture and Landscape Design within large-scale urban agriculture? Should we only consider environmental and economic aspects of sustainability while planning such spaces, or we can go deeper into relative social values? Wouldn't it be a better solution to integrate landscape theories like "Landscape Iconography" and "Temporal Perception" into our concepts and ideas? (both these theories are explained in sections 2.2.5 and 3.3.) This thesis tries to reflect the answers to the aforementioned questions on the development of the final proposal.

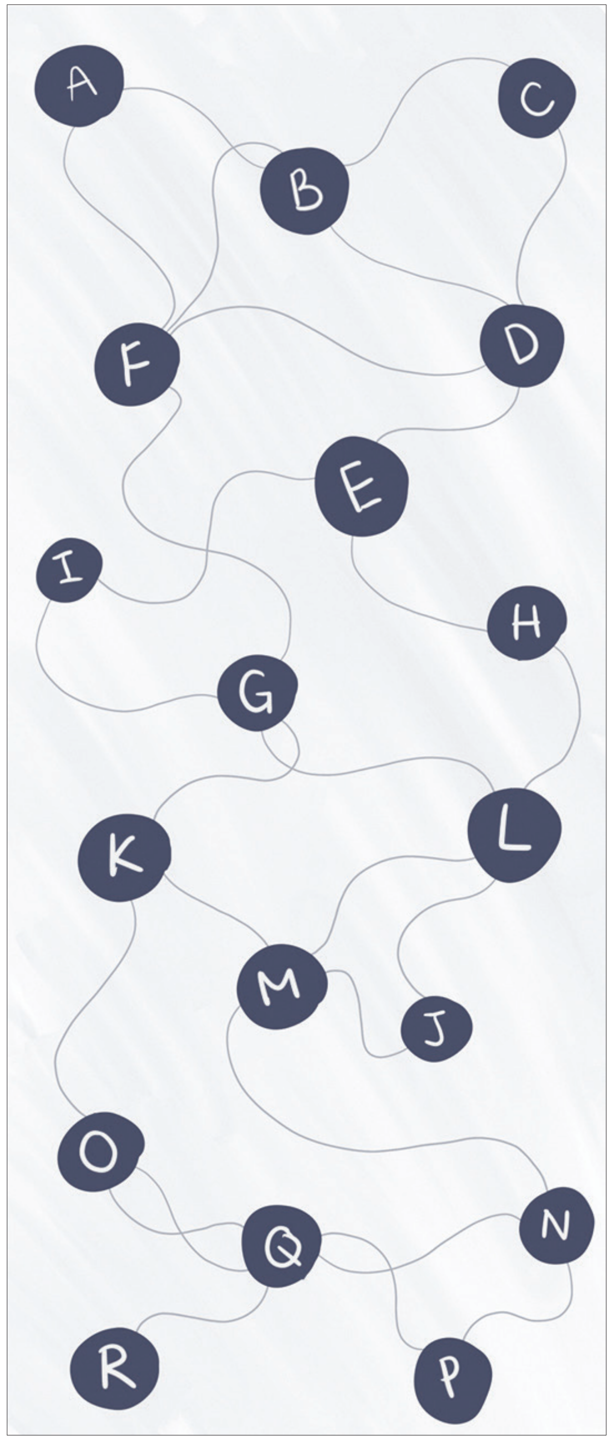


Figure 4. Balance between Systematic Thinkingand Design Thinking © Tyler La.

3- Aims and Objectives

The practice of CSA is not something recent. It started in the late '70s and has been popping up every year since the turn of the Millenium, especially in Brooklyn where is the birthplace of "Farm Garden" at the beginning of the 20th century [2]. Therefore this thesis is not planning to explore further into new application methodologies and economic models but more into its social and cultural aspects.

Each cultural group that adopts CSA shapes it differently to suit its historical circumstances and each CSA is site-specific, modeled to fit the producers, their land, their beliefs, their customers, and markets. This theory is also applicable to today's approach towards resiliency in architecture and landscape design. Our proposals need to consider vernacularism in every step of the design process while adopting the historical, environmental, and social context of the site and its surroundings [3].

The possible correlation between architectural design and the CSA model could be achieved through the definition of a new approach towards the revitalization of the abandoned industrial structures while creating a place for any sort of relative activities.

CHAPTER 1

INTRODUCTION

1.1 HISTORICAL TRACES

1.1.1 History of Urbanization in NYC

The first explorer to arrive in New York Bay in 1524 in the service of the French crown was a navigator called Giovanni da Verrazzano. The area, which he named 'New Angoulême,' was inhabited by the Algonquins and Iroquois Native Americans.

The Dutch were the first Europeans to settle in the area, building *"Fort Nassau"* in 1614, the first European settlement in the area today known as New York. In 1626, Peter Minuit, governor of the Dutch West India Company bought the island of Manhattan from Native Americans for 24 dollars and founded a colony called *"New Amsterdam."* That year, the Dutch West India Company sent some 30 families to live and work in a tiny settlement on *"Nutten Island"* (today's Governors Island) that they called New Amsterdam.

In 1674, as a consequence of the *"Treaty of Westminster,"* the island of Manhattan was passed to the English, The Dutch briefly recaptured New Amsterdam in 1673 but they lost it to the English again in 1674. This time it was renamed New York in honor of the Duke of York, brother of King Charles II. By 1700 New York had a population of almost 5,000 and it continued to grow rapidly. By 1776 the population was about 25,000. In 1800 New York City had about 60,000 inhabitants. In the 18th century, the main industry in New York was milling. Grain was ground into flour by windmills. Meanwhile, New York Merchants also traded with Britain and the West Indies [4].

During the 18th century amenities in New York improved. The first newspaper, New-York Gazette, began to be published

Figure 5. The Castello Plan, New Amsterdam, 1660, © John Wolcott Adams & Issac Newton Phelps

in 1725. The first theater in New York opened in 1732 and Kings College (now Columbia University) was founded in 1754. In 1776 George Washington withdrew from New York leaving the British army to occupy it. Then on 21 September 1776, New York was struck by a great fire, which destroyed hundreds of houses. Altogether about one-quarter of the city was destroyed. The British continued to occupy New York until the end of the war. George Washington entered New York on 25 November 1783.

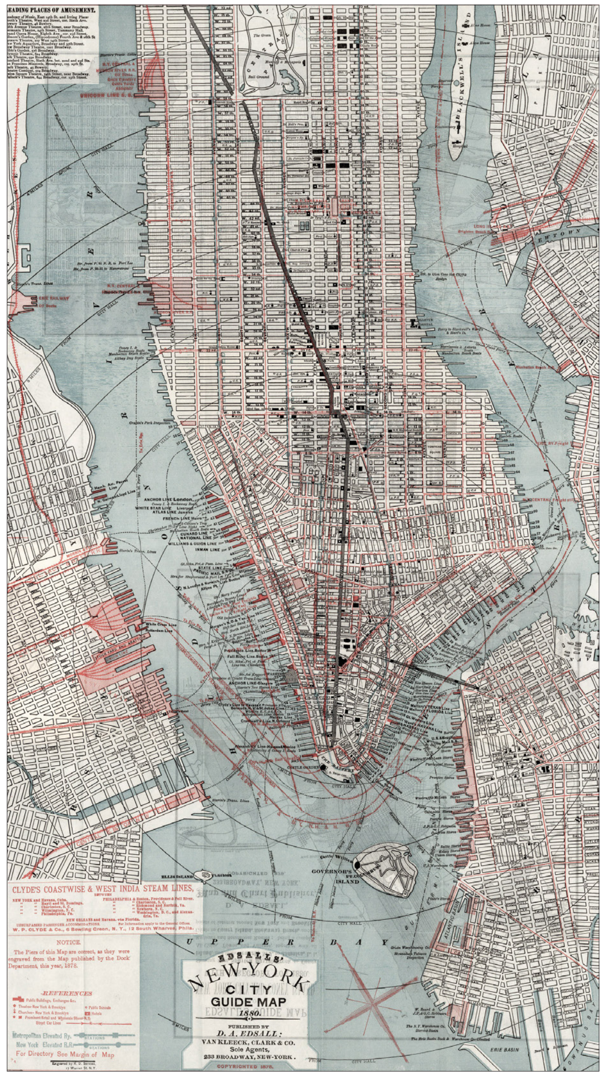


Figure 6. Map of New York, 1880, © David Rumsay Map Collection

On 20 April 1789 Washington took his presidential oath at Federal Hall [5].

The city recovered quickly from the war, and by 1810 it was one of the nation's most important ports. Southern planters sent their crop to the East River docks, where it was shipped to the mills of Manchester and other English industrial cities. Then, textile manufacturers shipped their finished goods back to New York. As the city grew, it made other infrastructural improvements. In 1811, the *"Commissioner's Plan"* established an orderly grid of streets and avenues for the undeveloped parts of Manhattan north of Houston Street. The economic growth and immigration transformed the city, making New York City the largest town in the States in 1835. In 1837, construction began on the Croton Aqueduct, which provided clean water for the city's growing population. The economic growth and immigration transformed the city, making New York City the largest town in the States in 1835. Up until 1898, New York was made up of only Manhattan. Later, the districts of Brooklyn, Queens, The Bronx, and Staten Island became part of the city. This was made possible thanks to the construction of many of its famous bridges and Subway in 1904 [6].

At the turn of the 20th century, New York City became the city we know today. In 1895, residents of *"Queens,"* the *"Bronx," "Richmond"* (knows as *Staten Island* after 1975), and "*Brooklyn"*–all independent cities at that time–voted to consolidate with *"Manhattan"* to form a five-borough *"Greater New York."* As a result, on 31 December 1897, New York City had an area of 155 square kilometers and a population of a little more than 2 million people; on 1 January 1898, when the consolidation plan took effect, New York City had an area of 930 square kilometers and a population of about 3,350,000 people.

The 20th century was an era of great struggle for American cities, and New York was no exception. The construction of interstate highways and suburbs after World War II encouraged affluent people to leave the city, which combined with

Figure 7. Map of Greator New York City, 1920,
© Harmsworth's New Atlas

deindustrialization and other economic changes to lower the tax base and diminish public services. This, in turn, led to more out-migration and "White Flight." The Immigration and Nationality Act of 1965 made it possible for many newcomers to settle in New York City [7].

1.1.2 Agricultural Timeline of NYC

As early as the 17th century, before Manhattan formed its famous 1811 street grid, the island contained farms in neighborhoods from Midtown to the Upper West Side. When the Dutch settled there in 1654, they named the path ***"Bouwerij"*** – an old Dutch word for farm – because it connected cattle farms and estates on the outskirts to (what is today) Wall Street. At the time, New York City (then known as New Amsterdam) featured rolling hills, forests, boulders, farms, and spaced-out homes.

Between 1818 and 1820, American surveyor John Randel Jr. prepared an atlas of 92 watercolor maps that illustrates the farm properties and old roads of pre-grid Manhattan (planned in 1811) as well as the future location of the new streets and avenues. Beginning in the mid-19th century, Manhattan started demolishing the area's hills – and thus farmland and some farmhouses – to make way for the city's level thoroughfares. Since lot owners were not required to level the bedrock to the street grade, some left large boulders [8].

In 1864, The New York Times estimated that 20,000 squatters, who faced a constant cycle of eviction and resettlement, lived in Manhattan. As the city grew northward,

Figure 8. Underneath the City Grid,Manhattan, NYC, 1820 © John Randel Jr.

German and Irish immigrants unable to find affordable housing built with wooden shacks and instead they were living in shanty towns. Many used to raise chickens and pigs, and grew vegetables to sell at local markets. Since much of the land was dug up, it became increasingly difficult for farmers

Figure 9. A shantytown at 104 Fulton Street,
Manhattan, 1896 © Jacob A. Riis

to raise livestock and grow crops. Down second Avenue on Manhattan's east side, some older homes remained until the late 1800s on top of hills that had not yet been leveled with the street grade. Irish pig farmers and German gardeners, as well as the African-American settlement of Seneca Village, worked and lived on the land that's known today as Central Park. Most of their homes were destroyed in the 1860s to create the park [9].

In the late 19th century, the city pushed to urbanize, and urban livestock – including hogs and dairy cows – were seen as a threat to the image and highbrow future of New York. According to CityLab, many members of Manhattan's elite bought (or took) the city's farmland, often owned by those of lower status, during this period.

Figure 10. New Row Houses and Mansions Overrunning the Old Factories, SquatterHomes, and Farmhouses, 94th Street, 1882-83 © Peter Baab

The newly graded streets attracted residents to upper parts of Manhattan. Within two decades, apartment buildings replaced the farmhouses. New York's street grid became denser throughout the early 20th century. Though the grid was great for housing, city commissioners soon realized the master plan – and high land values – deprived residents of space and sunlight [10].

1.1.3 History of Farm Gardens in NYC Parks

Although the era of social reform in the early 20th century was still driven by government and charitable organizations, in many ways Farm Gardens were early manifestations of a community gardening aesthetic. The first farm gardens in New York City appeared in 1902 in *"De Witt Clinton Park,"* shepherded by a "Mrs. Henry G. Parsons," Parsons who had seven children of her own, educated her children in the techniques of cultivating vegetables and believed that it should be part of the education of all children. Mrs. Parsons recognized that not all families had this luxury. Thus, she decided to bring the idea to the city and opened the first farm garden on the west side of Manhattan, near tenements that dominated the neighborhood at the time.

Figure 11. De Witt Clinton Farm Garden, 1902. © Parks Department Annual Report.

In the Farm Gardens, children from nine to twelve years of age cultivated plants and flowers. Crops included corn, beets, beans, peas, turnips, lettuce, spinach, cabbage, celery, and radishes. Additionally, an 3.5–by–5.5–meter farmhouse was constructed where girls were taught house chores and boys learned outdoor tasks. The program also showed participants the proper way to cook their harvest. Parsons proudly noted that girls were taught how to farm right alongside boys, a fundamental part of Farm Garden education. Both boys and girls kept diaries and tracked the progress of their vegetables through the growing season.

By 1908, the Board of Education took up the idea for its curriculum, and farm gardens run by schools had spread to 80 locations across the city (a farm garden curriculum has been revived by Brooklyn's PS 140 at Highland Park on the Brooklyn–Queens borde [11]..

The Farm Garden at De Witt Clinton Park lasted until 1932 when construction on the West Side Highway cut into the park's boundaries. Meanwhile, other sites flourished: a one-hectare farm garden at Thomas Jefferson Park in East Harlem was built in 1911, providing over 1,000 plots that went through two growing cycles each summer. A 1/4 hectare garden at Corlears Hook on Manhattan's Lower East Side opened in 1913. In Brooklyn, sites included McCarren Park (1914) and Betsy Head Park (1915); 715 plots in each served 1,430 children.

The Children's Farm Gardens were so successful that the idea survived subsequent administrations, and in fact, farm gardens existed in one form or other through the 1960s (and some have recently reemerged). Later Farm Gardens included Tompkins Square Park, which opened in 1930, and St. Vartan's Park (now known as St. Gabriel's Park), which opened in 1931 [12].

1.1.4 Brooklyn; Rebirth of Nation's Urban Farming

Brooklyn or former Kings County was one of the nation's leading vegetable producers as late as 1880, second only to neighboring Queens County. Though there was farming all across Long Island, the land was more productive on what is now the urban end of the island. Though Kings County had been a leading agricultural center for over 250 years, mostly due to the many farms in the outer-borough area, its land was rendered almost entirely urban residential in the twenty years between 1890 and 1910. The Brooklyn Eagle reported on Brooklyn's "last farmer" in 1949 [13]. Residents of Brooklyn have a long history of growing food in small community gardens. Community groups have even transformed sizable plots of city land into working farms like "*Red Hook Community Farm*," - which reemerged the idea of early 20th century Farm Gardens in a more modern scheme - and large-scale commercial rooftop operations have emerged, such as "*Brooklyn Grange*" and "*Gotham Greens*." Additionally, a contingent of local entrepreneurs including *"Edenworks," "Smallhold"* and *"Farm.One"* have begun to carve out a niche for high-tech agriculture by developing innovational practices like hydroponic, aeroponic, and aquaponic systems for growing food.

1.2 Identifying the Territory

1.2.1 Location of the Plot

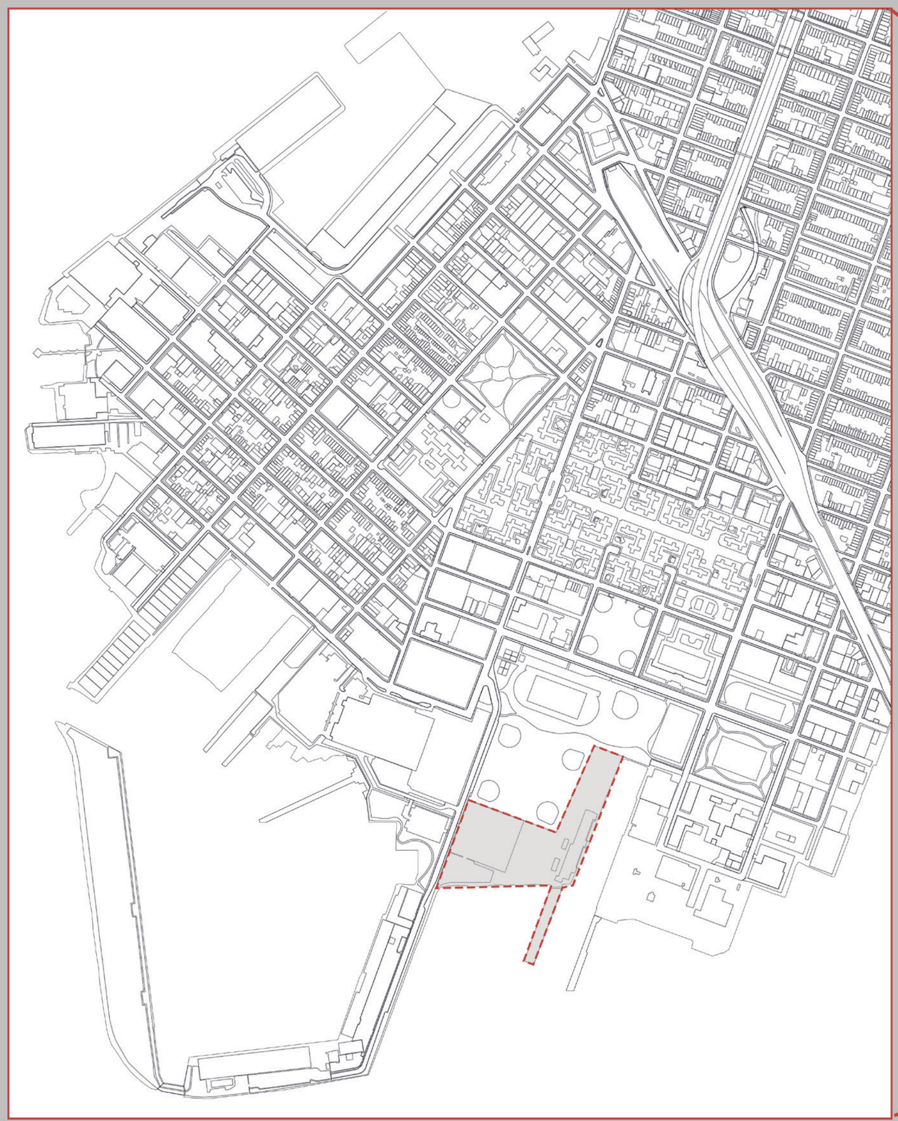


Figure 12. Map of Red Hook. Project's area marked in Red.
© NYC Department of City Planning.

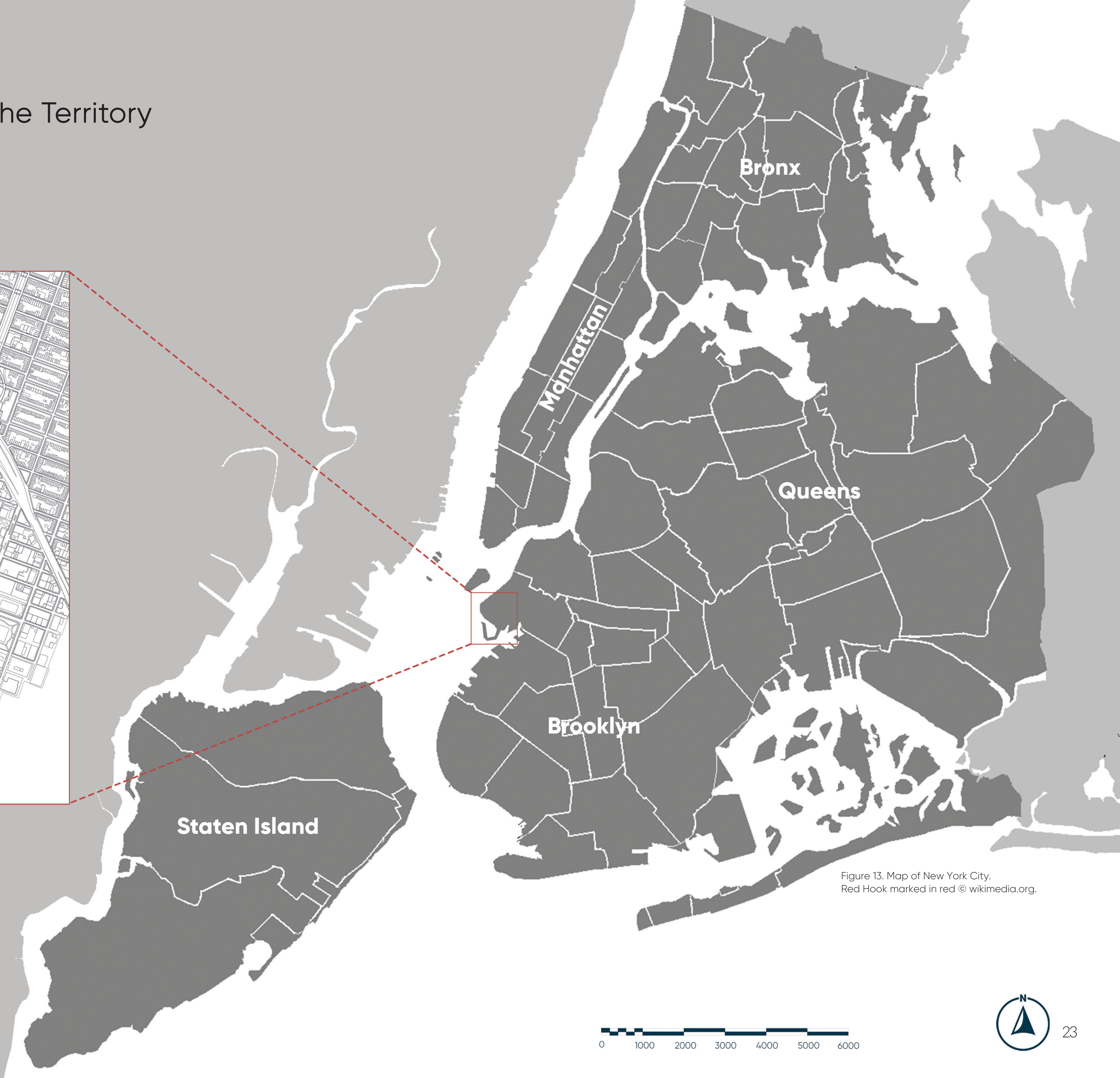


Figure 13. Map of New York City.
Red Hook marked in red © wikimedia.org.

1.2.2 Redhook and the Grain Terminal

Red Hook is a neighborhood in northwestern Brooklyn, New York City, within the area once known as South Brooklyn. It is located on a peninsula projecting into the Upper New York Bay and is bounded by the Gowanus Expressway and the Carroll Gardens neighborhood on the northeast, Gowanus Canal on the east, and the Upper New York Bay on the west and south. The Dutch established the village of Red Hook (Roode Hoek) in 1636. Red Hook was one of the earliest areas in Brooklyn to be settled. The area was named for its red clay soil and the hook shape of its peninsular corner of Brooklyn that projects into the East River. In the 1850s the Atlantic Basin opened and Red Hook became one of the busiest ports in the country [14].

Situated at the mouth of the Gowanus Canal, the Red Hook Grain Terminal was built in 1922, as part of the New York State Canal System (formerly known as the New York State Barge Canal). This project was a plan to incorporate a new series of waterways to re-route and improve shipping along the Erie Canal. The State Engineer went with the design of a 54-bin reinforced concrete grain elevator that was so complicated it took 16 months to finish. By the early 1920s, the grain trade was already in a state of decline. In an attempt to revitalize the Gowanus Canal and to coincide with the new canal system, plans were set in motion to build a grain terminal in Red Hook along the Gowanus Canal, which had already become an infrequently used waterway.

The Red Hook Grain Terminal (referred to as the Gowanus Canal Grain Terminal above) opened on September 1, 1922. It wasn't long before this grain terminal started causing problems, and was considered an immediate failure by some. Firstly, and most importantly, Red Hook failed to generate profit, the one thing that strikes deep inside the very fabric of every business. Even the Engineering News-Record magazine once said that this whole thing was "an expensive luxury". To demonstrate how bad the situation was, the Red Hook terminal, at that time, handled 1.7 million bushels of grain compared with Philadelphia, which handled some 26.5 million bushels of grain. However, the most successful of all was the New Orleans terminal, handling a whopping 238 million bushels.

After 21 years of struggling financially, it was finally decided that Red Hook Grain Terminal was to be decommissioned in 1965. Later, in 1987, the conveyor and the loading pier were demolished [15].

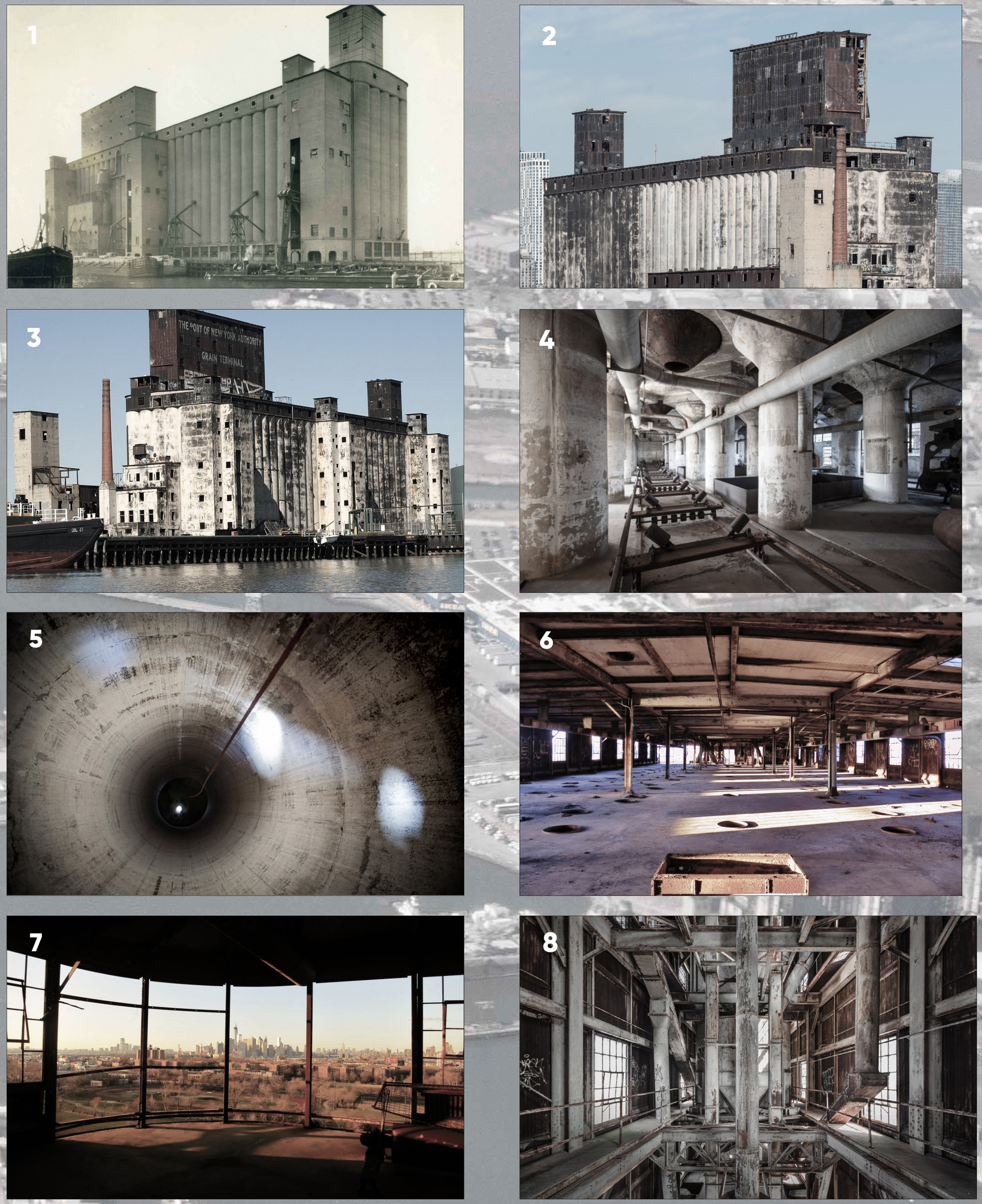


Figure 14. 1- Operating Terminal in 1930, 2- Southwestern View of the Terminal, 3- South Eastern View, 4- Ground Floor, 5- Interior of one of the cylandrical Silos, 6- Upper Floor (above silos), 7- View towards the Financial District (upper floor), 8- Interior of the Cupola (rectangular structure on top). © AbandonedNYC.com, © Hannah Frishberg, © flickr.com.

1.2.3 Building Anatomy

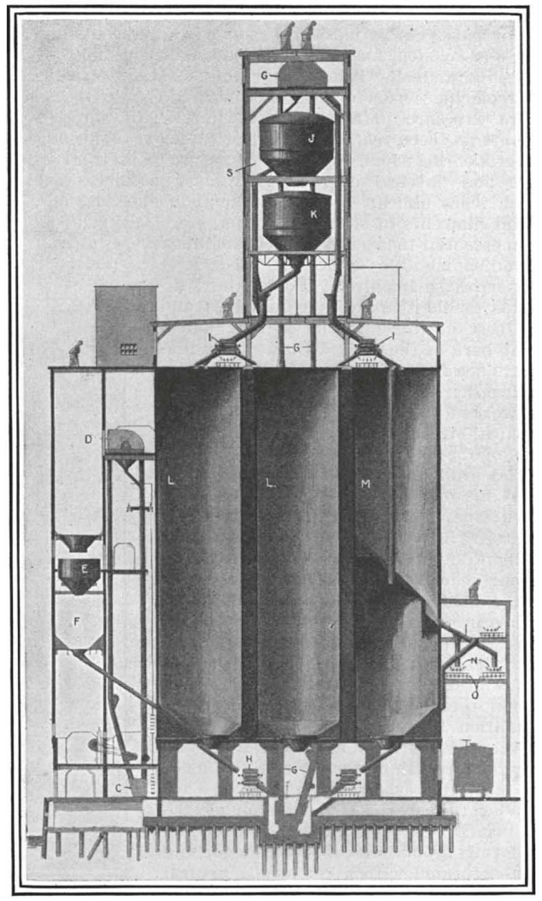


Figure 15. Vertical Section through House, showing Elevators and Belt Conveyors, © Scientific American, Vol 127, July 1922.

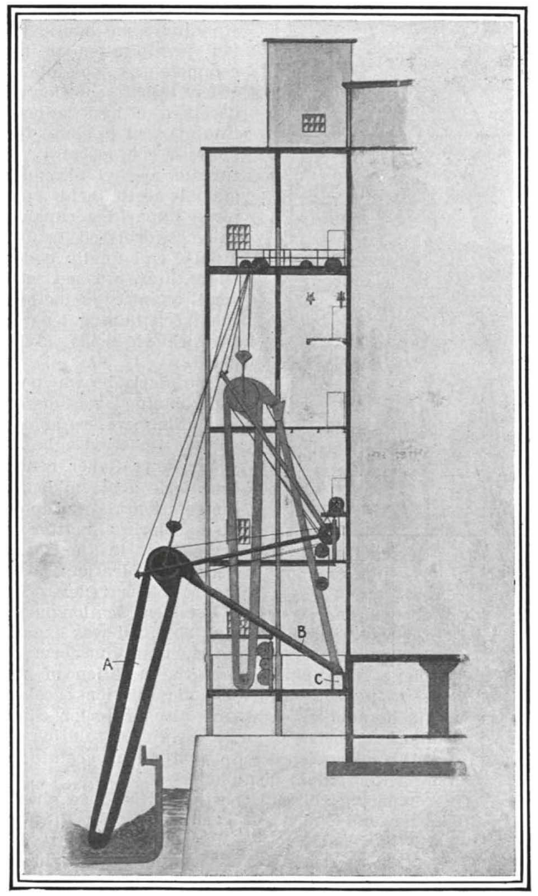


Figure 16. Vertical Section through a Marine Tower Lofter, © Scientific American, Vol 127, July 1922.

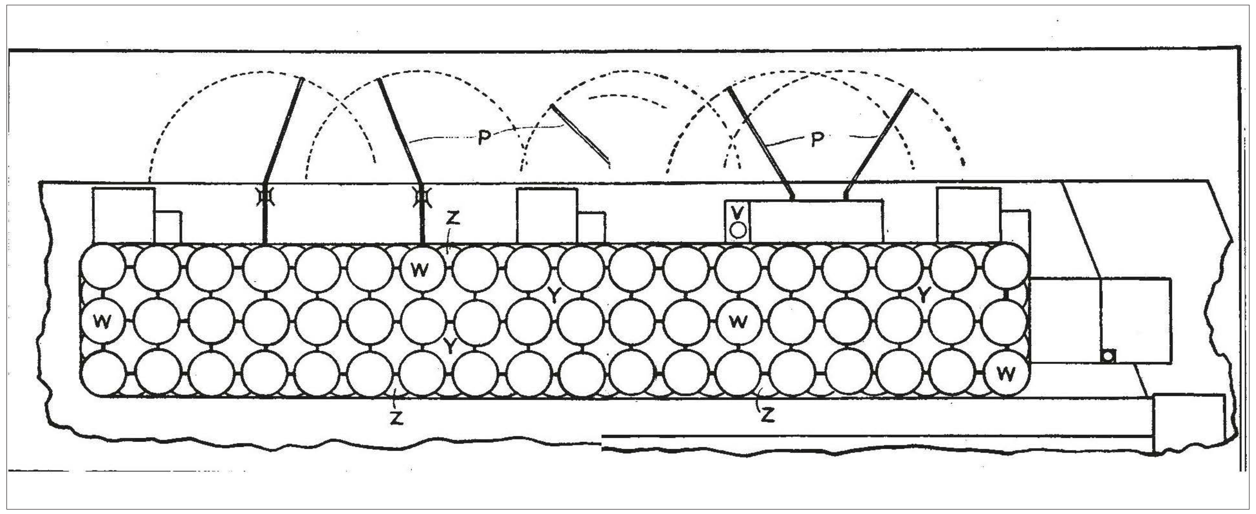


Figure 17. Section through Elevator House and Storage Bins , © Scientific American, Vol 127, July 1922.

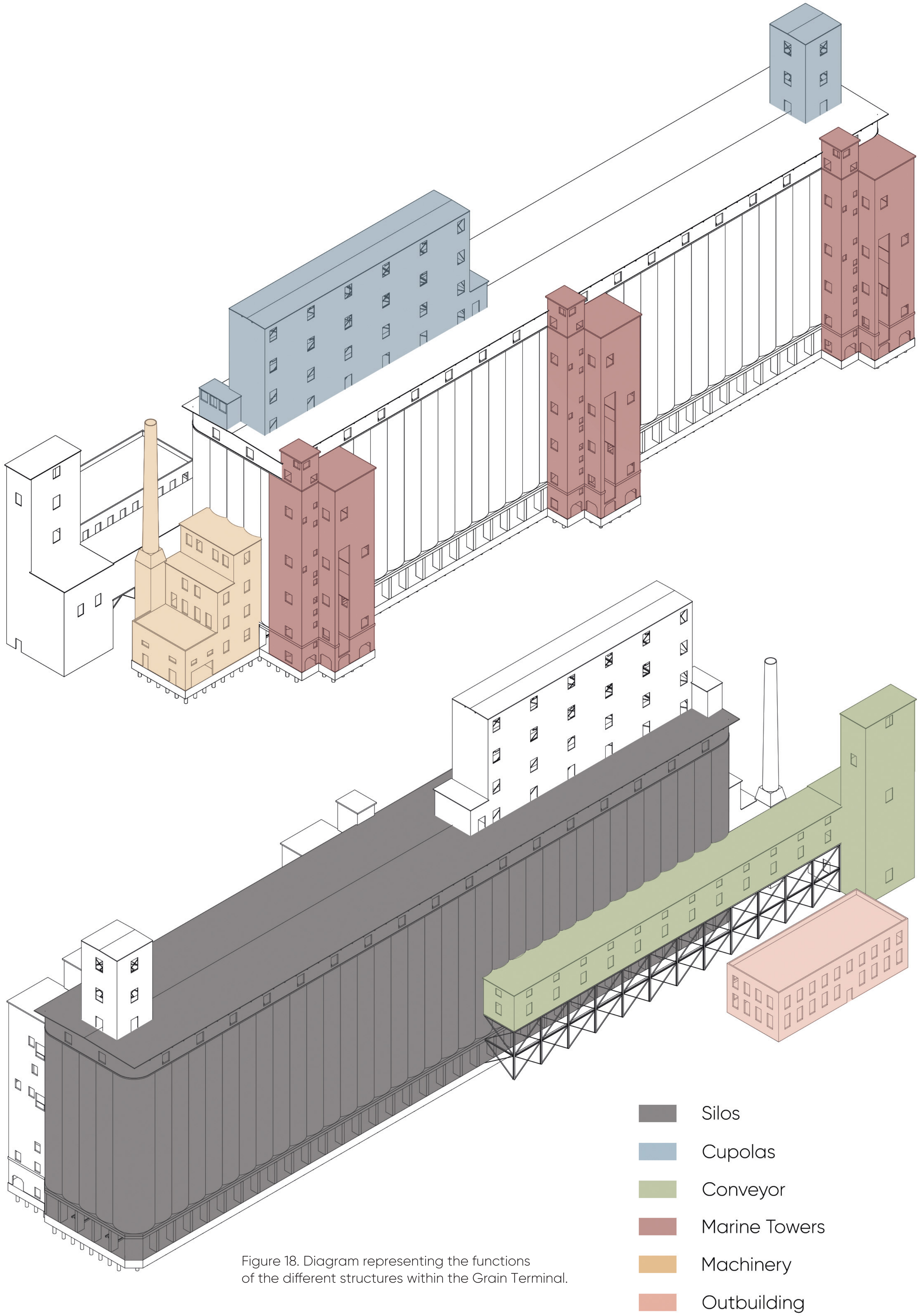


Figure 18. Diagram representing the functions of the different structures within the Grain Terminal.

CHAPTER 2

ANALYSIS OF THE SITE

2.1 MULTI-CRITERIA ANALYSIS

2.1.1 Macro-scale (Land Cover)

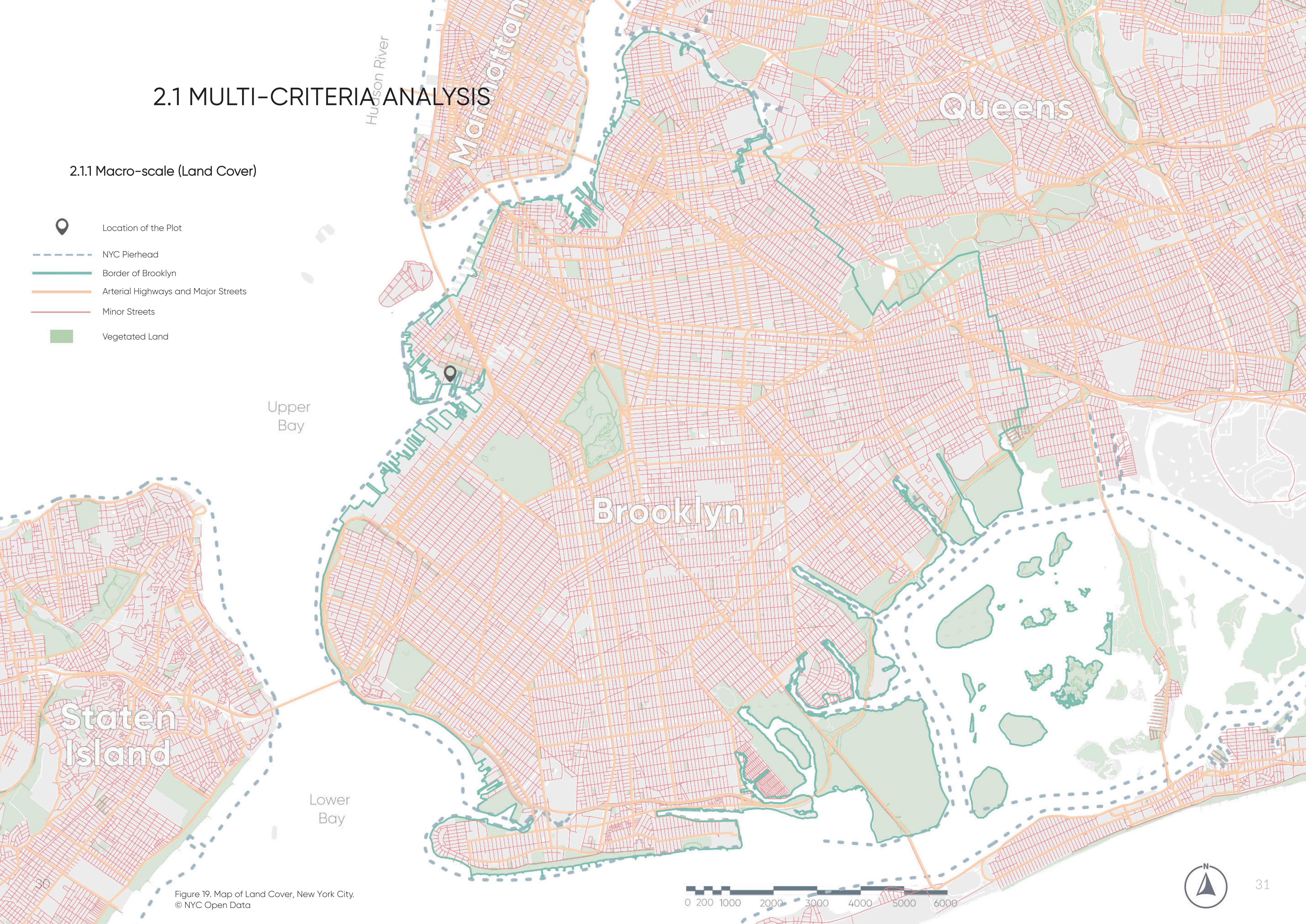


Figure 19. Map of Land Cover, New York City.
© NYC Open Data

2.1.1 Macro-scale (Transporation Network)

Figure 20. Map of Transporttion Networkr, New York City.
© NYC Open Data

2.1.1 Macro-scale (Street Tree Density / Urban Agriculture Points)

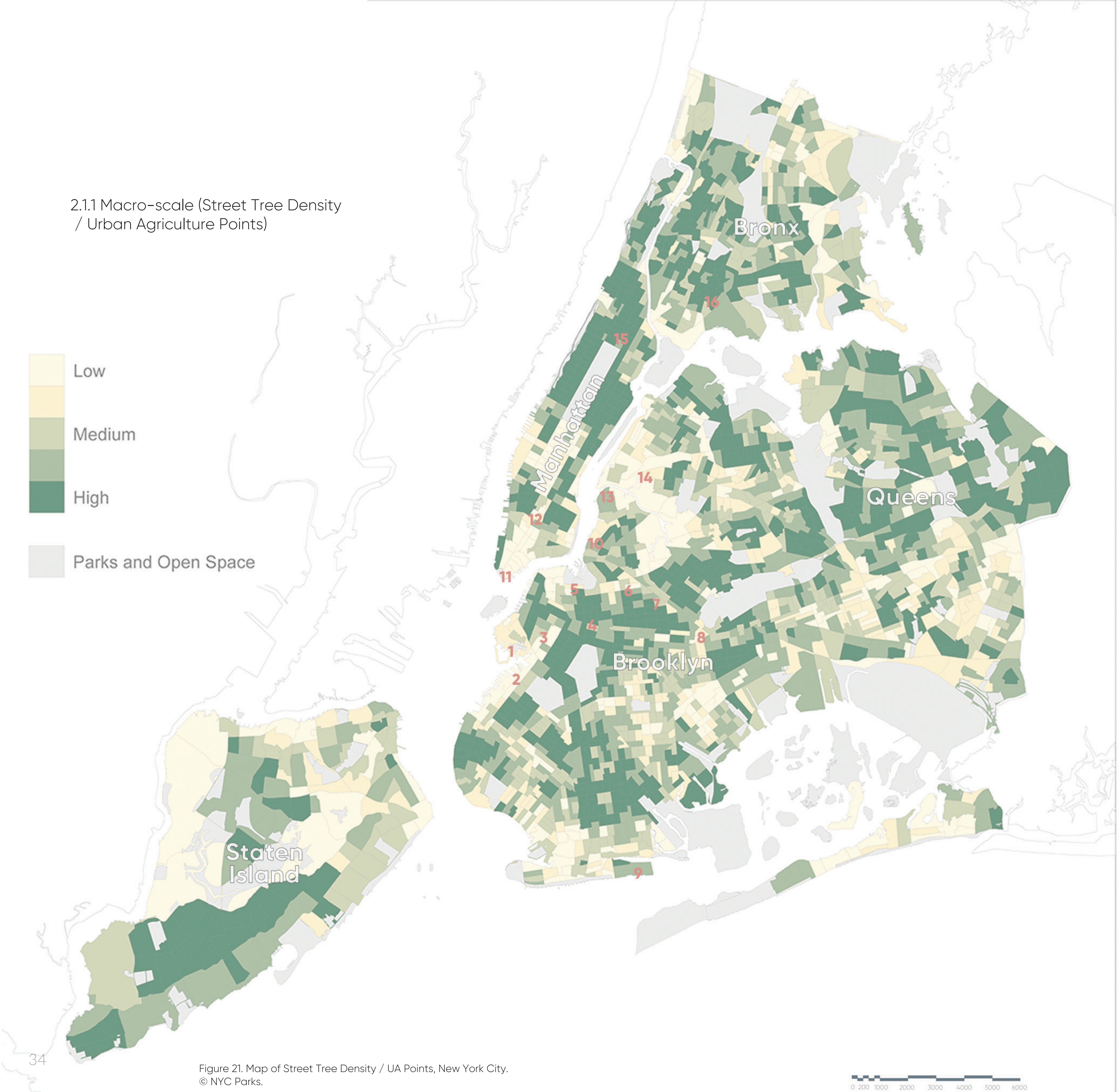


Figure 21. Map of Street Tree Density / UA Points, New York City.

Most Common Trees

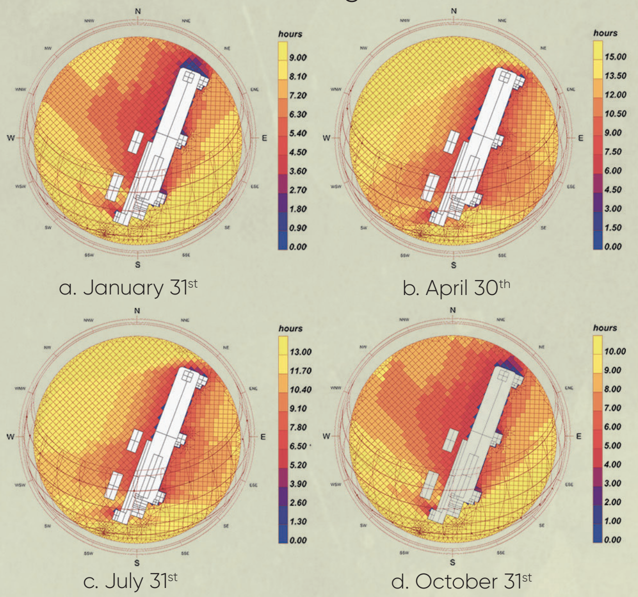
Platanus × acerifolia	13.9%
Pyrus calleryana	10.8%
Gleditsia triacanthos inermis	9.1%
Quercus palustris	7.5%
Tilia cordata	5.7%
Ginkgo biloba	5.0%
Zelkova serrata	4.8%
Gymnocladus dioicus	4.1%
Celtis occidentalis	3.8%
Phellodendron amurense	3.4%
Catalpa speciosa	2.7%
Prunus cerasifera	1.6%

Urban Agriculture Points

Red Hook Community Farm	1
Brooklyn Grange	2
Gotham Greens_Sunset Park	3
Farm One	4
City Growers	5
Square Roots City Growers	6
Bushwick City Farm	7
Saragota Urban Farm	8
KCC Urban Farms	9
OKO Farms	10
The Battery Urban Farm	11
NYC Urban Farm Lab	12
Eagle Street Rooftop Farm	13
Brooklyn Grange_Long Island	14
Urban Garden Center	15
Libertad Urban Farm	16

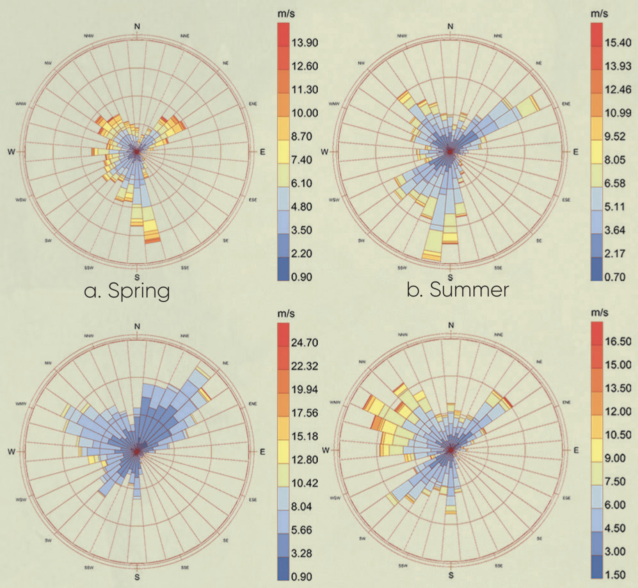
2.1.2 POSITION-GEOMETRY-CLIMATE

After a brief overview of the historical context of the site, a highly detailed site analysis complements the understanding of the territory. The multi-criteria analysis, demonstrated in chapter one, studies the environmental, social, and economic aspects of the neighborhood. The second chapter encompasses the remaining of site analysis which focuses mostly on morphological and anthropological characteristics of the existing structure and its relationship with the surrounding urban context.



a. January 31st b. April 30th c. July 31st d. October 31st

Figure 15. Sunlight Hour Analysis (Around the Existing Structure). Done by © Ladybug, Grasshopper



a. Spring b. Summer c. Autum d. Winter

Figure 22. Seasonal Wind Rose Analysis, Done in © Ladybug, Grasshopper.

According to figure 14, the area around the terminal receives 5-6 hours of sunlight on the coldest day of the year (21st of January) and this amount goes up to 8 hours a day in spring and summer. This also applies to the western and eastern facades of the building throughout the year.

The wind rose analysis shown in figure 15, does not propose a prevailing wind direction, but we can interpret that most of the time the wind travels along the Northeast-Southwest axis, similar to the orientation of the grain terminal.

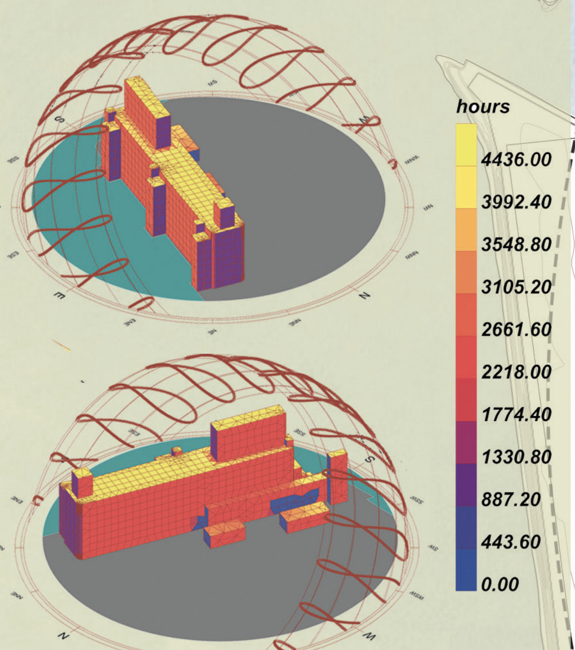
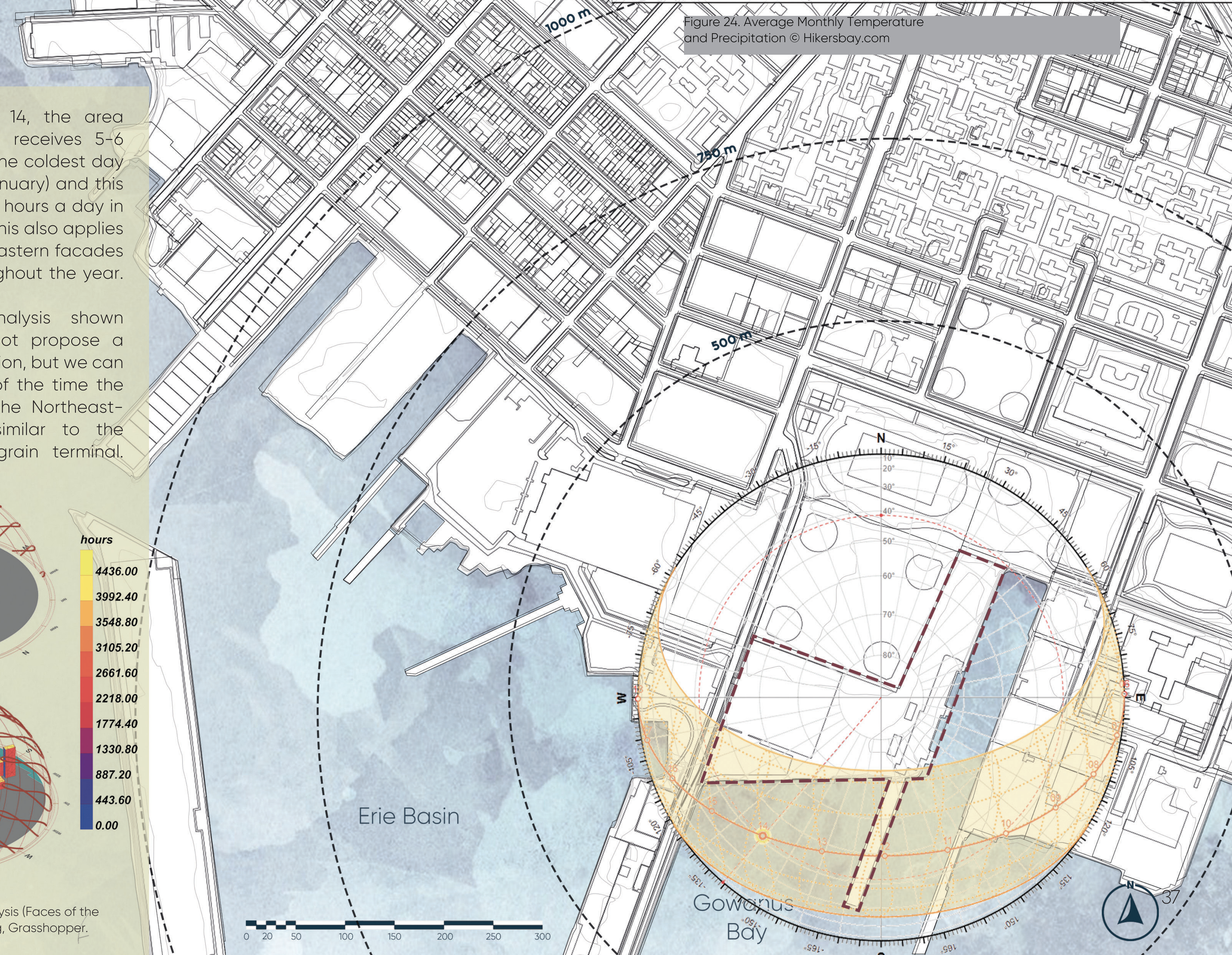


Figure 23. Sunlight Hour Analysis (Faces of the Building). Done in © Ladybug, Grasshopper.

Figure 24. Average Monthly Temperature and Precipitation © Hikersbay.com



2.1.3 LAND USE-SOCIO-ECONOMIC

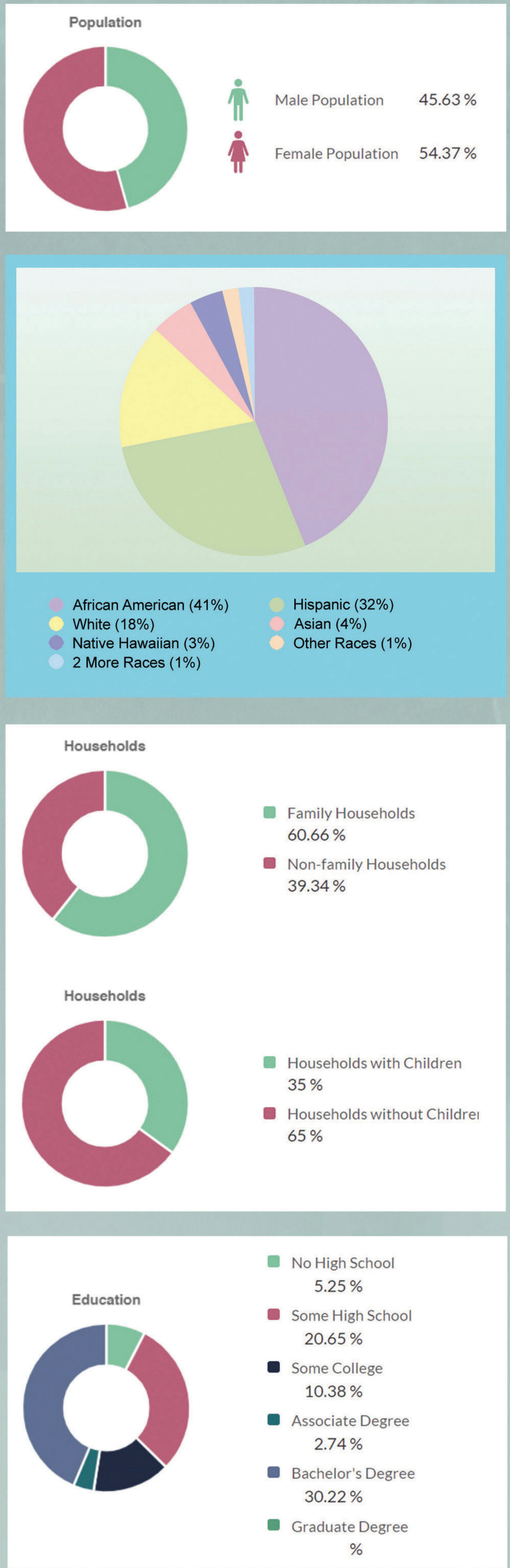
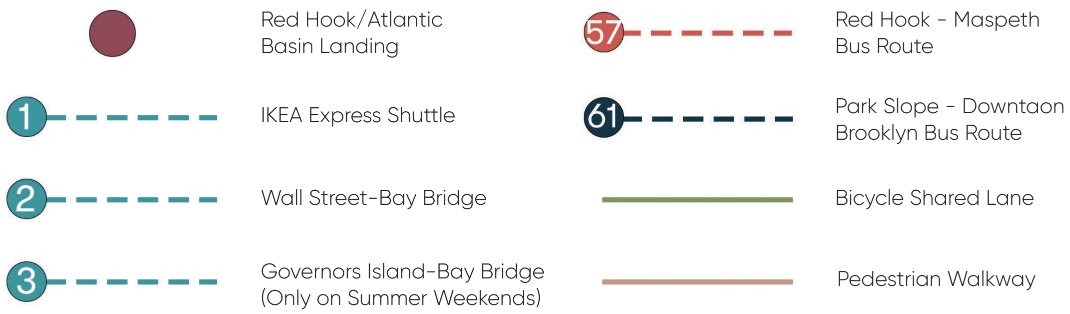


Figure 25. Demographics of Red Hook, Brooklyn, New York City © niche.com & citi-data.com.

With a total population of almost 21000 people (according to citi-data.com), Red Hook is one of the most racially diverse neighborhoods in all of New York City. Most of the neighborhood is covered with light-to-heavy manufacturing zones and low to mid-rise residential units. The community faces ongoing daily challenges illustrated by a socioeconomic profile that includes an unemployment rate of 10.6%, low average levels of educational achievement (31.6% of the population did not graduate from high school), almost 10% being under the poverty line and mid to high crime rate (referring to figure 18). Despite having plenty of land use dedicated to sports and recreational activities, the community lacks an adequate number of places for educational and community-related programs. Aside from tackling unemployment and the resulting rate of crime, the rejuvenated grain terminal can be a consolidated model of the classic ***"Farm Garden"*** for more social integration of such community with 35% of its population being under the age of 18.

Figure 26. Land Use Map. Red Hook, Brooklyn, New York City

2.1.4 TRANSPORTATION-AIR QUALITY



Subway is the main mean of transportation among New Yorkers since its opening at the beginning of the 20th century. The closest subway station to the grain terminal (Smith-Ninth Streets) is located a kilometer away in the adjacent northeastern neighborhood called Caroll Gardens. The journey from the mentioned station to our site takes less than 10 minutes with an ordinary bike. There are three types of bicycle path in the whole district: 1. Share Lanes, where the rider should share the sharrow-marked driving lanes with other vehicles. 2. Isolated bicycle lane, which run pararel to the traffic route. 3. Protected bicycle lane with access point, mostly found in the southern coastal edge. Red hook has its designated ferry dock on the northern edge which is part of the Southern Brooklyn route. The dock is 1.5 kilometers away from the site but again it can be reached by bike in a couple of minutes. There is also a free express shuttle ferry that takes passengers from Midtown, Brookfield, and Wall Street terminal to the famous IKEA furniture store only on weekends from 11:00 to 18:00.

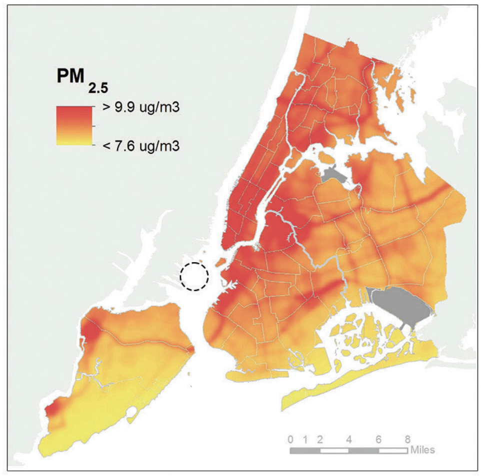


Figure 27. $PM_{2.5}$ Concentration, Annual 2019 Average (Moderate), © NYC Health.

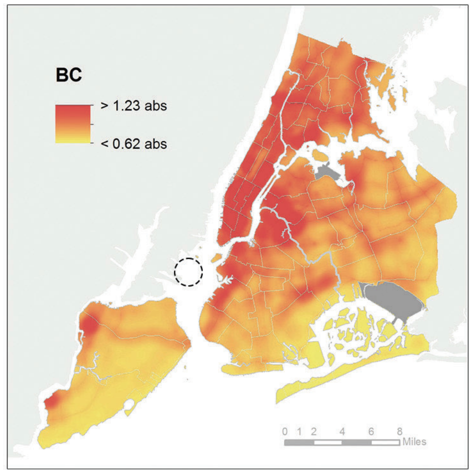


Figure 28. BC Concentration, Annual 2019 Average (Moderate), to © NYC Health.

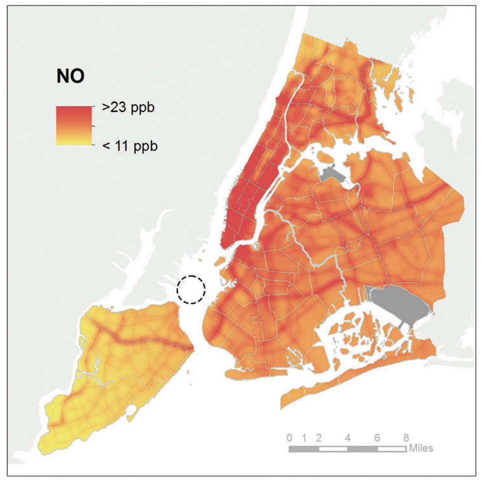


Figure 29. NO Concentration, Annual 2019 Average (Moderate), © NYC Health.

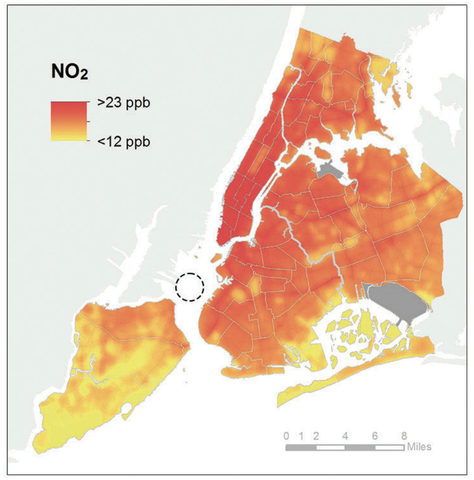


Figure 30. NO_2 Concentration, Annual 2019 Average (Moderate), © NYC Health.

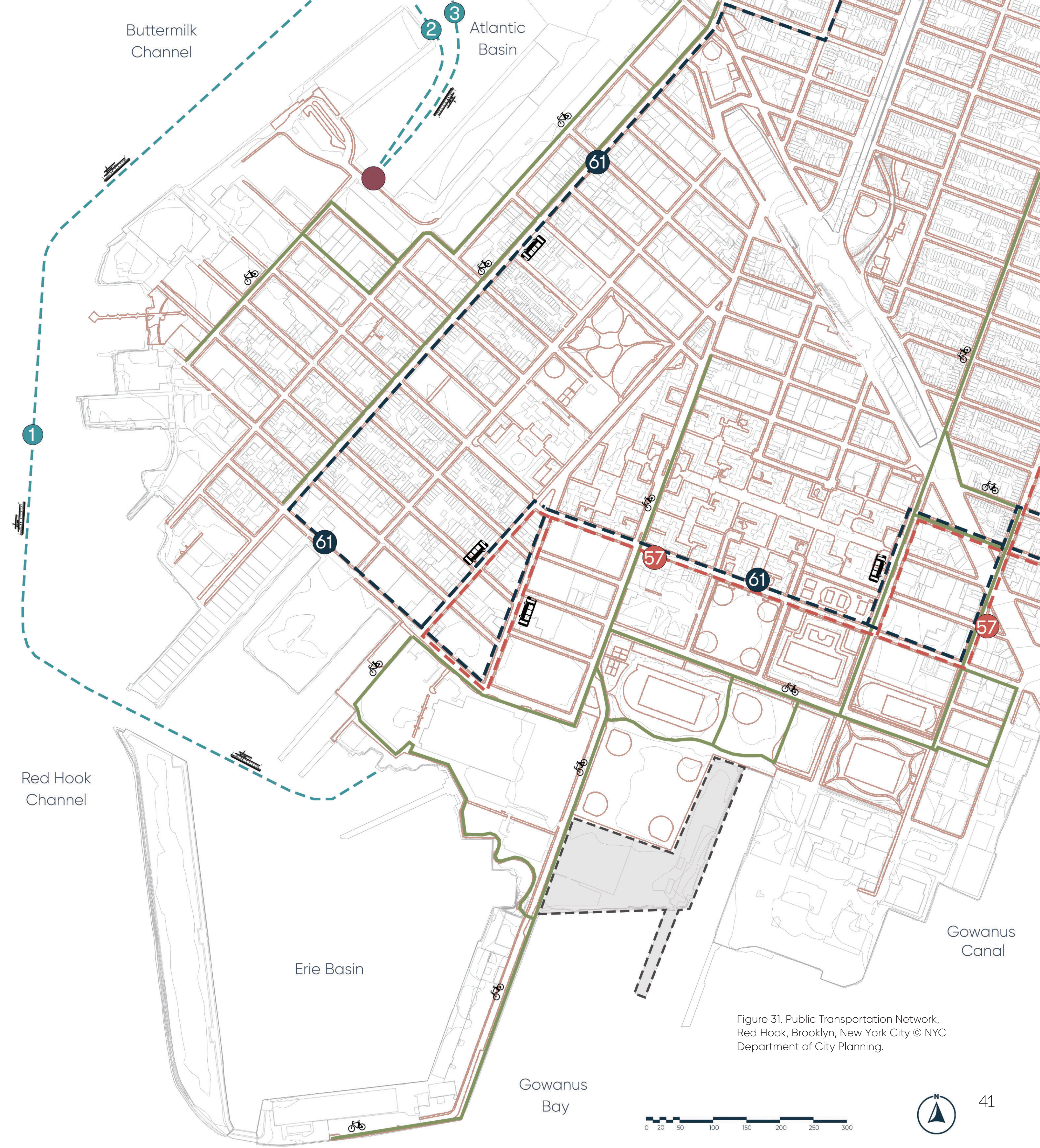


Figure 31. Public Transportation Network, Red Hook, Brooklyn, New York City © NYC Department of City Planning.

2.1.5 FLOOD RISK AND RESILIENCE

Hurricane Sandy Storm Surge

As a result of storm surge generated by Hurricane Sandy on October 29, 2012 , nearly the entire Red Hook peninsula suffered flooding. The severity of this flood has highlighted the vulnerabilities of Red Hook and New York City's urban waterfront as a whole. Flooding in Red Hook took three forms: (1) floodwaters directly from the New York Upper Bay, which were characterized by significant wave action at the water's edge, (2) inundation of water on upland streets and from secondary waterways such as the Gowanus Canal, and (3) from the drainage infrastructure below the street as the sewer system's catch basins, man-holes, and storm drains were overwhelmed by surge inundation.

Red Hook was flooded from all three of its coasts- the Buttermilk Channel from the west, the Upper New York Bay from the south, and the Gowanus Bay and Gowanus Canal from the east. The rest of the peninsula was significantly flooded with waters that reached over 11 feet (3.35 meters) at the Gowanus Canal at the peak of the storm surge. Based on surveys done by the US Geological Survey, additional high water marks were also registered for points along the Red Hook waterfront above 11 feet (3.35 meters).

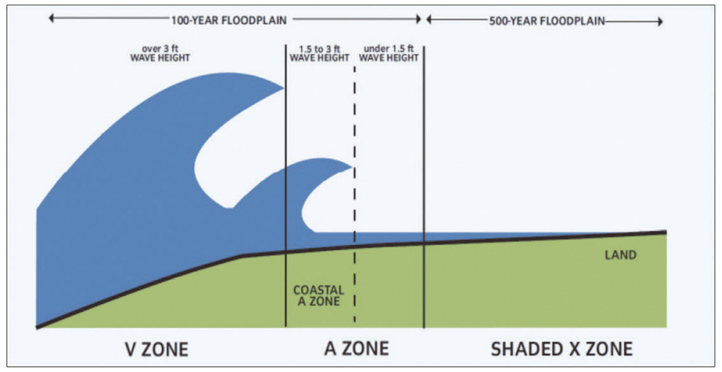


Figure 23. **Zone A:** is comprised of the area subject to storm surge flooding from the 1% annual chance coastal flood. These areas are not subject to high velocity wave action butare still considered high risk flooding areas. **Coastal A/AE:** Areas where wave heights are computed as less than 1 meter. While the wave forces in coastal A zones are not as severe as those in V zones, the capacity for the damage or destruction of buildings is still present. **Zone V/VE:** An area of high flood risk subject to inundation by the 1% annual-chance flood event with additional hazards due to storm-induced velocity waveaction. Typically, this is the area where the computed wave heights for the base flood are 1 meter or more.

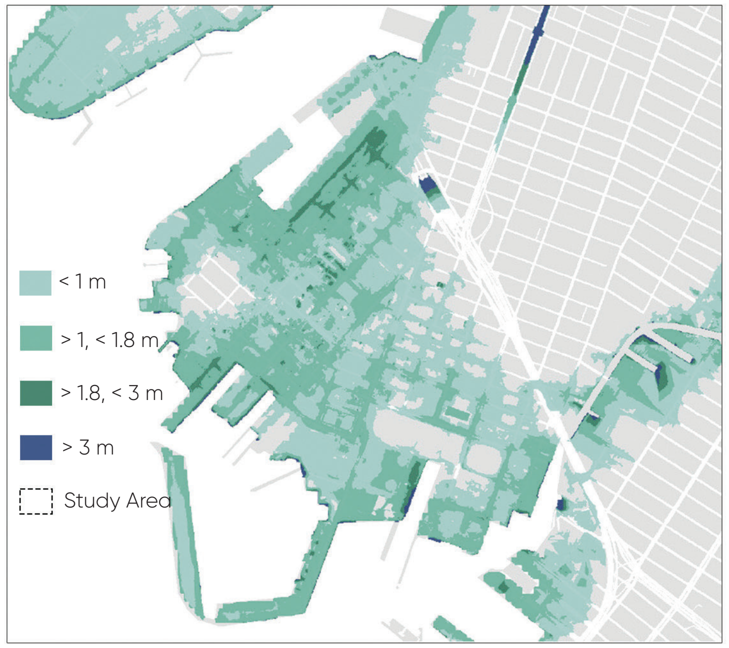


Figure 32. Hurricane Sandy, Storm Surge Extent © Ferederal Emergency Management Agency.

Infrastructural Impact of Hurricane Sandy

Hurricane Sandy impacted critical systems across New York City and interrupted delivery of power and electricity, disrupted transportation services, and impacted waterfront infrastructure along the waterfront. Unlike the majority of Brooklyn which has an underground distribution system, the power supply for most of Red Hook's residential areas is distributed by way of overhead power lines. Along the waterfront, however, the power is distributed through underground networks that are typically more reliable, as they support the power system from multiple power sources. They are, however, more vulnerable in the event of flooding, when aboveground systems such as those found in the residential areas of Red Hook tend to fare better than underground networks. As such, some areas of Red Hook remained with power after the storm.

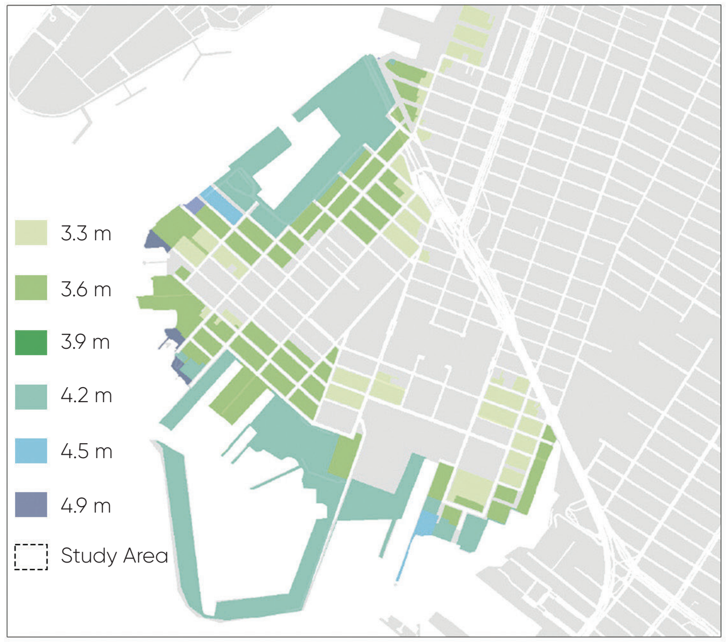


Figure 33. Buildings and Base Flood Elevations in 100 yr Flood by Lot © Ferederal Emergency Management Agency.

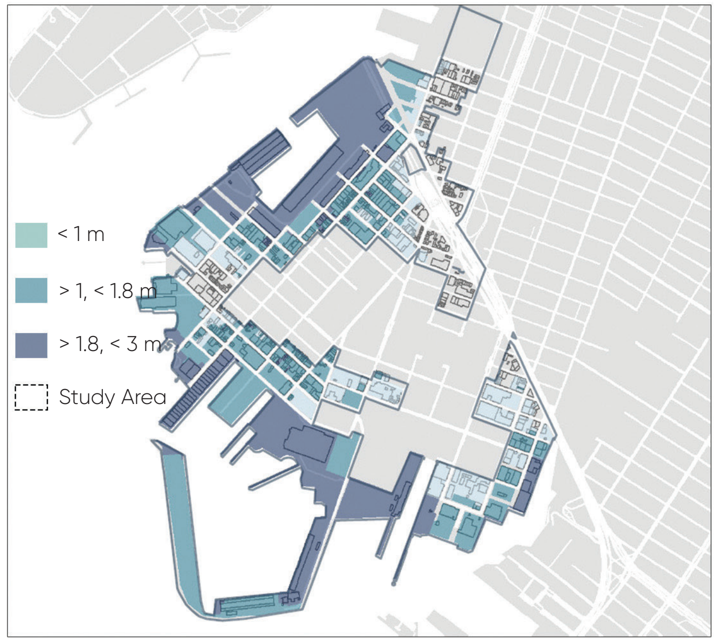


Figure 34. Expected Flood Depth by Lot in 100yr Flood © Ferederal Emergency Management Agency.

Base Flood Elevation

The Base Flood Elevation (BFE) is the water surface elevation resulting from a flood that has a 1-percent chance of occurring in any given year. Concerning Red Hook, the 100-year flood zone established by FEMA in 1983 and the extent to which storm surge as a result of Hurricane Sandy, the floodwaters reached well beyond the expected extent of the 100-year flood. Figure 26 shows the Base Flood Elevations that have been established for the Red Hook neighborhood. With respect to the *"Red Hook Brownfield Opportunity Area"*, 503 buildings are presently captured in the 100-year flood zone. Based on current revised maps, 91 percent of the Red Hook BOA is in the 100-year flood zone. The analysis of future flooding also included the development of maps displaying future coastal flood risk. Figure 26 illustrates the expected flood depth by lot according to 100-year estimations. Based on this map and the earlier statistics, Any new or revitalized structure in this area should expect 3-4 meters of floodwater in times of extreme weather conditions.

Sewer and Power

There are several Combined Sewer Outfalls (CSOs) along the waterfront that empty into local waterways around Red Hook. These outfalls include four along the Atlantic Basin, and 12 along the Gowanus Canal, in addition to CSOs at the termini of Wolcott, Van Brunt, Columbia, Creamer, and Sackett Streets. During periods of heavy rainfall or snowmelt, however, the wastewater volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. For this reason, combined sewer systems are designed to overflow occasionally and discharge excess wastewater directly to nearby streams, rivers, or other water bodies." The presence of CSOs near Red Hook indicates environmental contamination in Red Hook's surrounding water bodies. This issue is complicated by the risk of flooding in Red Hook and other low-lying coastal areas, as flood waters can carry dangerous raw sewage. The power supply for most of Red Hook's residential areas is distributed by way of an overhead power lines. Along the waterfront, however, the power is distributed through underground networks that are typically more reliable, as they support the power system from multiple power sources. However, they are vulnerable to flooding [16].

2.2 THEMATIC & CONTEXTUAL ANALYSIS

Unlike the first part where the focus was mostly on the territorial understanding of the site, this chapter tries to analyze the physical, psychological, and contextual characteristics of the area and its elements. A sustainable approach towards architecture and landscape design use context to provide a clear connection with concepts, so the resulting projects appear entirely as a part of their environment. There is no such thing as an isolated project, there should be always a context to relate to, even in cases where the aim is to create a contrast rather than harmony. Figure 27 analyzes the topographic profile of the Red Hook district along the waterfront and the metropolitan section of the neighborhood. The slight topographical transition might require some modifications for any additional structure or agricultural facilities. Figure 28 demonstrates the exterior perceptions of the structure. Any initial thoughts for the design development can be merged in these frames to enhance any further imagination. Since the current building is part of the collective memory of the area and its residents, any new function with its dedicated space should act as a complementary element to the existing complex and its territory.

2.2.1 TOPOGRAPHY-VIEWS-BUILDING SKYLINE

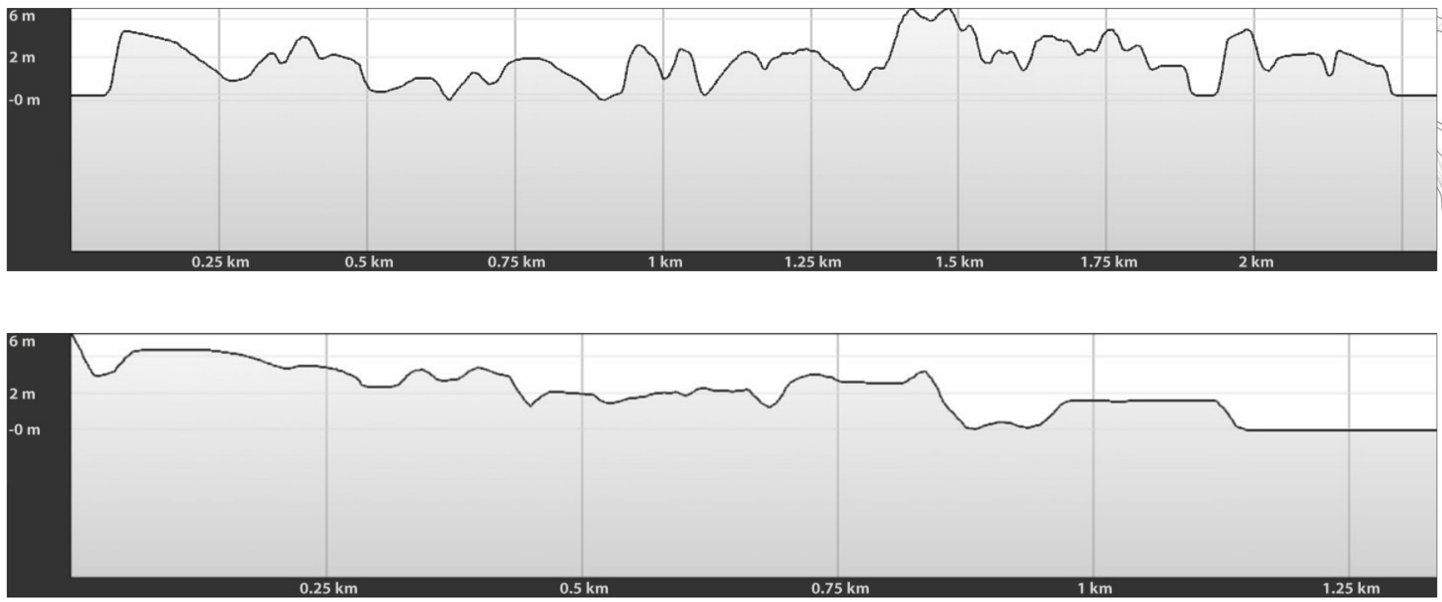


Figure 35. Elevation Profile. top: Path 1, bottom: Path 2 © Courtesy of Google Earth.

Figure 36. Multiple Perceptions towards Red Hook Grain Terminal, Brooklyn, New York City, © abandonednyc.com, brooklyneagle.com

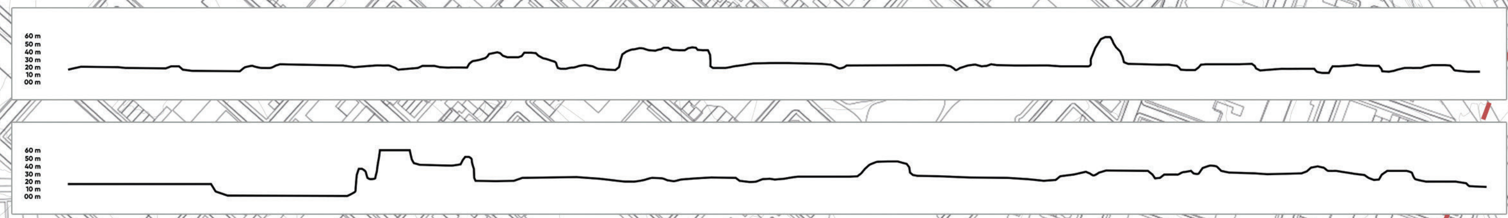


Figure 37.. Red Hook's Skyline, top: Elevation A, bottom: Elevation B.

2.2.2 SOFTSCAPE / HARDSCAPE

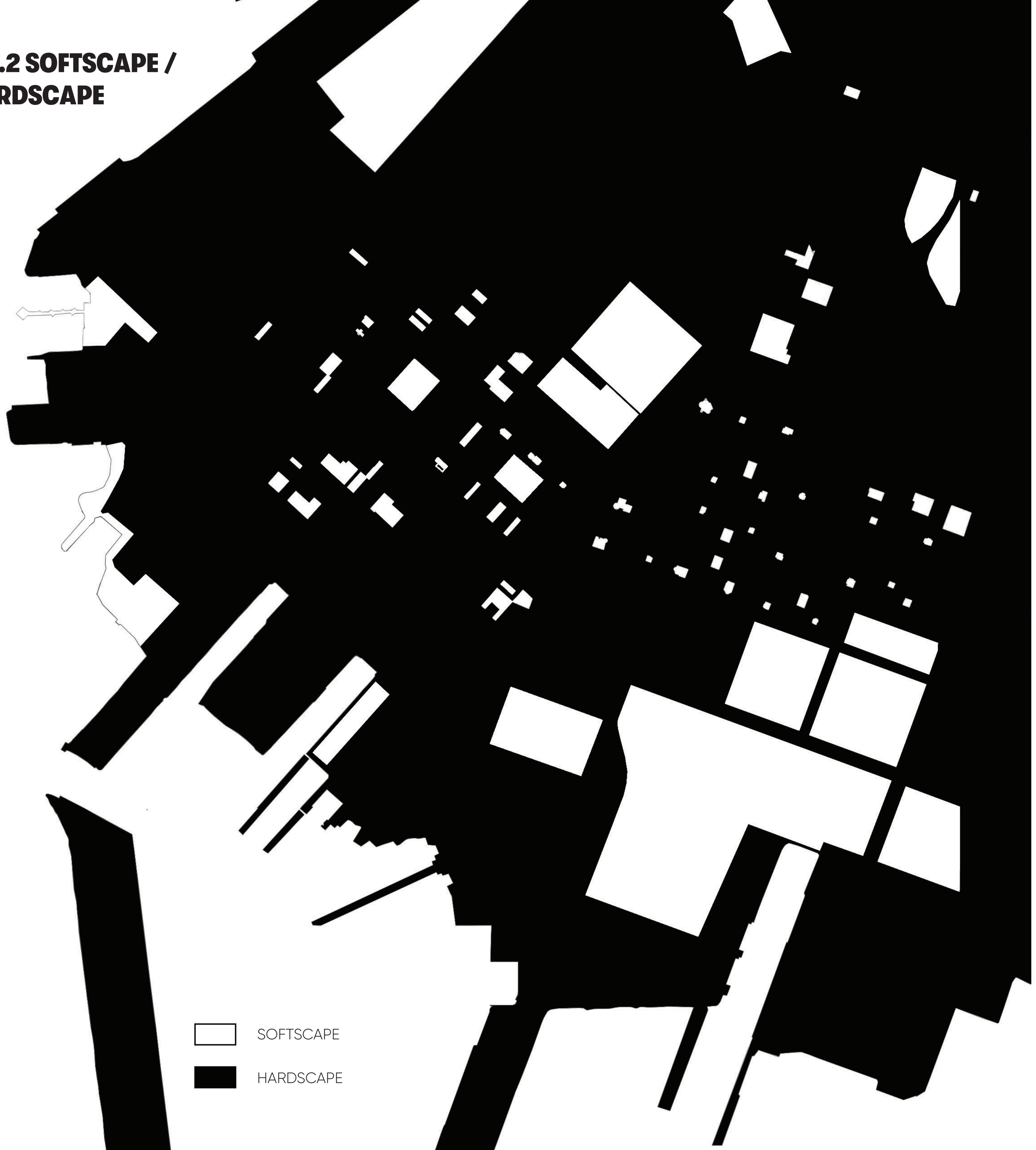


Figure 38. Softscape vs Hardscape, Red Hook, Brooklyn, New York City.

Due to excessive dependency on vehicle roads in metropolitan cities like NYC, there is a great dominance of hard floor over the softscape. In my case of a proposal, the introduction of new green spaces can create an interesting contrast with a rough sold element like the Grain Terminal. On the other hand, there is still a possibility for adding a new extension due to the existence of vast open spaces around the site.

2.2.2 FIGURE GROUND (SOLID / VOID)

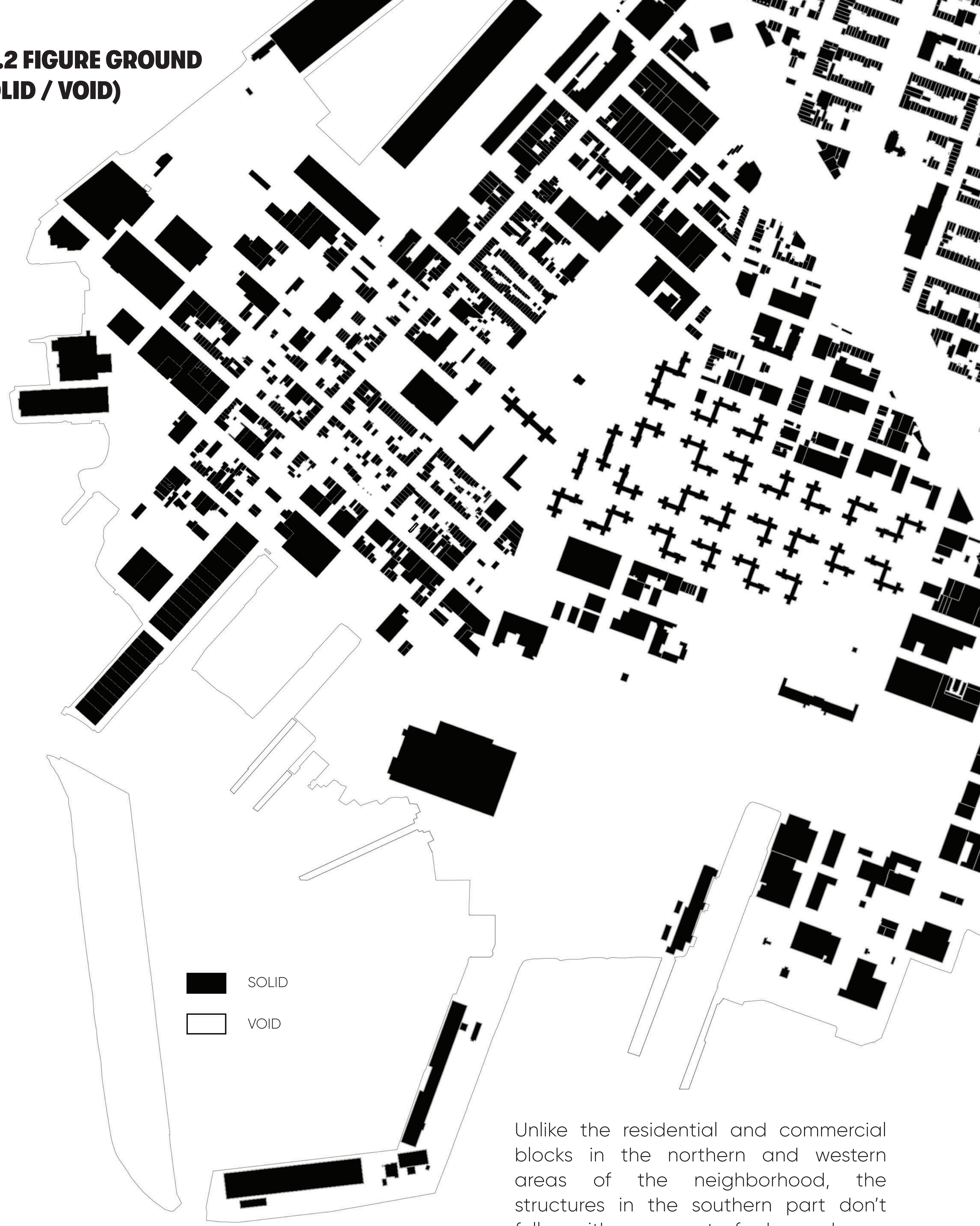


Figure 39. Solid vs Void, Red Hook, Brooklyn, New York City.

Unlike the residential and commercial blocks in the northern and western areas of the neighborhood, the structures in the southern part don't follow either any sort of urban scheme. or geometrical patterns. Due to green spaces dedicated to recreational and sports activities, the conformation of the urban growth tapers off towards the waterfront in the southern edges, exactly where the terminal is located.

2.2.3 KEVIN LYNCH'S ANALYSIS

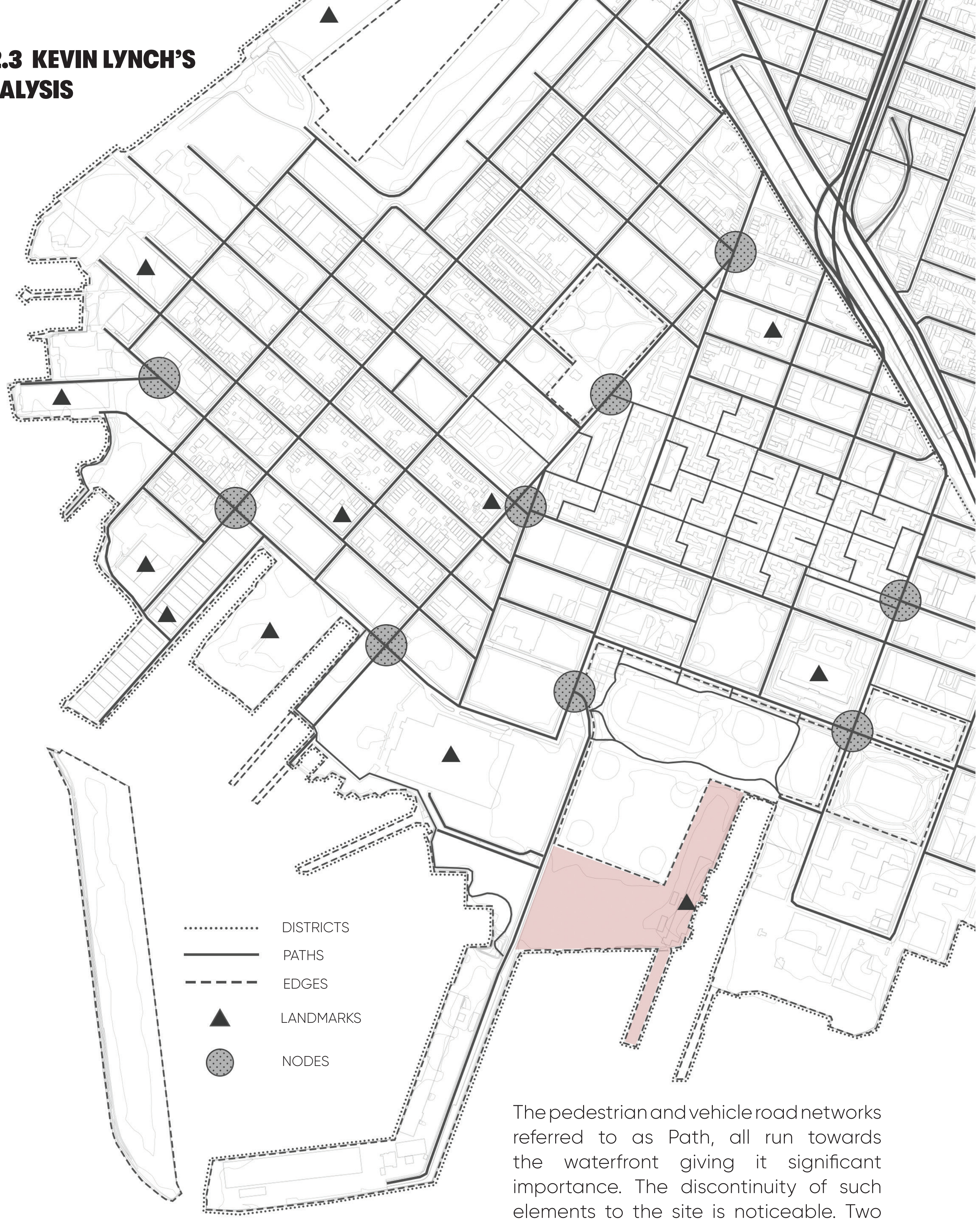


Figure 40. Kevin Lynch's Analysis; Paths, Edges, Landmarks and Nodes, Red Hook, Brooklyn, New York City.

The pedestrian and vehicle road networks referred to as Path, all run towards the waterfront giving it significant importance. The discontinuity of such elements to the site is noticeable. Two very important Nodes close to the site are the junctions surrounded by social and cultural activities. These sorts of functions can be extended to the project The site is like a peninsula engulfed by three Edges of green spaces and water bodies.

2.2.3 AXIS PATTERNS

Figure 41. Axis Patterns, Red Hook, Brooklyn, New York City.

By emphasizing the pedestrian axis, especially the ones along the waterfront, a series of new approaches can be undertaken for creating new public spaces. The majority of the pedestrian axis in Red hook is in harmony with the organic shape of the shoreline. Extending the existing pedestrian surface (starting from IKEA to Columbia street) towards the terminal created a sense of continuity into a series of possible novelties.

2.2.4 STRUCTURAL SITUATION - CONSTRUCTION TYPOLOGY

How would a building interact with the structural real around the site? This question can only be answered if the surrounding buildings' structural situation is properly analyzed. By doing such analysis we can predict the sense of the future. According to figure 35, the majority of the structures located in the neighborhood were built between 1900 to 1950, especially the ones located around our site. Although some of these buildings have been renovated over and over and some iconic landmarks of the area have been demolished, the industrial identity is still noticeable while walking through the network of streets. There is a possibility that some of these buildings are about to be demolished and some will be refurbished in the forthcoming future; therefore, any proposal in this project should pursue a bidirectional balance between a modern approach and maintaining the industrial character of the area. Knowing the construction typology is another approach towards creating a socially sustainable idea. As shown in figure 34, almost 90 percent of the buildings used brick as the primary material for the wall system. Buildings dated earlier than 1920 mostly rose on a timber skeleton system and more recent structures benefited from the more advanced technology of steel structural framing.

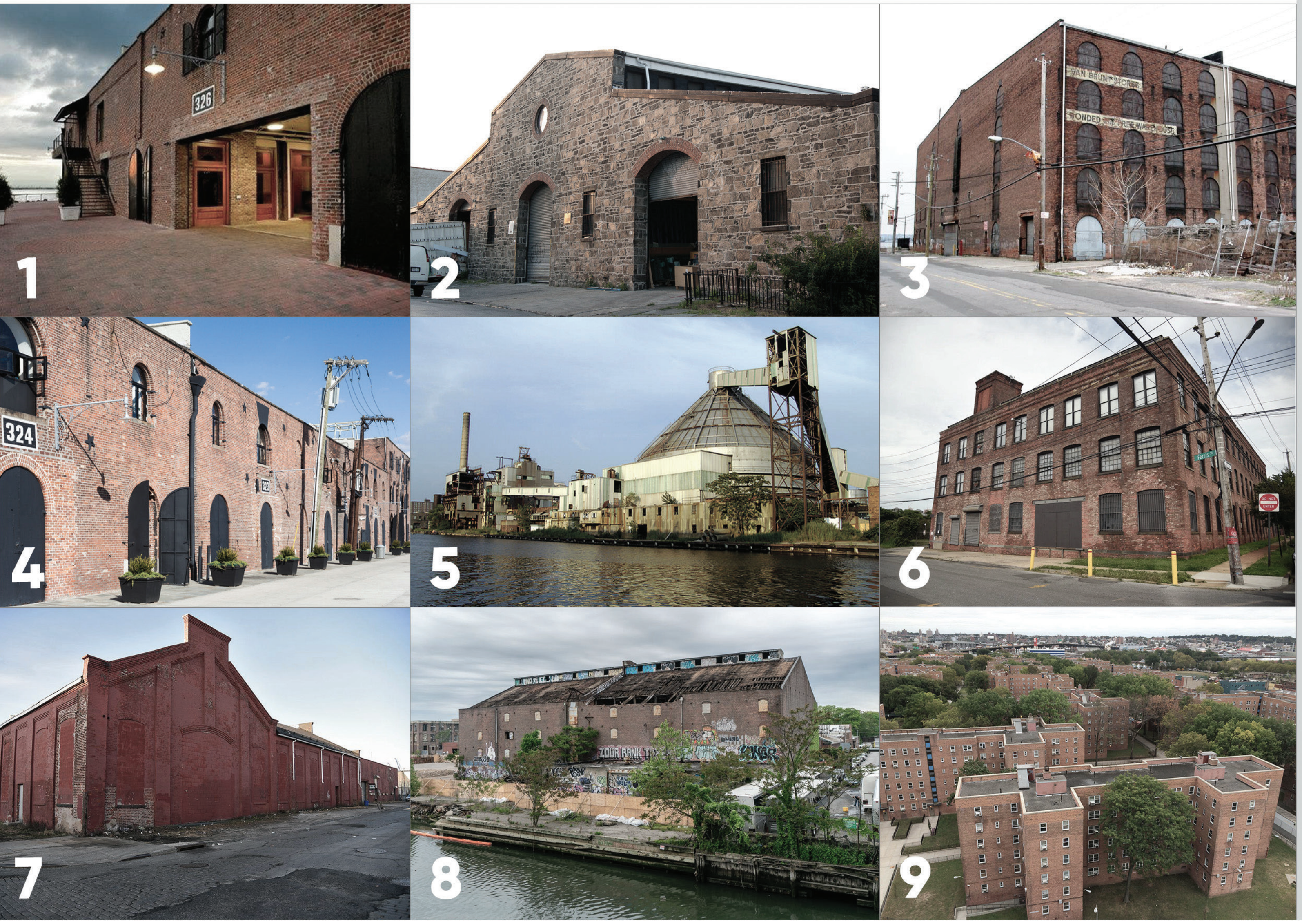


Figure 42. Iconic Landmarks of Red Hood, Brooklyn: 1- The Merchant Stores (1873-present). 2- Brooklyn Clay Retort and Fire Brick Works Storehouse (1859-present). 3- The Red Hook Stores (1873-present). 4- The Beard and Robinson Stores (1872-present). 5- Revere Sugar Factory (1915 - 2006). 6- Brick Warehouse ,former Le Comte & Co. (1905-present). 7- Red Hook's Lidgerwood Complex (1882-2016). 8- S.W. Bowne Grain Storehouse (1886-2017). 9- Red Hook Residential Blocks (1946-present). © redhookwaterfront.com, ny.curbed.com

Figure 43. Buildings by Age of Red Hook, Brooklyn,New York City © Brooklyn's Past and Present by bklynr.com

<1825 1850 1900 1950 2000

2.2.5 Landscape Iconography

In European languages, especially French and Italian, "landscape" refers more to its representation over the object represented. Instead, in Germany, England, and Holland, it refers to the region, country, or homeland itself. In French, for example, "paysage" contains the word "pays" (Country/Town) but thanks to the suffix -age at the end, it would refer to a glance or a representation of the object through an experience. From there, contemporary reflections arise in which both traditional theories, based on aesthetic and perception, and more recent ones stem from ecology. Then landscape becomes the mix between the Subject (individual or community) and the Object (nature, environment, or territory).

What Landscape Iconography tries to implement is to vanish the line between architectural elements and the surrounding environment, where nature itself or man-made territories. Since landscape could be treated as an intercessor between the man and his environment, it also could represent how human actions shaped and influenced nature all around. It is, in fact, a way of feeling and representing nature. Although the focus of the later analysis is mostly on the visual phenomenon, a desirable approach should engage other data brought together by the other senses or particular movements, touching or feelings of the atmosphere (warmth, cold, etc...). "Figure 44" represents different color tonalities of the landscape elements as well as the color palette of building materials used in the majority of the neighborhood's structures. Right after this figure, we can see the most recognizable texture patterns in the area including the building facades, ground surfaces, surrounding water bodies, and even the shipping containers. What is shown in "figure 46" is the most frequent existing tree species in the borough of Brooklyn with the emphasis on the geometrical shape of the canopy. "Figures 47 to 54" are a series of drawings where the architectural elements of some of the landmarks in the area, are highlighted including doors, windows, roof shares, circulation, and the view towards iconic monumental structures. The outcome of all the mentioned analysis would lead to a system that could exploit the pre-existing features of the territory and lead to a functional redevelopment entrusted to the reintroduction in the local production of a series of agricultural products, providing, in addition, the insertion of some punctual elements that, from the city to the site, amplify and intensify the perception and exploratory experience of the agrarianl landscape [17].

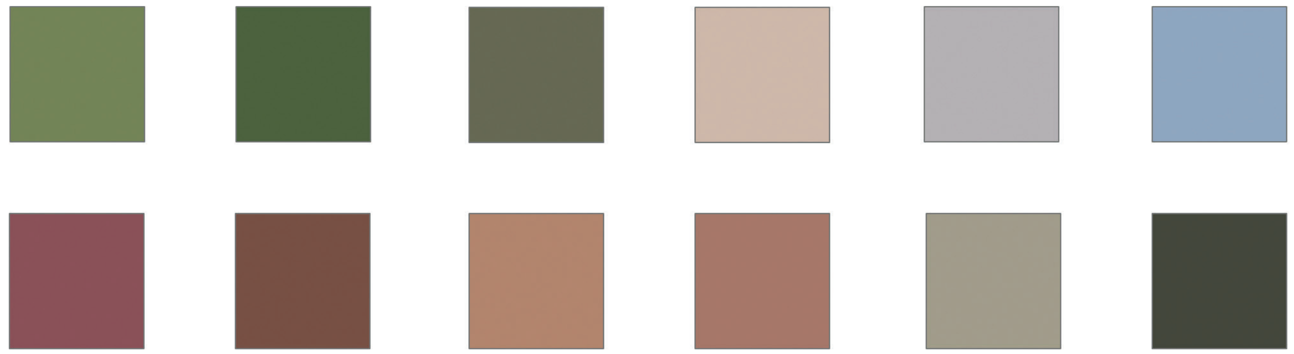


Figure 44. Color Tonalities of the Landscape Elements (upper row) and the Building Materials (lower row)

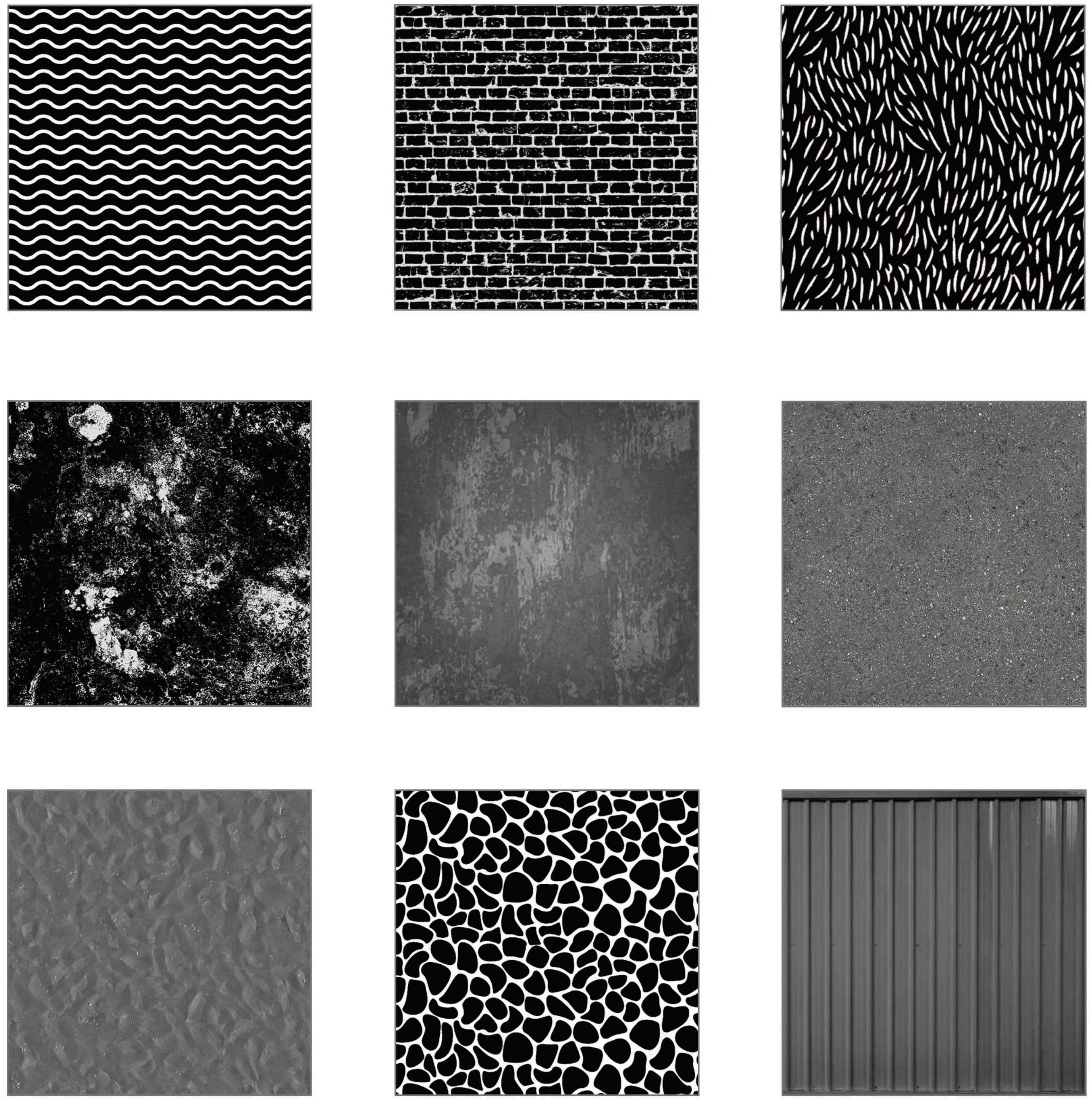


Figure 45. Texture Patterns of the Site Elements: (from left to right, up to down): 1- Water. 2- Brick. 3- Grass. 4- Grunge Concrete. 5- Rusted Steel. 6- Asphalt. 7- Sand. 8- Stone. 9- Shipping Containe. © textures.com

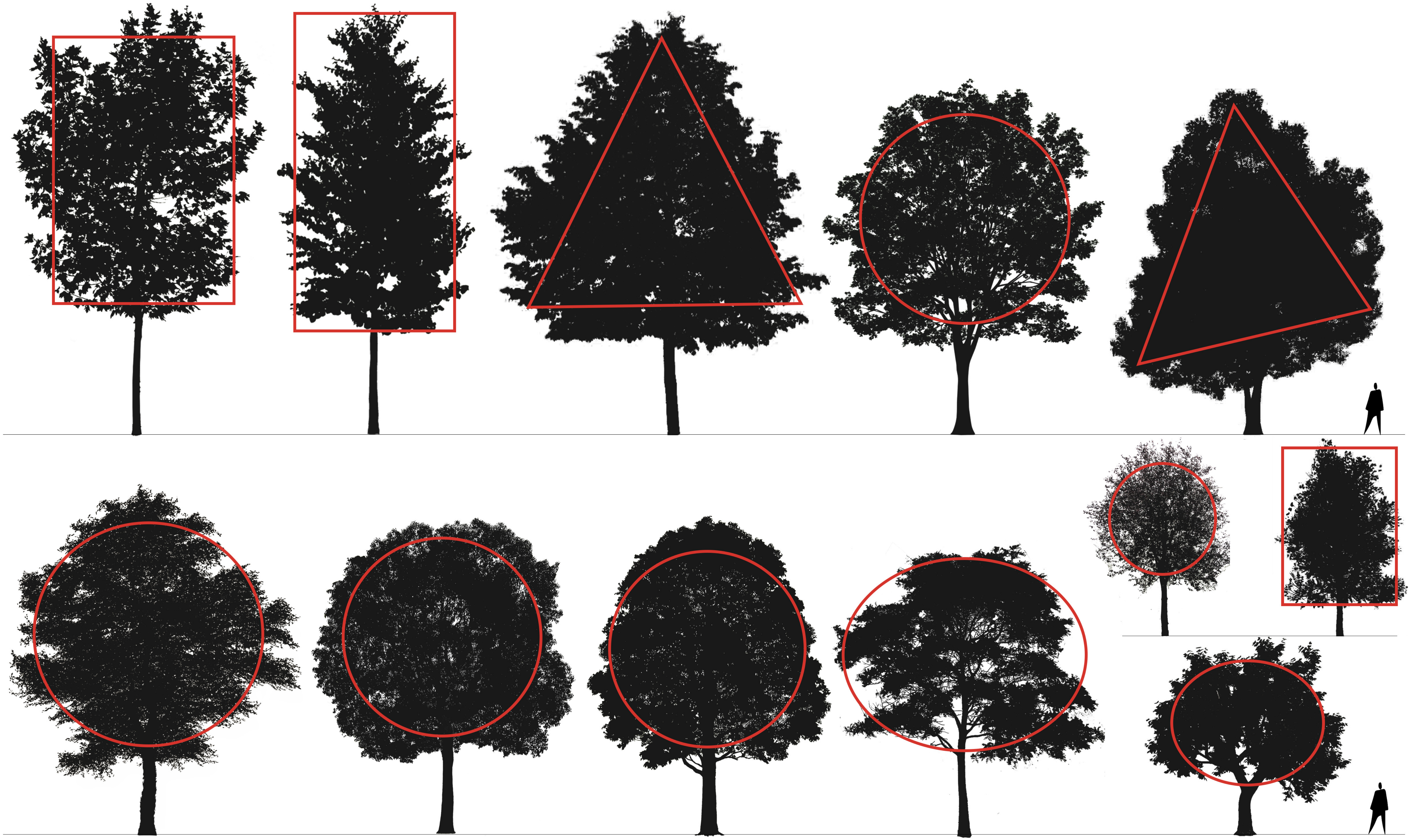


Figure 46. Most Frequent Tree species in New York City (upper line, from left to right): 1- Platanus × acerifolia. 2- Ginkgo biloba. 3- Tilia cordata. 4- Zelkova serrata. 5- Quercus palustris. (lower line, from left to right) 6- Gymnocladus dioicus. 7- Celtis occidentalis. 8- Catalpa speciosa. 9- Gleditsia triacanthos inermis. 10- Prunus cerasifera. 11- Pyrus calleryana. 12- Phellodendron amurense. © redhookwaterfront.com

Figure 47. Geometrical Analysis of Architectural Elements, North-Western Facade of Rod Hook Stores, Brooklyn, New York City.
© redhookwaterfront.com

Figure 48. Geometrical Analysis of Architectural Elements, Western Facade of Rod Hook Merchant Stores, Brooklyn, New York City.
© redhookwaterfront.com

Figure 49. Geometrical Analysis of Architectural Elements, South-Eastern Facade of Beard and Robinson Stores, Red Hook, Brooklyn, New York City. © redhookwaterfront.com

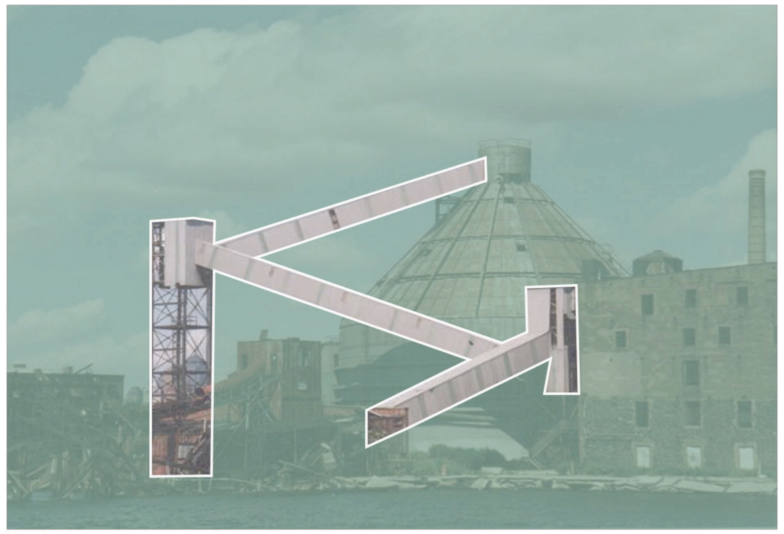


Figure 50. Geometrical Analysis of Architectural Elements, Revere Sugar Factory, Rod Hook, Brooklyn, New York City. © redhookwaterfront.com

Figure 51. Geometrical Analysis of Architectural Elements, Residential Building, Brooklyn, New York City.

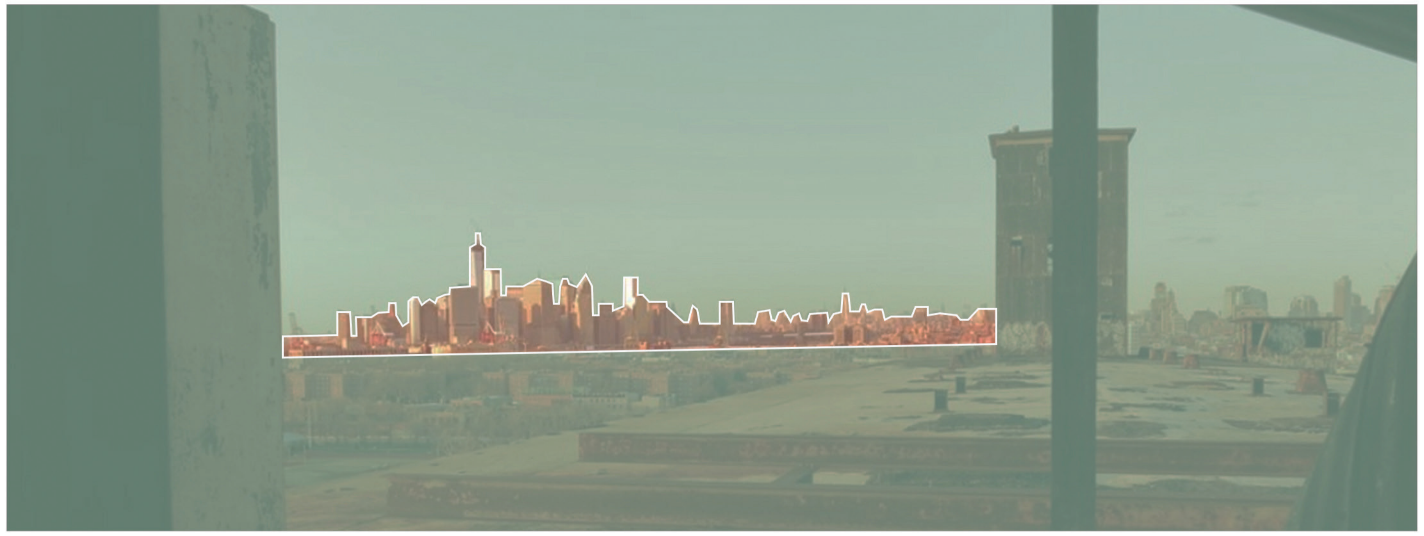


Figure 52. Financial District Skyline, Visible from the roof of Red Hook Grain Terminal, Brooklyn. New York City.
© gothamist.com

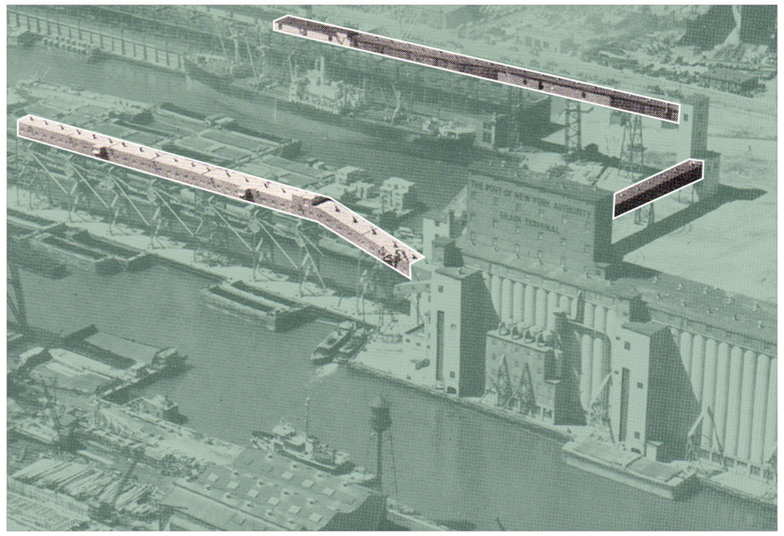


Figure 53. Harbor Conveyor, Red Hook Grain Terminal, Brooklyn, New York City. © brooklynrelics.blogspot.com

Figure 54. Statue of Liberty, Visible from the roof of Red Hook Grain Terminal, Brooklyn. New York City.

2.3 OUTCOMES

2.3.1 SWOT Analysis

The following diagram is a tool to envisage a strategy-driven approach toward proposing the final concept. The outcomes of the multi-criteria site analysis, which focused mainly on the environmental and socio-economic aspects of the study area, lead to the formation of the SWAT matrix. Its goal is to summarize the inferred results cohesively. It combines the study of the strengths and weaknesses of our geographical area, with the study of the opportunities and threats to their environment. As such, it is a useful tool in developing and formulating design strategies.

Strengths

1- Most of the open space sports facilities that are also used by people from adjacent neighborhoods, are located in the vicinity of the site.

2- The grain terminal is very close to the IKEA furniture store which has its ferry express shuttle on weekends.

3- 60% of the residential units are occupied by family households that maximizes the assumption of the community's integration in such projects.

Weaknesses

1- High unemployment rate due to an unbalanced ratio between workplaces and the available workforce.

2- Lack of adequate number of educational spaces compared to the number of residents in the neighborhood.

3- The site is not directly connected to the channel of the bicycle routes running through the Red hook district.

Opportunities

1- Eastern, Western, and top surfaces of the existing structure annually receive direct sunlight for 5-8 hours a day. This provides a perfect atmosphere or agricultural purposes.

2- Existing community farms in the area can create the opportunity of proposing a more consolidated and complex project.

3- The area has the potential to revive nostalgic "Farm Garden" concept

Threats

1- Southwest wind can direct the odor from Gowanus Bay towards the projects area.

2- The presence of combined sewer outfalls near Red Hook indicates environmental contamination in Red Hook's surrounding water bodies.

3- High flood risk due to the possibility of storms surges and high base flood elevation in preassumed 100-year flood zoning.

Figure 55. SWOT Analysis based on the Multicriteria Site Analysis.

2.3.2 Visual and Contextual Guidelines

The above figure summarizes the results based on the second part of the site analysis, where the focus is more on the physical elements and the visual characteristics of the territory. The skyline, topographic transition, shoreline axis, and pedestrian movement are shown under the category of patterns. The latter category demonstrates the most common materials and textures of the existing buildings and the landscape elements within the area of Red Hook. The frequent geometrical shapes analyzed from the elevations of the landmarks as well as existing trees are presented in the last table.

Patterns

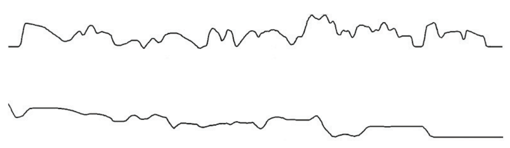


Figure 56. Topographic Transition.

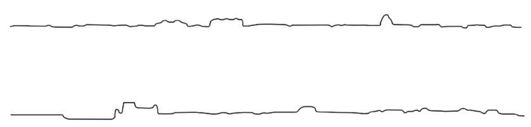


Figure 57. Skyline Pattern.

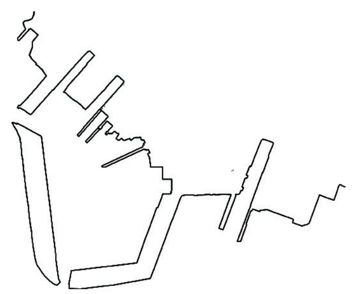


Figure 58. Shoreline Pattern.

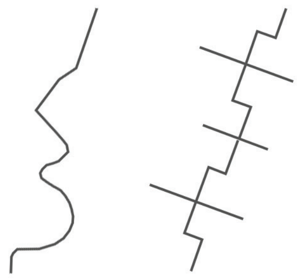
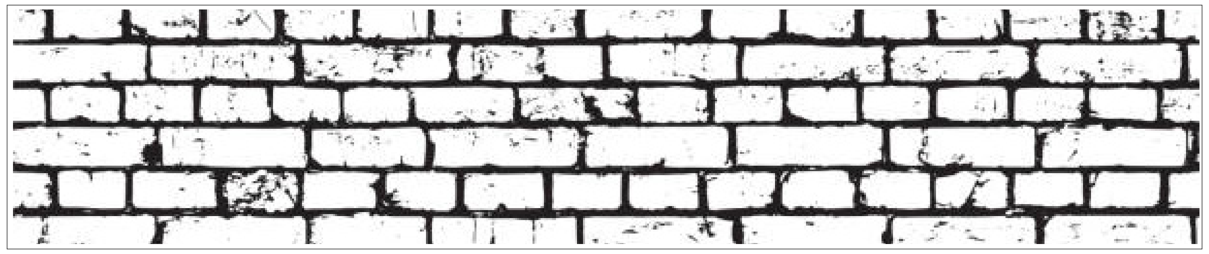
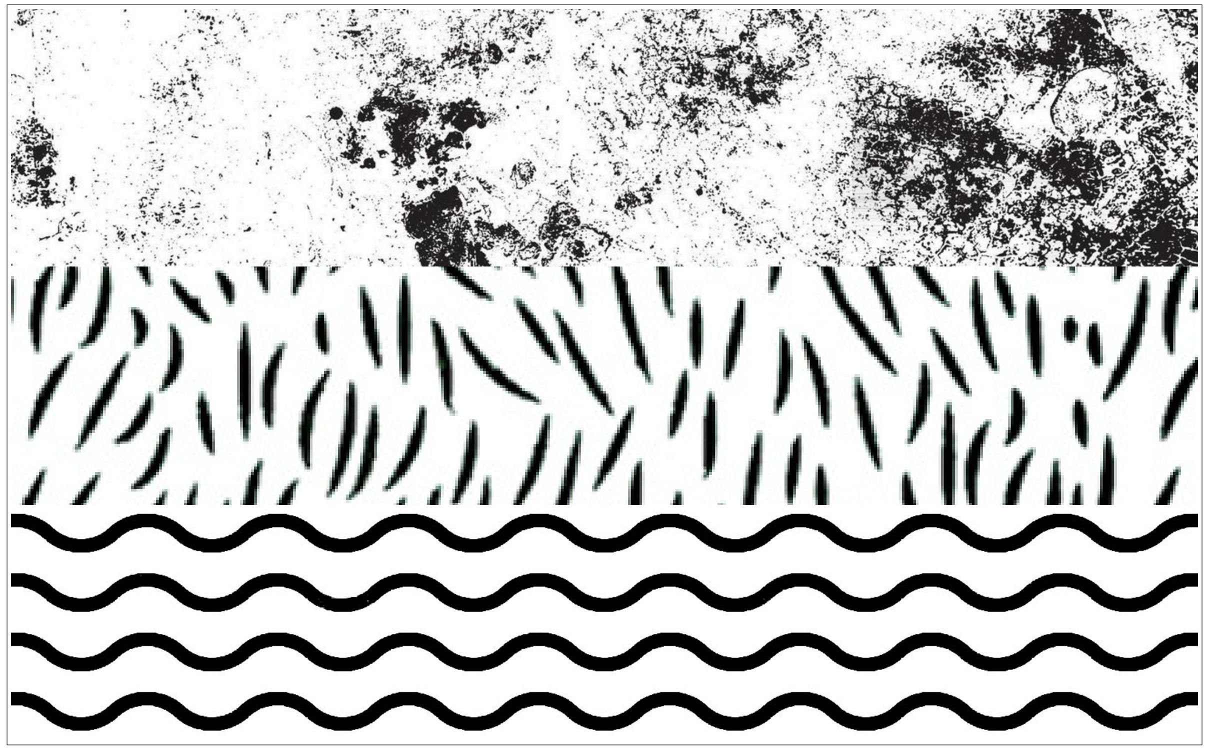


Figure 59. Patterns of Pedestrian Movement.

Materials & Textures





Geometrical Variation

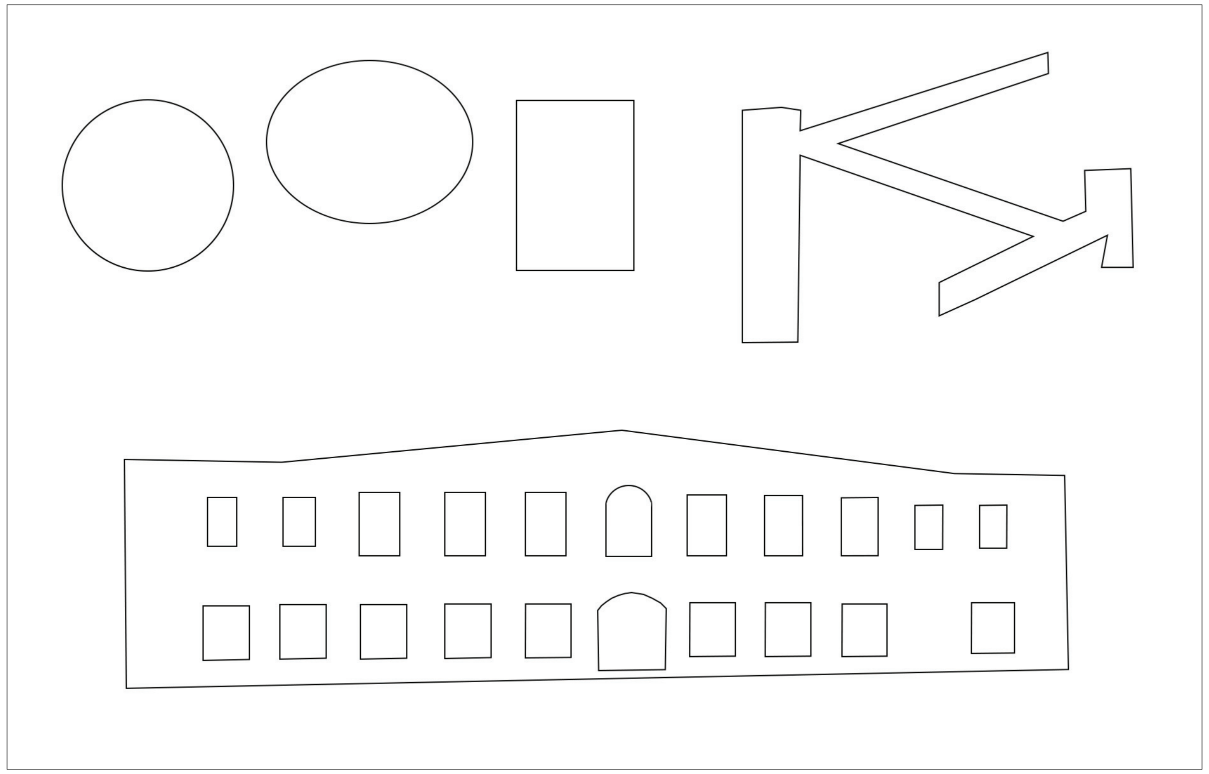


Figure 60. Geometrical Interpretations of the Landscape and Architectural Elements. Based on the Thematic and Contextual Site Analysis.

2.3.3 Design Strategies (part 1)

High flood risk. Base flood elevation for this site is around 4 meters.	Minimum enclosed functions in the ground floor of the existing structure. To prioritize elevated structure for new proposal. (3-4 meters). Vegetation belt along the canal and the basin.
The roof receives more than 4000 hours of direct sunlight.	Solar energy harvest.
The Southeastern wind directs the odor from Gowanus canal towards the site.	Vegetation belt along the canal.
The Neighborhood hosts 4500 family households that 2200 of them have children.	Social activities and educational programs for children (school-aged and adolescent).
The sudden skyline transition from Columbia street to the terminal.	Creating a gradual skyline by proposing new landscape and architectuarl elements.
The diverse typology ond movement patterns within the area.	Combination of linear and circular pedestrian and bike routes for a more dynamic perception.
The dominace of brick, grunge concrete and rusted steel texture wrapping the landmarks of the area, in combination with grass and water.	Using the materials of the exisiting structures in the area to create a more homogenous project.
Geometrical interpretations of the landscape and architectural elements through iconogpraphy and symbolic representation.	Intergraation of such items while creating forms and fucntion for new design elements.

Figure 61. Design Strategies based on the synthetis of the overall Site Analysis.

CHAPTER 3

CONCEPT DEVELOPMENT

3.1 SUSTAINABLE DEVELOPMENT GOALS

Figure 62. Diagram showing UN Sustainable Development Goal. © ec.europa.eu

The 17 Sustainable Development Goals (SDGs) are the world's plan to build a better world for people and our planet by 2030. Adopted by all United Nations Member States in 2015, the SDGs are a call for action by all countries to promote prosperity while protecting the environment. They recognize that ending poverty must go hand-in-hand with strategies that build economic growth and address a range of social needs including education, health, equality and job opportunities while tackling climate change and working to preserve our ocean and forests [18].

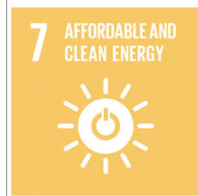
The mentioned targets in "figure 60" are examples of the complex table of defined indicators that this project tries to integrate. Although most of the goals, defined by the UN are set for large-scale outcomes at national and global levels, their implementation on smaller scales also leads to some set of solutions that help the community and the users of the site. The derived solutions are written after each target and also in the second part of the design strategies "figure 76" .

Target 2.4: ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality. (application of the urban agriculture innovations.)

Target 3.9: substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination. (Application of the urban agriculture innovations.)

Target 5.4: Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate. (application of community-supported agriculture as a method for collabrative food production.)

Target 6.4: substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity. (Rainwater Harvesting.)



Target 7.4: By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology. (Solar Energyr Harvesting.)

Target 8.8 & 8.9: Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment. Devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products. (application of community-supported agriculture as a method for collabrative food production.)

Target 9.3: Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets. (application of community-supported agriculture as a method for collabrative food production.)

Target 11.7: provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities. (Integration of universal design guidelines and facilities.)

Figure 63. Specific Targets of SDGs © unstats.un.org

3.2 URBAN AGRICUTLTURE

3.2.1 Targets and Outcomes

Urban agriculture (UA) is beneficial both for developing cities and for industrialized and advanced ones because it is based on the three pillars of sustainability, including the economy, society, and the environment. Based on the numerous subjective assessments done to evaluate sustainable attributes of UA, the following goods and services can be improved in case the UA is strategically applied:

1- **Social:** Food Security and Access, Diet and Health, Psychological Well-being, Sence of Place, Social Interaction, Community Building, and Personal Skills.

2- **Economy:** Employment and Income Production, Economic Value of Land, Diversified Industry based in Cities, and Energy Transport (Food Miles).

3- **Environmental:** Urban Heat Reduction, Wastewater Recycling and Filtration, Noise and Odor Reduction, and Air Quality.

Food Production

The most obvious benefits of urban agriculture are related to the production of foods in close proximity to the consumers (it is also one of the ten core sustainable design objectives of Urban Parks) [19]. The availability of fresh fruits, vegetables, and other foods for urban residents should not be underestimated, particularly in communities and neighborhoods where grocery stores and markets have moved out, leaving a -food desert. In some cases, the food is consumed directly by the producer, improving food security (access to healthy and culturally acceptable food) for the household. In other cases, much of the food is sold through local markets, providing income for individual residents and economic vitality for the community. Urban agriculture activities are broad and diverse and can include the cultivation of vegetables, medicinal plants, spices, mushrooms, fruit trees, and other productive plants. By using intensive production strategies and focusing on high-value crops, the economic value of urban agriculture systems can be substantial.

Ecological & Social Functions

In addition to production functions, urban agriculture offers a wide range of ecological functions (e.g., biodiversity, nutrient cycling, and micro-climate control) and cultural functions (e.g., recreation, cultural heritage, and visual quality) that benefit the nearby community and society. By producing food locally and balancing production with consumption, the embodied energy of the food required to feed the cities is reduced because of lower transportation distance, less packaging and processing, and greater efficiency in the production inputs. The reduced energy requirements could in turn decrease greenhouse gas emissions and global warming impacts compared with conventional food systems. Energy is also conserved by reusing urban waste products locally, both biodegradable wates for compost, and waste-water (e.g., stormwater and greywater) for irrigation. The reuse of wastes offers another benefit in reducing transportation and land use requirements for disposal and long-term management, essentially closing the loop in the cycle of waste resources. Urban agriculture, like urban gardens, can also contribute to biodiversity conservation, particularly when native species are integrated into the system. These systems can offer additional ecological benefits in modifying the urban micro-climate by regulating humidity, reducing wind, and providing shade. In situations where food production occurs on vacant lots or other derelict land, the effect of greening the neighborhood alone is a positive outcome for all residents in terms of visual quality and human health and well-being . The entire community also benefits from the creation of new jobs for residents who struggle to find work, from opportunities to socialize and cooperate with friends and family , and from the environmental awareness that comes from a connection to an agroecological system [20].

Production Typology

In the preliminary stages of any UA project, there are typically three alternatives for choosing the right approach of production typology in any particular site : 1- Cultivation of Vegetables, 2- Cultivation of Fruit Trees and Shrubs, and 3- Urban Farm (Focused on Animal Husbandry). In my project, the criteria for choosing the best alternative are to reduce the life cycle costs, have the high-income capability, promote public education, and create new recreational opportunities for people. Due to the different kinds of social constraints, urban farms are usually an eliminated option unless the project is on the marginal territories adjacent to rural premises. Fruit trees have lower costs of plantation and maintenance compared to vegetables, but they need a long time frame to bear fruits. Instead, fruit shrubs (e.g., berry family) and microgreens (e.g., aragula, basil, beets, kale) can be easily grown in a short period of time. On the other hand, some sort of vegetables like medical herbs can bring annual income. Chamomile, thyme, lavender, sage, rosemary, yarrow, brassica, lemon balm, and peppermint are a few examples of these sorts of herbs that can be integrated into the proposal.

3.2.2 Functional Analysis and Systematic Application

After recognizing the benefits and possible outcomes of urban agriculture, there should be a strategic plan to identify the systematic development of urban agriculture's application in the real world. This phase should be undertaken by the desired teamwork including stakeholders, governmental authorities, and designers in charge. The members of the team should draw up a table called the "Functional Analysis System Technique" diagram by identifying the desired functions to achieve the goal of sustainable development with the guidance of the facilitators (people who conduct the academic studies who might get involved in design stages as well). The facilitators' task at this stage is usually to provide the experts with a unified expression of the project and to move the discussion from the project components to the project functionalities. Fig. 35 shows the FAST diagram for our project. It plays a key role in conducting the design program [20].

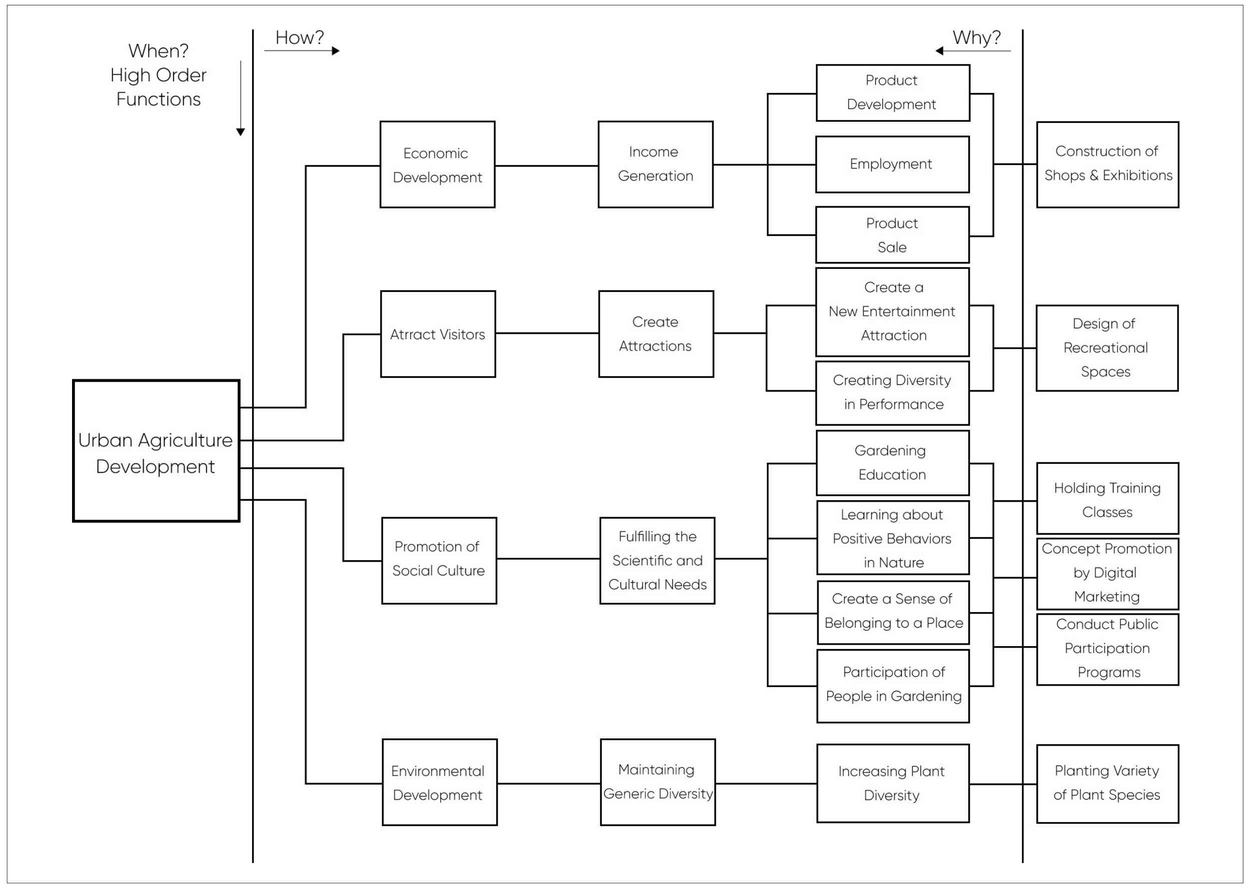


Figure 64. Technical FAST Diagram. A cost-benefit analysis of applying urban agriculture in sustainable park design, done by: Nazanin Hosseinpour, Fatemeh Kazemi, Hassan Mahdizadeh. © sciencedirect.com

3.2.3 Innovations and Novelties

In the field of agricultural production, technology and infrastructure, various new ideas and technical novelties are applied and tested by both business-oriented and non-profit UA. These novelties vary from very simple structures to complex technological solutions. The technical infrastructure which are mostly used worldwile (more specifically in United States where our site is located) are listed below:

1- **Raised Beds:** Boxes from wood or other recycled materials filled with layers of soil and residues of plants or compost to grow plants.

2- **Moveable Beds:** Small box system, (e.g., bakery boxes, or sacks) filled with soil and compost to grow plants; box systems are light weight and/or easy to assemble.

3- **Hydroponics:** Plant growing system in which plants grow in nutrition solutions rather than soil.

4- **Aquaponics:** Combined system of hydroponic plant growing and raising fish. fish waste is used as nutrition for plants.

5- **Aeroponics:** The process of growing plants in an air or mist environment without the use of soil or an aggregate medium.

6- **Rainwater Harvesting:** System to Harvest Rainwater; the simplest form is a rain barrel; most of the water is collected on a rooftop so that the gradient can be explored for transportation.

7- **Vertical Farming:** Vertical farming is the practice of growing crops in vertically stacked layers. It often incorporates controlled-environment agriculture, which aims to optimize plant growth, and soilless farming techniques such as hydroponics, aquaponics, and aeroponics [21].

Figure 65. Raised Bed Garden © Corradi.eu

Figure 66. Hydropinics Technology, © Corradi.eu

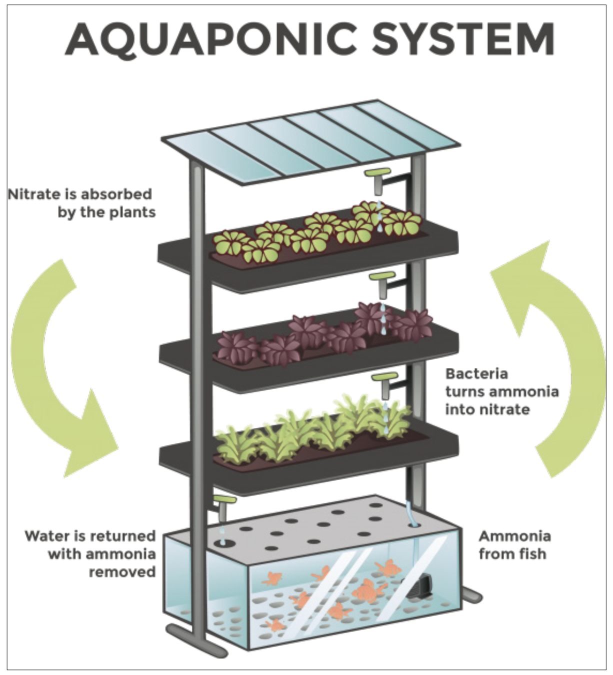


Figure 67. Aquaponic System © projectfeed110

Concerning markets and demands, new ideas and approaches are organizational processes and new products. Especially in the learning area of distribution and food supply, new relationships between consumers and producers are tested. The novel concepts are listed below:

1- Bundles of Herbs: Service innovation in which teenagers from the community deliver bundled herbs for tea or remedies to seniors in the neighborhood.

2- Community-supported Agriculture (CSA): Model wherein a group of consumers buys the harvest from the producer in advance and gets a share of the harvest during the season. (The novelty being used in the proposal)

3- Three-tier Approach: Income model in which one part of the harvest is donated, a second part is sold at a reduced rate and a third part is sold to the highest bidder. Approaches and aims of such novelties lead to generating revenues by obtaining access to markets and learning about consumer demands. Additionally, social goals are met. Current operations that engage such approaches demonstrate the relevance of distributing food not only to people who pay the Thus, collaborative consumption patterns, such as donations and bartering within networks in the neighborhood, are often practiced. Sharing knowledge about products and growing practices with food distribution is a further social goal of applying the novelties in the learning area of markets and demand. Education is distributed with the food, while, e.g., specific medical herbs are bundled or the producer explains how to prepare certain vegetables or fruits.

Social Dimensions

Social Accpetance & Cultural Learning
UA is a relatively new activity within (some) cities and raises land use conflicts. When a group of gardeners or an entrepreneur starts a garden or farm project in an unfamiliar neighborhood, conflicts or misunderstandings arise because of different cultural or educational backgrounds or different value judgments. Many gardeners complain that a direct impact of these differences is vandalism or the theft of vegetables. Thus, the area of learning in terms of social acceptance in the neighborhood is a major topic in UA regarding both business-oriented and non-profit UA operators.

Sustainable Dimensions

While hydroponic or aquaponics technologies, as well as rooftop farms, are regarded as promising approaches that save water, reduce environmental impacts and potentially contribute to food security and urban diversity, a substantial amount of construction materials and electricity are needed to install and operate such technologies. Currently, low-cost solutions, such as rainwater harvesting and irrigation systems, which were developed due to practical needs and under limited budgets, may have a greater positive environmental impact than high-technology innovations, such as, e.g., Sanye-Mengual et al. 2015 demonstrated in the case of rooftop production. They examined that food products from a low-tech rooftop garden had lower environmental impacts than those from high-tech rooftop greenhouses. Certainly, one potential disadvantage of technology-extensive solutions is that they are barely transferable because they are one-way solutions for certain local issues in the specific context of the garden or farm and utilize available materials.

Diffusion Posibilities

From the perspective of innovation and learning, solutions targeting the social dimension of sustainability are highly dynamic and transferable to other localities and projects. Successful diffusion may depend on the precise description and awareness of the relevant aspects of the organization, the relationships between the involved people, and their dependencies. Independent from the intrinsic aim to create a viable business or to gain financial resources that lead to the application of novelties in the area of "financing and funding", economic goals lead to organizational novelties in the area of "markets and demands". Approaches addressing changes in relationships and interactions between consumers and producers imply an alternative understanding of the economy. Elements of collaborative consumption or the sharing economy become visible within the new concepts and novelties. The diffusion of these new concepts may depend on their impacts on consumers and producers and the society as a whole and whether the benefits that the groups receive will overbalance the disadvantages and contribute to sustainability, welfare, and an enhanced quality of life [21].

3.3 TEMPORAL ASPECTS OF LANDSCAPE

3.3.1 Space-Time Relationship

Landscapes are experienced sequentially in space and time. In fact, time can be seen as the sequential ordering of space as one moves through the landscape. Conversley, the spatial continuum can be seen as series of experiences organized in time, with spatial relationships communicated by the time it takes to move from one to another. We come to understand space as we change our location over time. As we move in space and time, perception continually changes. According to Rapoport (1977), as we view the world around us, we seek perceptual change: we desire ro perceive variability. On the other hand, we also seek constancy of schemata; that is, we want mental constructs of the world to be reasonably constant. Landscape design must address the relationship of perceptual variability and schematic constancy as we temporally experience the landscape.

Individual cultures and groups have differing perceptions of time. some see time as alinear progession; others see cyclical or rhythmic time and some focus on the present and have and instantaneous perception. The following paragraphs explain these three categories :

1- Linear Time

Time moves forward in this sort of perception. The past was, the present is and the future will be: time as three different entities. The present is seen as derived from the past and affecting he future, but distictly seperated from both.

2- Cyclical Time

People with this vision see past, present and future inextricably bound by cycles. This belief is reflected in their cultural values and expressions that encode a consciousness of the interrelatedness of past, present, and future intor their designed environment.

3- Instantaneous Time

Many cultures, including the present American one, perceive instantaneous time and seek instantaneous gratification. Individuals with this vision want things to happen now, seek immediate rewards, are goal-driven, and place a premium on convenience and function. Perception of instantaneous time promotes decisions that maximize gain over the short period. often at the expense of long-term in efficiency.

3.3.2 Movement and Perception

As it has been mentioned in the previous section , wee experience the sorrounding landscape as a time-space continuum as we move through it. As we move, our perception of the place physically changes and it also affected by what was previously experienced and what is anticipated. For example, entering a grand space via a smaller one can make the grand space more awe-inspiring.

Route Selection

The route via which we move through a landscape can radically affect our perception of it. Route selection might vary rhythmically, as when we select a daytime route for its distant view, and a nighttime route for views of pools of light flickering on the hillside above. Route selection might also change seasonally, for example, to view azaleas during their period of bloom. Route choice might also change over time based upon an increasing understanding of the place, and the evolving cognitive map or mental construct that emerges. The selected route might also change as the landscaoe evolves.

Serial Vision

Landscape perception involves *serial vision;* that is, vision as a series of perceptions. Through the series of images, the mind's eyes developes a spatio-temporal image of a place, and the scene viewed at any time is perceived within this overall spatio-temporal context. In the mind, the perceived image synergizes with the past and anticipated experience to produce a complex, evolving sense of a place [22]

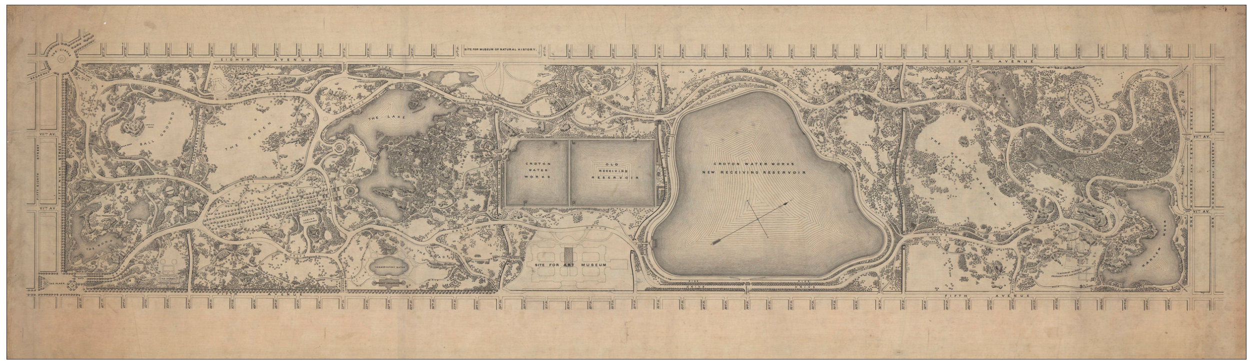


Figure 68. Map of Central Park, 1875, Feredrick Law Olmsted, © archives.nyc. A natural setting that is highly monotonous would lose the sense of place with every visit. The design is focused on the point of view of a moving person and hence designed to reveal more with every step or passing corner. This putting together dynamic components in an informal design approach is a classic example of the application of serial vision [23].

3.4 CASE STUDIES

3.4.1 Gotham Greens, Greenpoint Wood Exchance, Brooklyn, NYC, USA.

Figure 69. View from Adjacent Rooftop
© Gothamgreens.com

Figure 70. Interior of the Greenhouses
© Gothamgreens.com

In 2009, Viraj Puri and Eric Haley founded Gotham Greens, an innovative urban agriculture company focusing on "hyper-local, premium-quality, greenhouse-grown vegetables and herbs. Gotham Greens currently operates over 16,000 square meters of hydroponic growing facilities in urban areas, including the world's largest rooftop greenhouse at 7,000 square meters located in Chicago, United States.

Built in 2011, Gotham's first greenhouse in Brooklyn, N.Y., was the first-ever commercial facility of its kind. At more than 1400 square meters, it remains among the most iconic urban agriculture projects worldwide. Combatting climate change is at the heart of Gotham's mission. By growing produce for hyper-local consumption, transportation-related fuel consumption and food wastage are practically eliminated. Gotham's facilities run year-round, are powered by 100% renewable energy, and feature energy-saving mechanisms such as lighting and ventilation controls. All irrigation water is 100% recycled and enclosing the growing space protects the produce from harsh weather conditions and the damaging effects of climate change itself.

Hydroponics is the foundation of Gotham's innovative growing practices. In such system, nutrients are dissolved into the water that is fed directly to the plants. This method can produce 20-30 times as many crops per acre as a conventional farm. Without the need for nitrogen-based fertilizers, hydroponic systems do not produce ground-contaminating runoff or contribute to greenhouse gas emissions. Because hydroponic systems do not use soil, they are lightweight and can be installed in large rooftop arrays, making them well-suited to the built-up fabric of major cities [24].

3.4.2 Sky Greens Vertical Farming, Singapore.

Sky Greens' four-story rotating greenhouse produces 1 ton of leafy greens every other day using a hydraulic-driven system that rotates and provides sunlight for the growing troughs. Designed by engineer and entrepreneur Jack Ng, Sky Farms runs on a so-called Sky Urban Vertical Farming System and is also heralded as "the world's first low-carbon hydraulic driven urban vertical farm."

What does that mean? Well, for such a modern and innovative idea, Sky Greens actually uses good ol' fashioned rainwater and gravity. Using a water-pulley system, 38 growing troughs rotate around an A-shaped aluminum tower that's about 9 meters tall. The rotating troughs ensure even distribution of natural sunlight for each plant.Not only that, the same water used to turn the troughs also nourishes the plants. According to the company, "With the plants irrigated and fertilized using a flooding method, there is no need for a sprinkler system thereby eliminating electricity wastage, as well as water wastage due to run-offs." Only 0.5 liters of water is required to rotate the 1.7 ton vertical structure, the company boasts. "The water is contained in a enclosed underground reservoir system and is recycled and reused." Additionally, only 40W electricity, or the equivalent of one light bulb, is needed to power a single 9 meter tower. The farm consists of 1,000 vertical towers and produces 800 kilograms of Chinese cabbage, spinach, kai lan and other greens everyday for the bustling Southeast Asian metropolis, according to The Straits Times. The farm has been producing vegetables commercially since 2012 [25].

Figure 71. Hydraulic-Driven Vertical Farming
© ecowatch.com

3.4.3 Value Farm, Schenzhen, China.

Built on 2013 with total area of 8120 square meters, Value Farm creates value by cultivating the land as a collective effort. The project intersects issues of urban transformation, architecture and urban agriculture with an international cultural event, and explores the possibilities of urban farming in the city and how that can integrate with community-building. It forms part of the Shenzhen Hong Kong Bi-city Biennale of Urbanism\Architecture 2013, within Ole Bouman's Value Factory located at the Shekou Former Guangdong Glass Factory in Shenzhen, a site that is itself undergoing radical transformation. Responding to the Biennale's theme of 'Urban Border' and Shekou's post-industrial regeneration, Value Farm is realized as new architectural and landscape design providing permanent infrastructure for the site's future.

The design inspiration from Hong Kong is twofold. First is the trend of flourishing rooftop farms in the city's dense urbanity. Besides creating a green oasis above the urban chaos, reconnecting city dwellers with nature and the therapeutic hands-on experience of growing crops, urban farming offers a more sustainable, secure, accessible food supply as well as pointing to an attitude, lifestyle change. Second is the lively urban vernacular of the Central district's 170 year-old Graham Street wet market precinct, whose low-rise fabric embody the city's fine-grain metamorphosis. The precinct is currently facing wholesale redevelopment and with it the potential eradication of the city's self-evolving meshwork of spatio-cultural practices. Value Farm speculates retroactively turning rooftops of an entire demolished wet market block into farming terrain. Nature is excavated anew from Hong Kong's urban past; rooftop configurations are taken as "new ground" to cultivate a viable post-urban future.

Figure 72. Landscape Framing © Archdaily.com

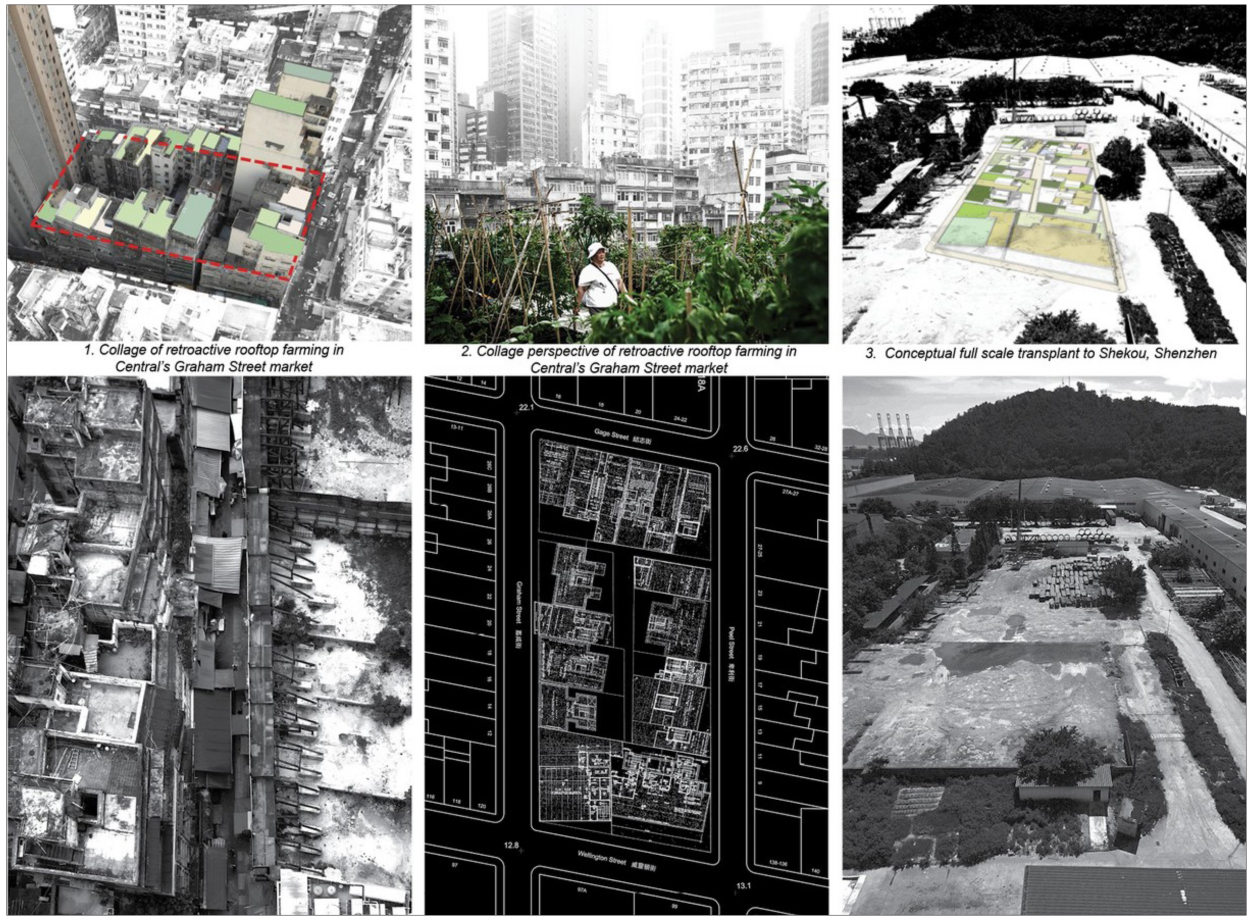


Figure 73. Concept Development © Archdaily.com

The concept is transplanted onto a full-scale 2,100m2 open site within the factory premises as "test ground". Brick enclosures are abstracted and compressed "rooftop farming plots" whose different heights allow varying soil depths for different crops. Original stair cores are converted into brick platforms and open pavilions to accommodate future activities. An irrigation pond collecting the site's natural underground water source, an integrated sprinkler system, nursery as well as projection room and exhibition facilities are added. Instead of treating "landscape" as a passive, detached 'view of the land', Value Farm emphasizes curative transformation. The site's existing qualities are revealed, features such as old walls and large trees redeemed and given new life, resources such as the natural underground water are gathered by digging a new irrigation pond, and simply decorating it with the large rocks uncovered by the excavation. Invoking the analogy of the self-reliant convent lifestyle, the site is also conceptualized as an enclosed garden configured for physical cultivation [26].

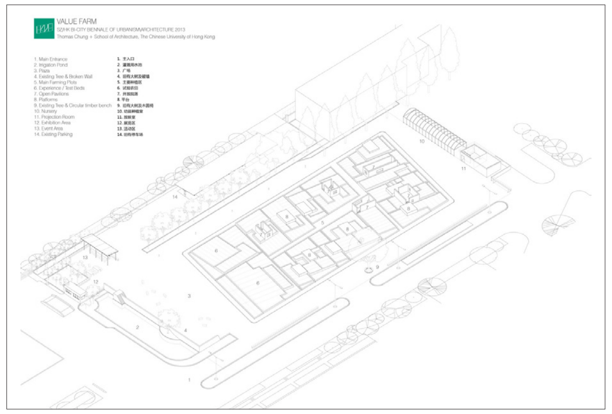


Figure 74. Site Plan © Archdaily.com

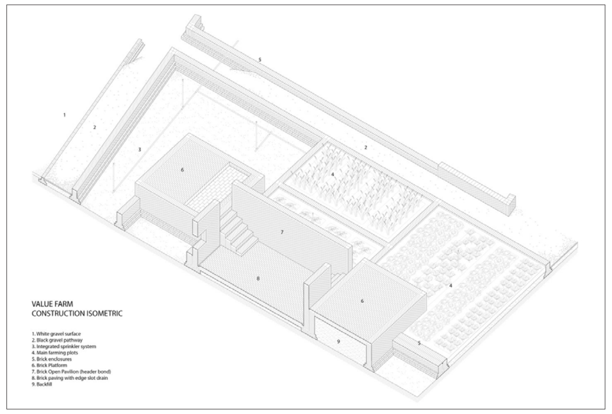


Figure 75. Construction Isometric © Archdaily.com

Figure 76. Aerial View © Archdaily.com

3.4.4 Manassas Park Elementary School in suburban Washington D.C., USA.

Manassas Park Elementary School in suburban Washington D.C., USA, includes a 300 m3 rainwater storage tank fed by the roof of the building (Fig. 4a). Rainwater passes through a filter then into the poured-in-place concrete tank. The below ground storage tank is covered by a concrete slab that serves as an outdoor classroom (Fig. 4b), complete with an aboveground pump house including signs describing the rainwater harvesting system (Fig. 4c). In addition, a special water level gauge, which pushes a color-coded steel pole upwards from the tank by buoyancy, shows students the quantity of water in the tank and increases their awareness of drought and the impacts of their water use. The rainwater is pumped from the storage tank and through additional water treatment to remove sediments and disinfect the harvested rainwater. The harvested rainwater is then used to supply the toilets and landscape irrigation, with a water well providing backup water supply as needed. In the event of large and/or sustained rainfall events, the excess water overflows into an outdoor amphitheater that also serves as a bioretention area (Fig. 78). In this way, the rainwater harvesting system is part of a stormwater treatment train. Designers predicted that the system m3 would save 4900 m3 of potable water per year, but monitoring of the system showed that the potable water savings were actually 30 % higher. While rainwater harvesting was not the only potable water reducing innovation at Manassas Park Elementary School, it has been a major factor in the 85 percent reduction in per capita student water use when compared to a neighboring school [27].

Figure 77. Pump House, used as an outdoor classroom
© Rainwater Management Solutions

Figure 78. Amphitheater and Bioretention Are
© Rainwater Management Solutions

3.5 OUTCOMES

3.5.1 Design Strategies (part 2)

Contamination of the soil in most industrial premises.

Long time frame of production cycles and less income capabilities for certain urban agriculture methods.

→ Implementation of modern urbanagriculture innovations:

1- Raised Bed

2- Hydroponics

3- Aquaponics

4- Vertical Farming

5- Rainwater Harvesting

Landscape perception involves *serial vision;* that is, vision as a series of perceptions. Through the series of images, the mind's eyes developes a spatio-temporal image of a place, and the scene viewed at any time is perceived within this overall spatio-temporal context.

→ Creating an informal design thatis focused on the point of view of a moving person and hence designed to put together the dynamic components.

Application of certain targets (taken fron UN sustainable development goals) in the project taken fron UN sustainable development goals.

→ Target 2.4: Application of the urban agriculture innovations.

Target 3.9: Application of the urban agriculture innovations.

Target 5.4: Application of coomunity-supported agriculture as a method for collabrative food production.

Target 6.4: Rainwater Harvesting

Target 7.4: Solar Energy Harvesting

Target 8.8 & 8.9: Application of coomunity-supported agriculture as a method for collabrative food production.

Target 9.3: Application of coomunity-supported agriculture as a method for collabrative food production.

Target 11.7: Integration of universal design guidelines and facilities.

Figure 79. Design Strategies based on the synthetis of the UA innovation, serial vision, SDGs and case studies.

3.5.2 Synthesis of Design Strategies

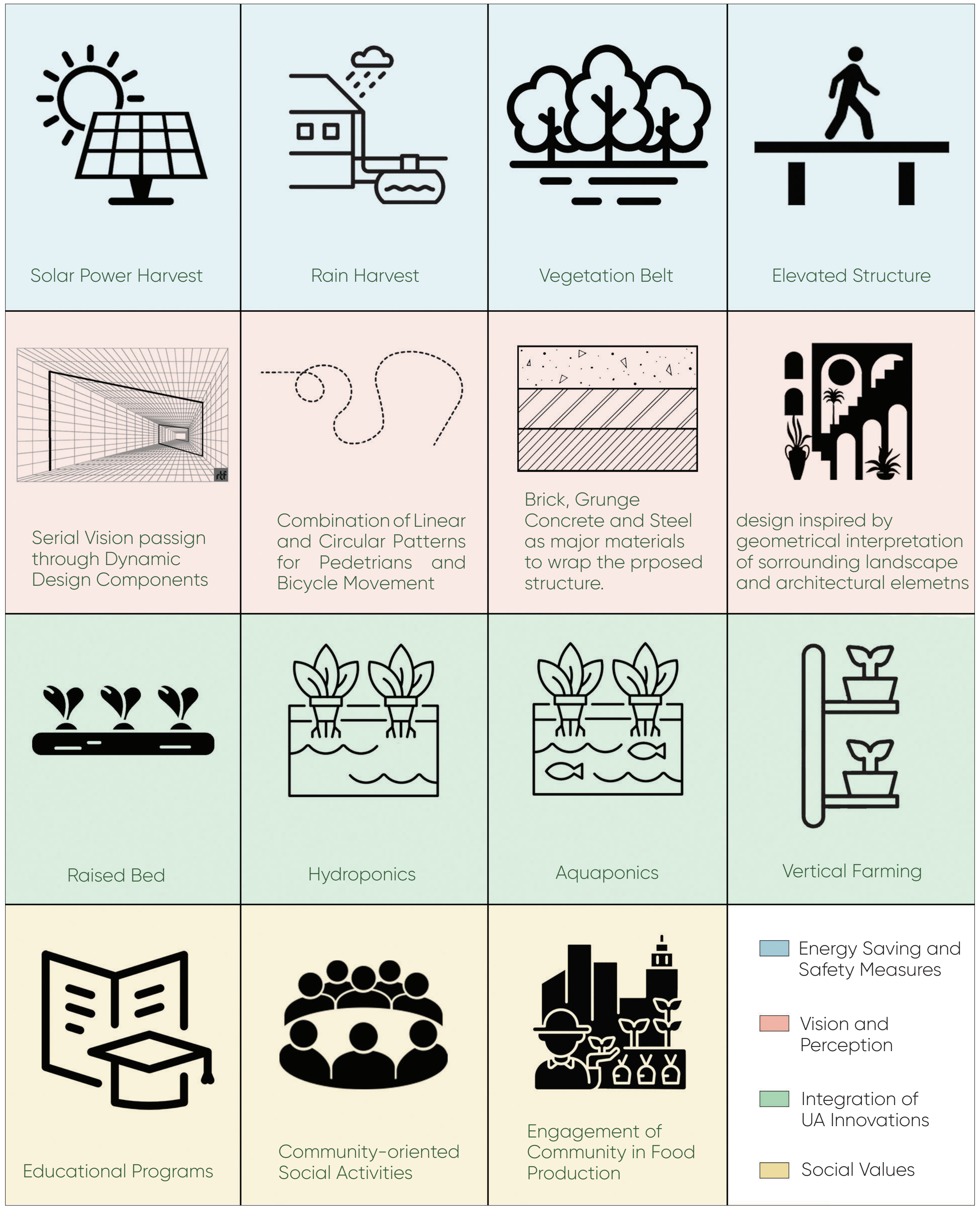


Figure 80. Diagram showing proposed design strategies.

CHAPTER 4

THE PROPOSAL

4.1 MASTERPLANS

Figure 81. General Masterplan.

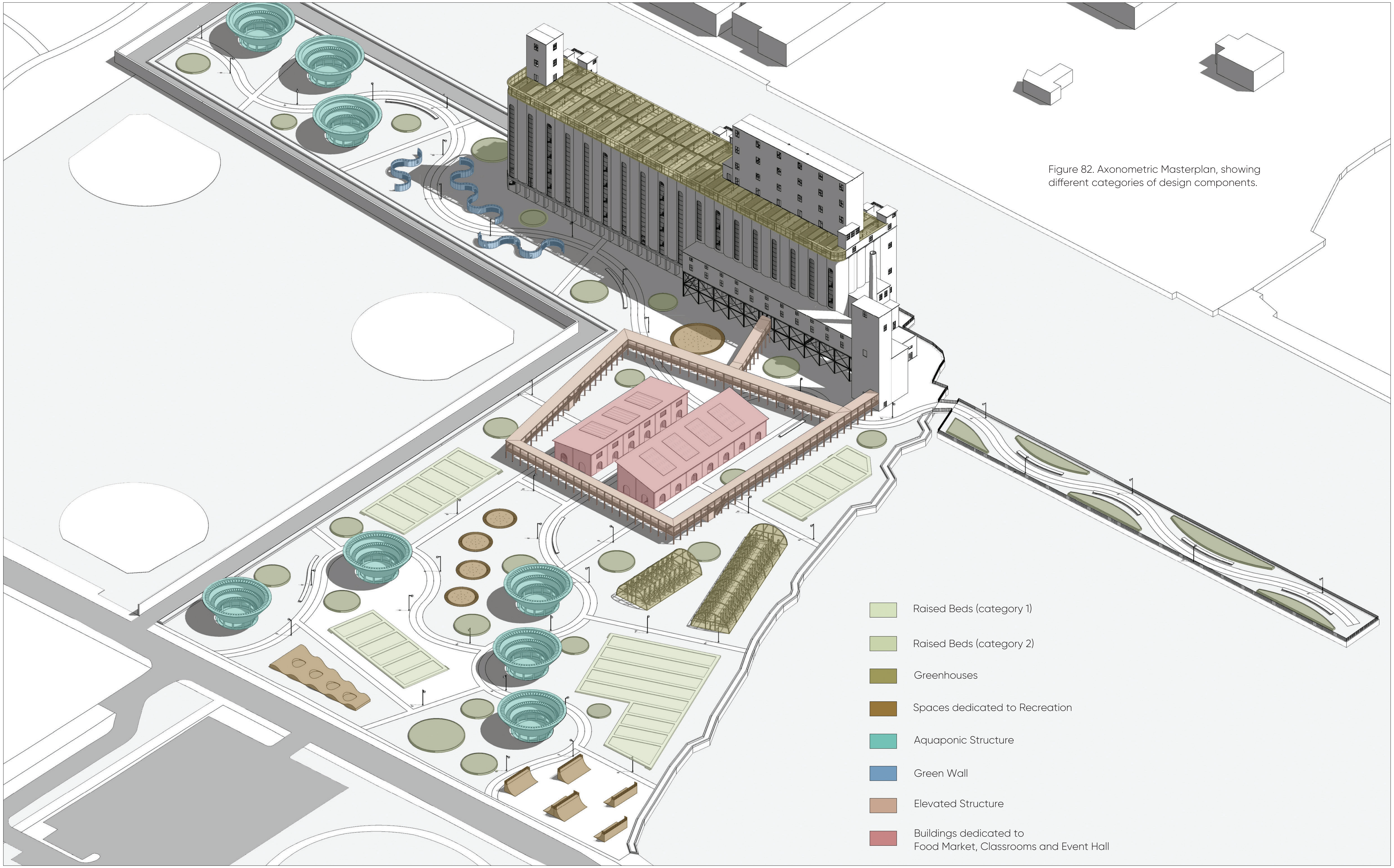


Figure 82. Axonometric Masterplan, showing different categories of design components.

4.2 DESIGN COMPONENTS

4.2.1 Aquaponics / Raised Bed / Green Wall

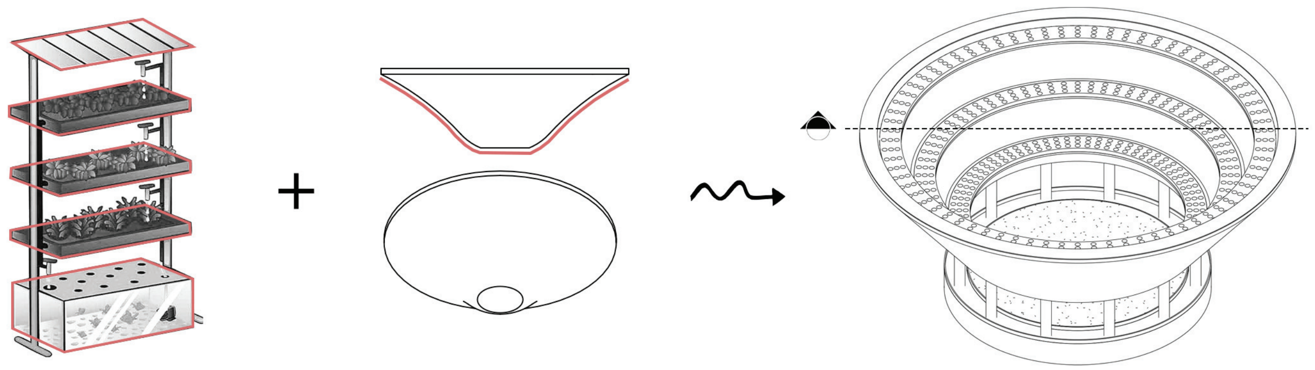


Figure 83. The design development of the Aquaponic Structure (combination of aquaponic scheme and a design element of the existing terminal

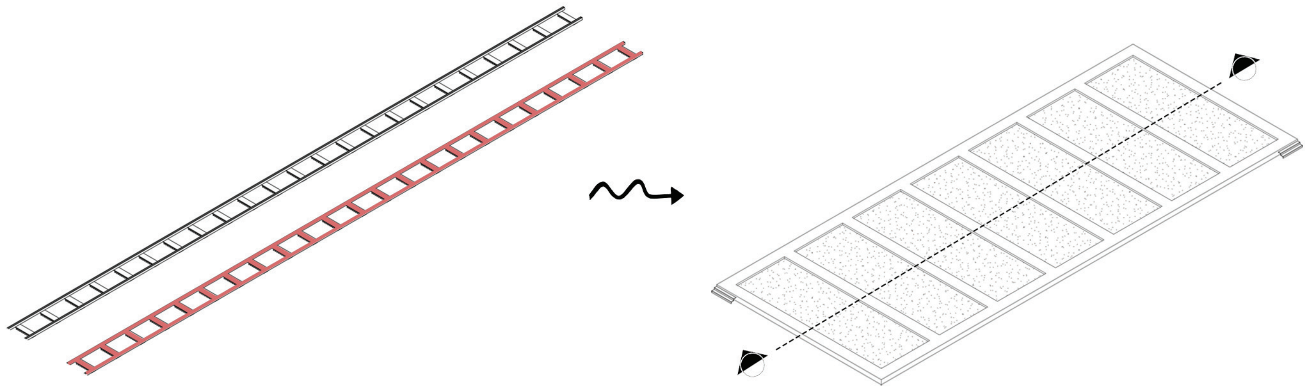


Figure 84. The design development of the Raised Bed. Inspired by the shape of the railroad exisiting in the ground floor of the building.

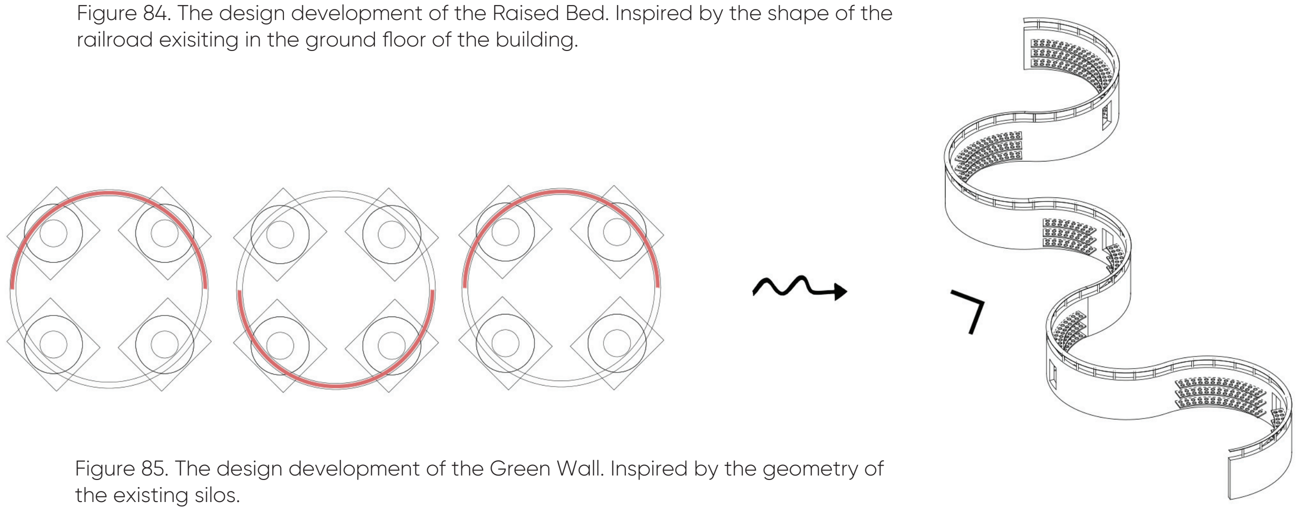


Figure 85. The design development of the Green Wall. Inspired by the geometry of the existing silos.

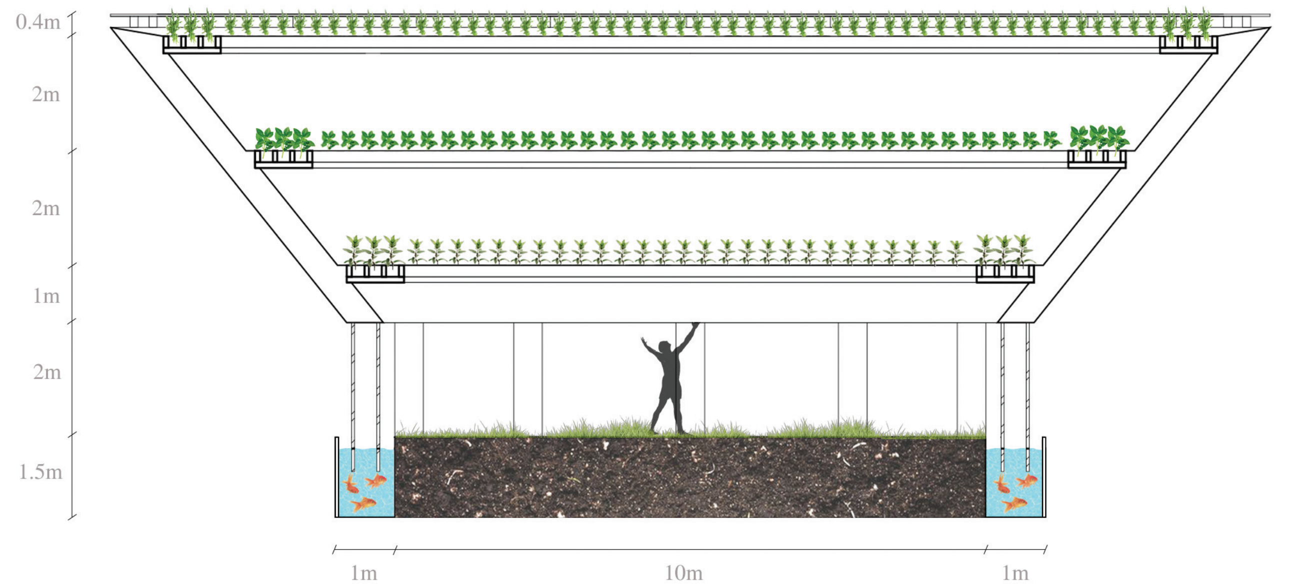


Figure 86. Section through proposed Aquaponic Structure

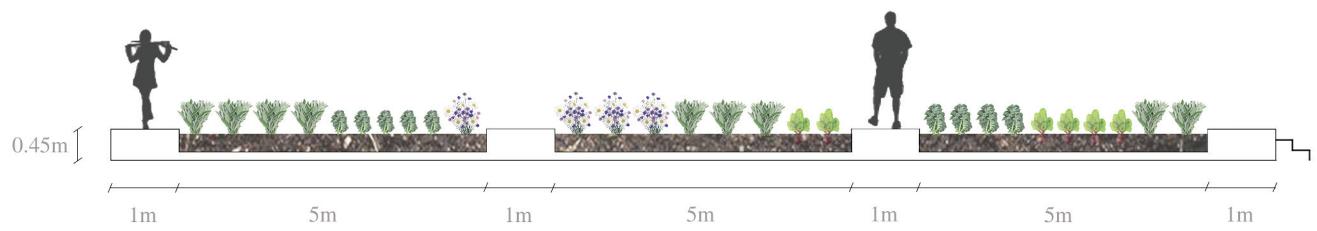


Figure 87. Section through proposed Raised Bed

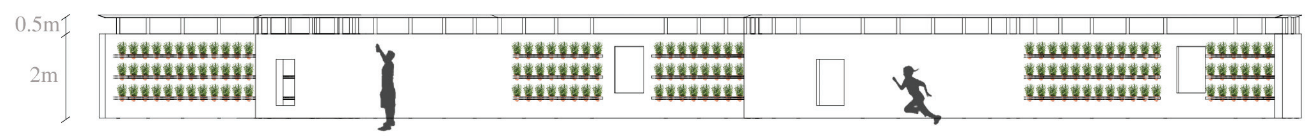


Figure 88. Elevation of the proposed Green Wall

4.2.2 Greenhouses

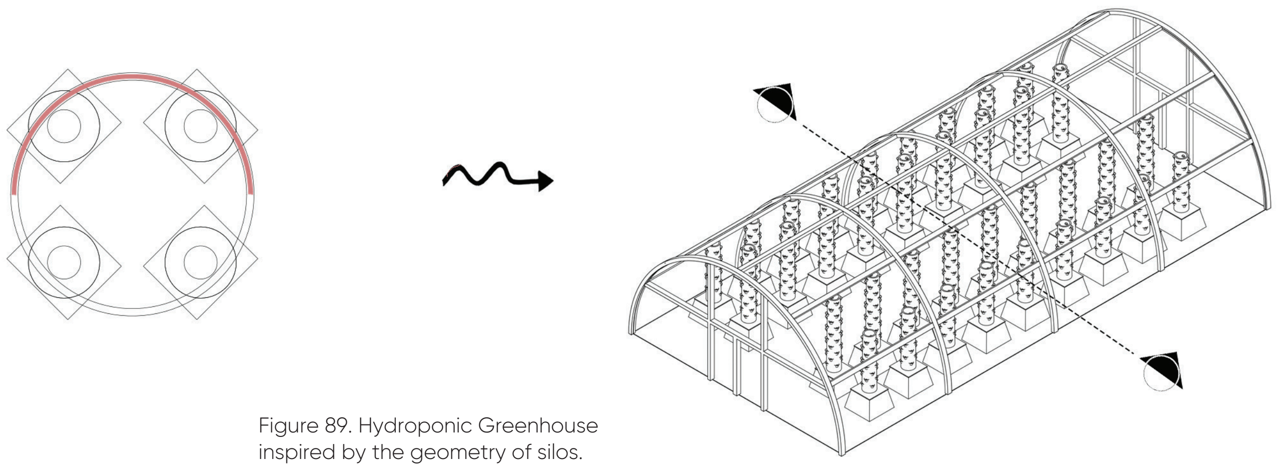


Figure 89. Hydroponic Greenhouse inspired by the geometry of silos.

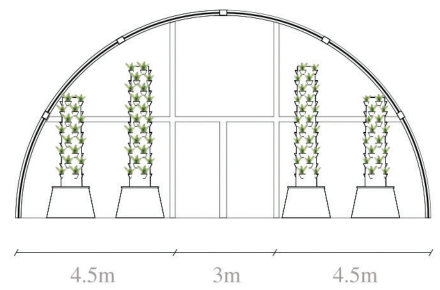


Figure 92. Section through proposed Hydroponic Green House

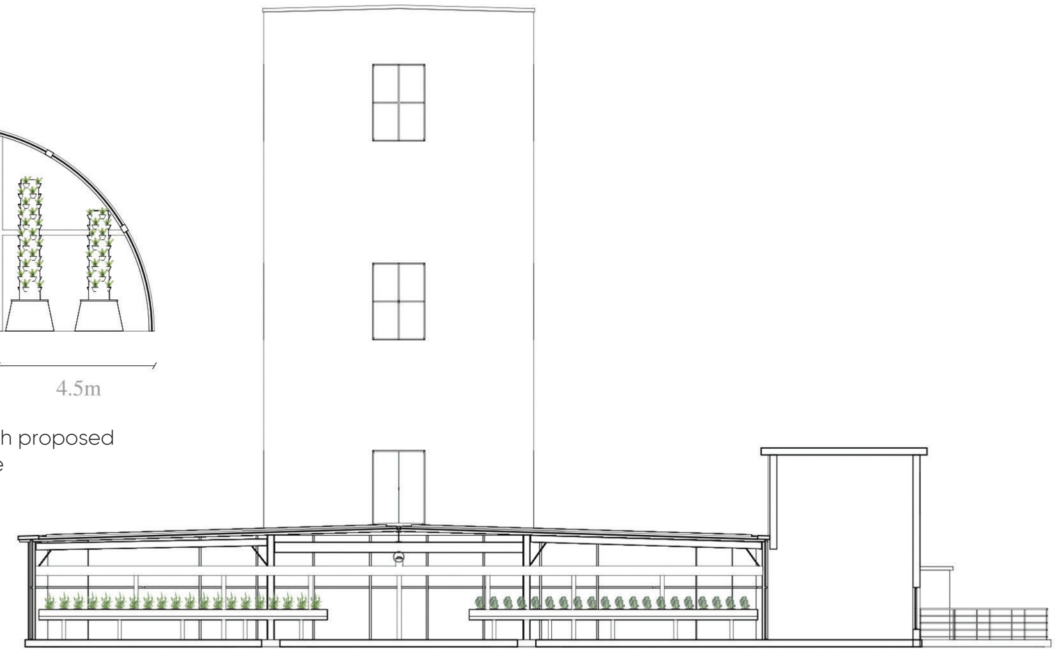


Figure 93. Section through proposed Hydroponic Greenhouse (Upper Level)

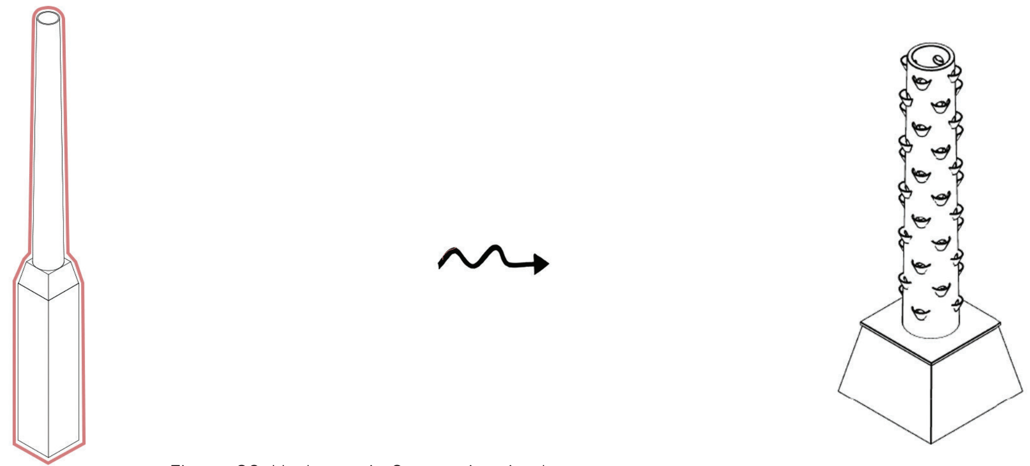


Figure 90. Hydroponic System inspired by the shape of the existing chimney.

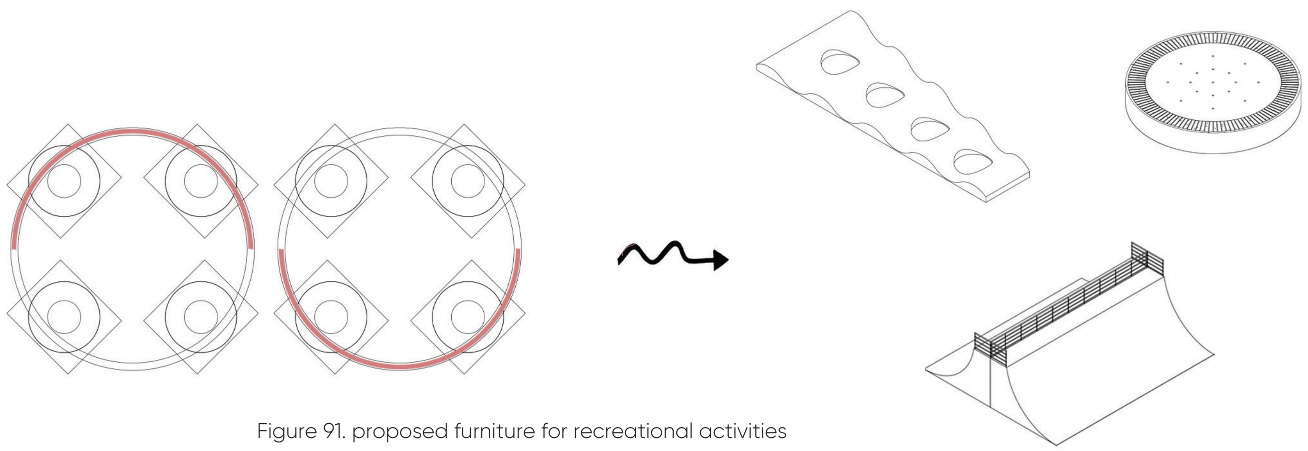
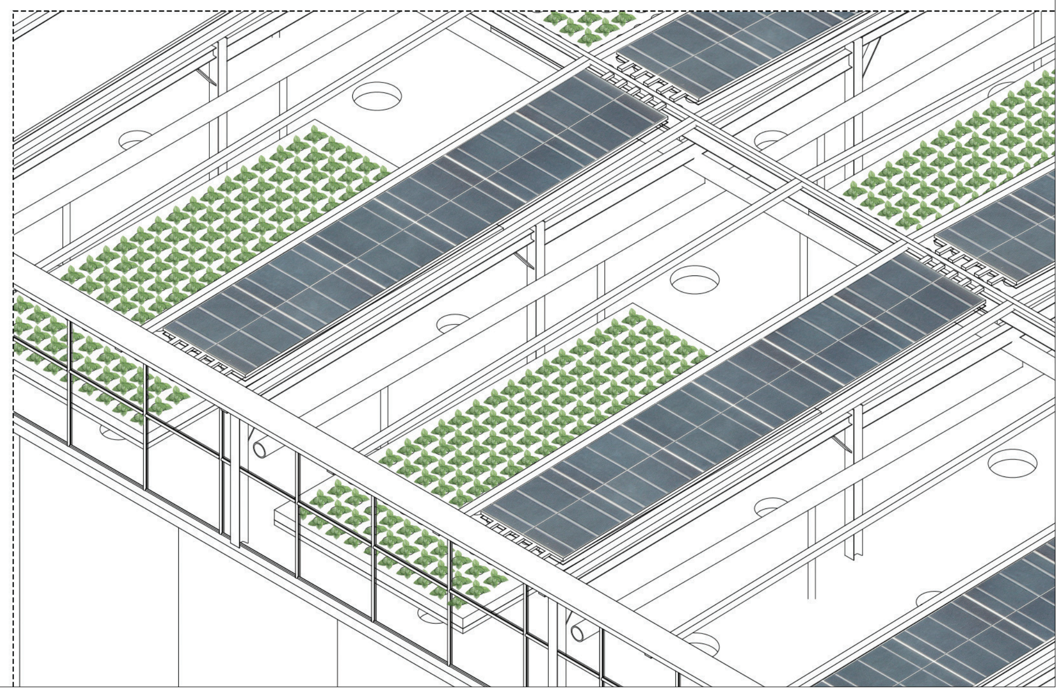


Figure 91. proposed furniture for recreational activities

Figure 94. Diagram showing the solar panel and the aquaponic system (upper greenhouse).



4.2.3 Rain Harvesting System / Vegetation Typology

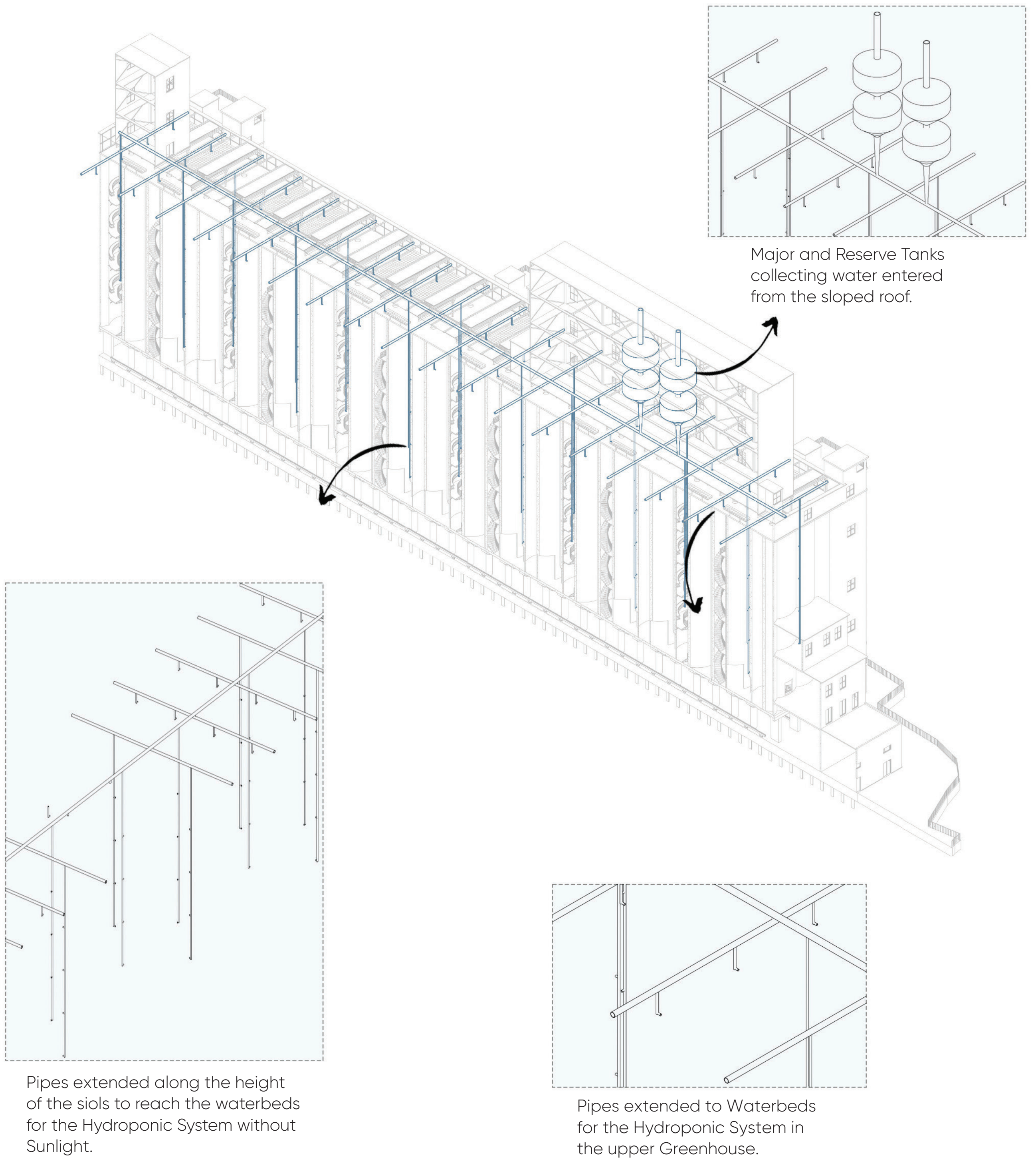


Figure 95. Diagram showing various components of the proposed Rain Harvesting System.

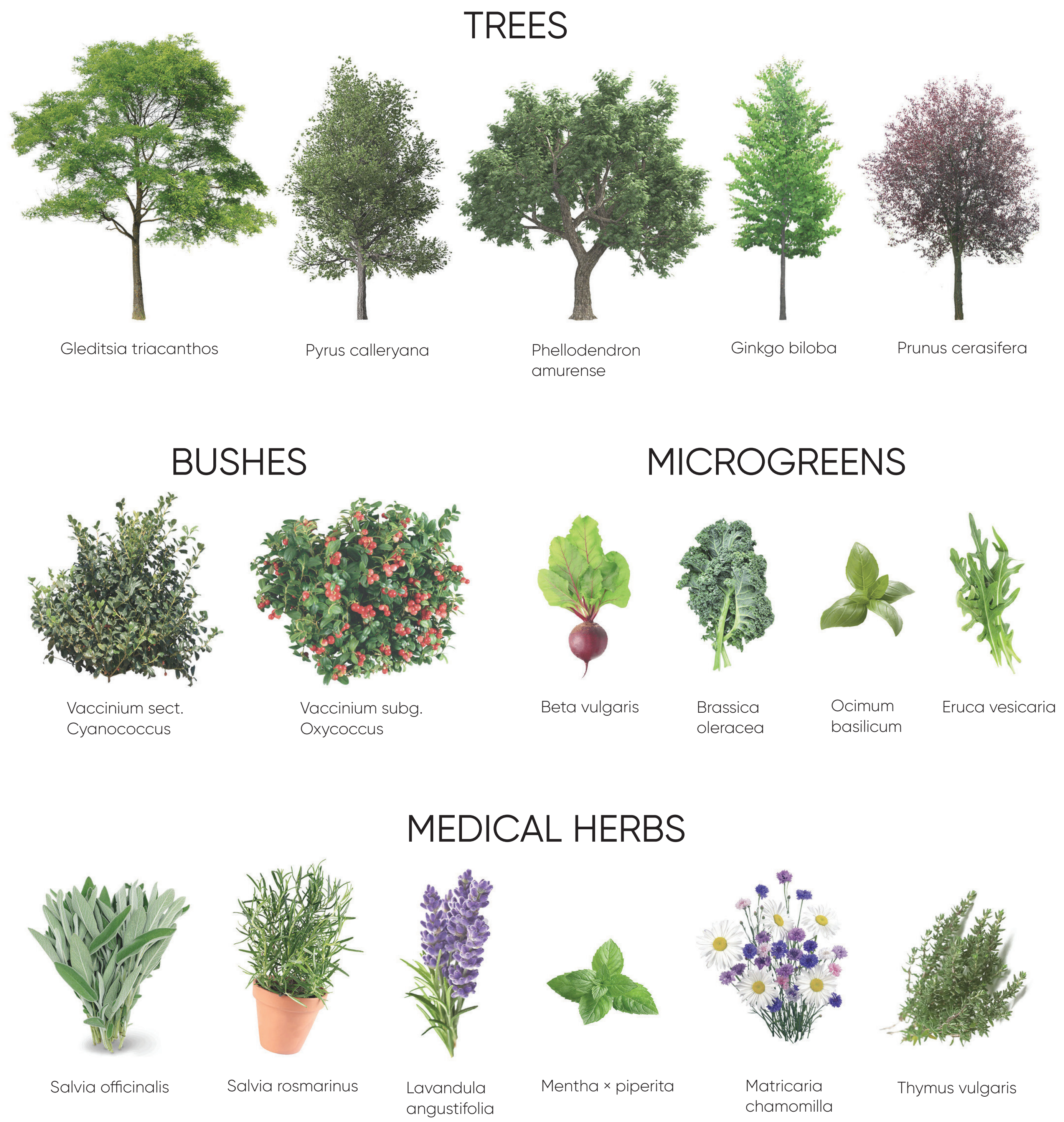


Figure 96. Vegetation Typology being used in the area of the project.

4.2.4 Existing Structure

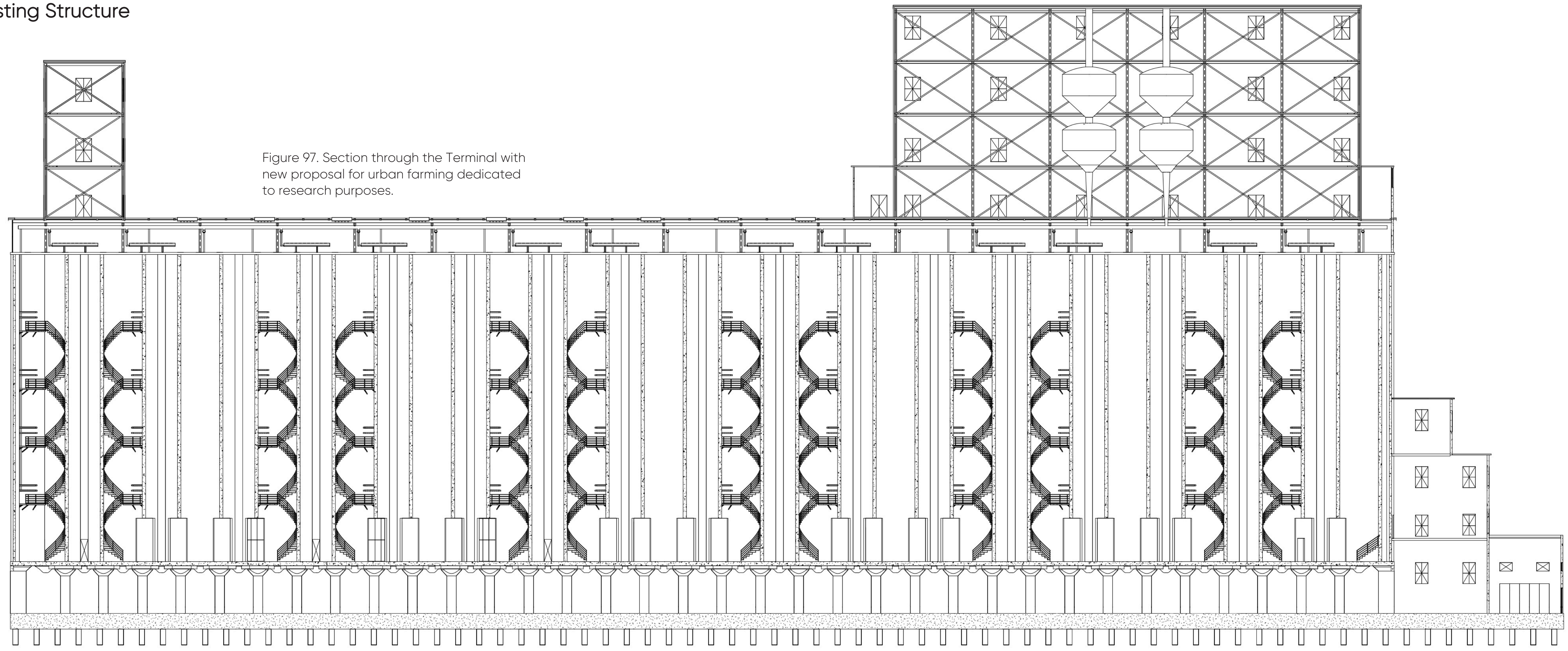


Figure 97. Section through the Terminal with new proposal for urban farming dedicated to research purposes.

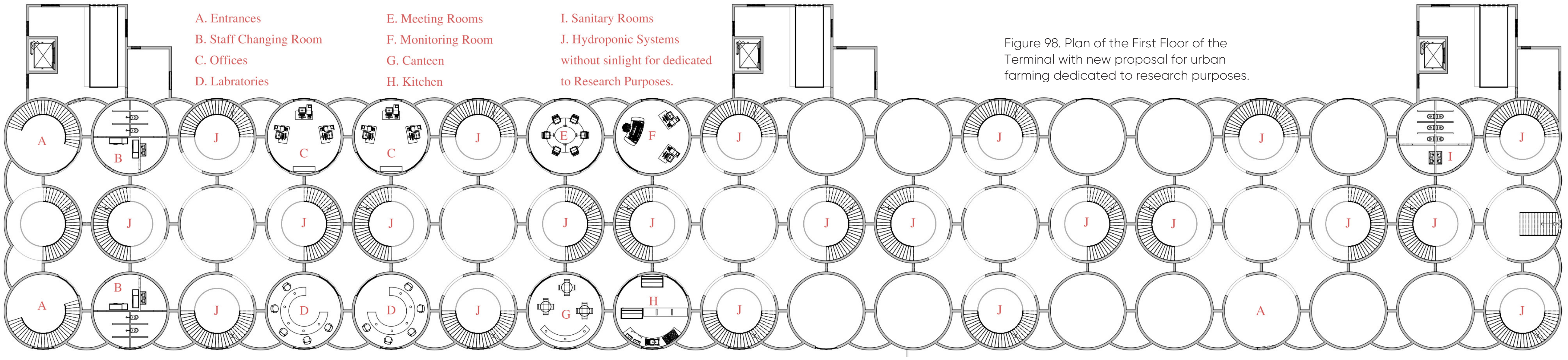


Figure 98. Plan of the First Floor of the Terminal with new proposal for urban farming dedicated to research purposes.

4.2.5 Elevated Structure

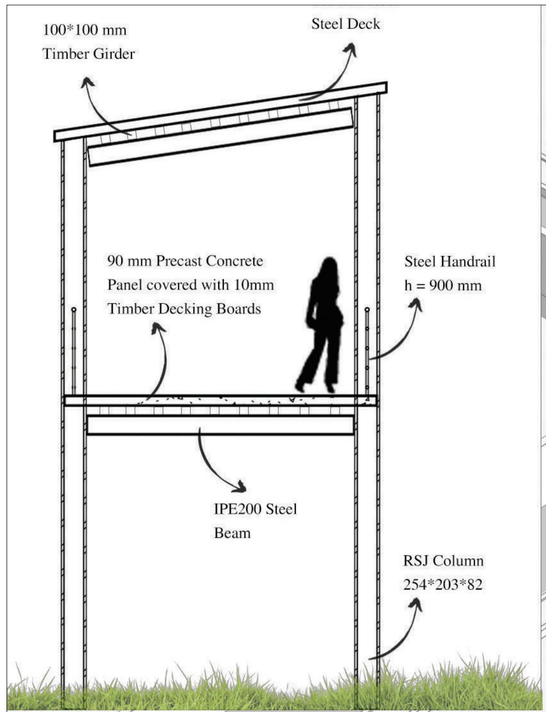


Figure 99. Section through the Elevated Structure, showing the materials.

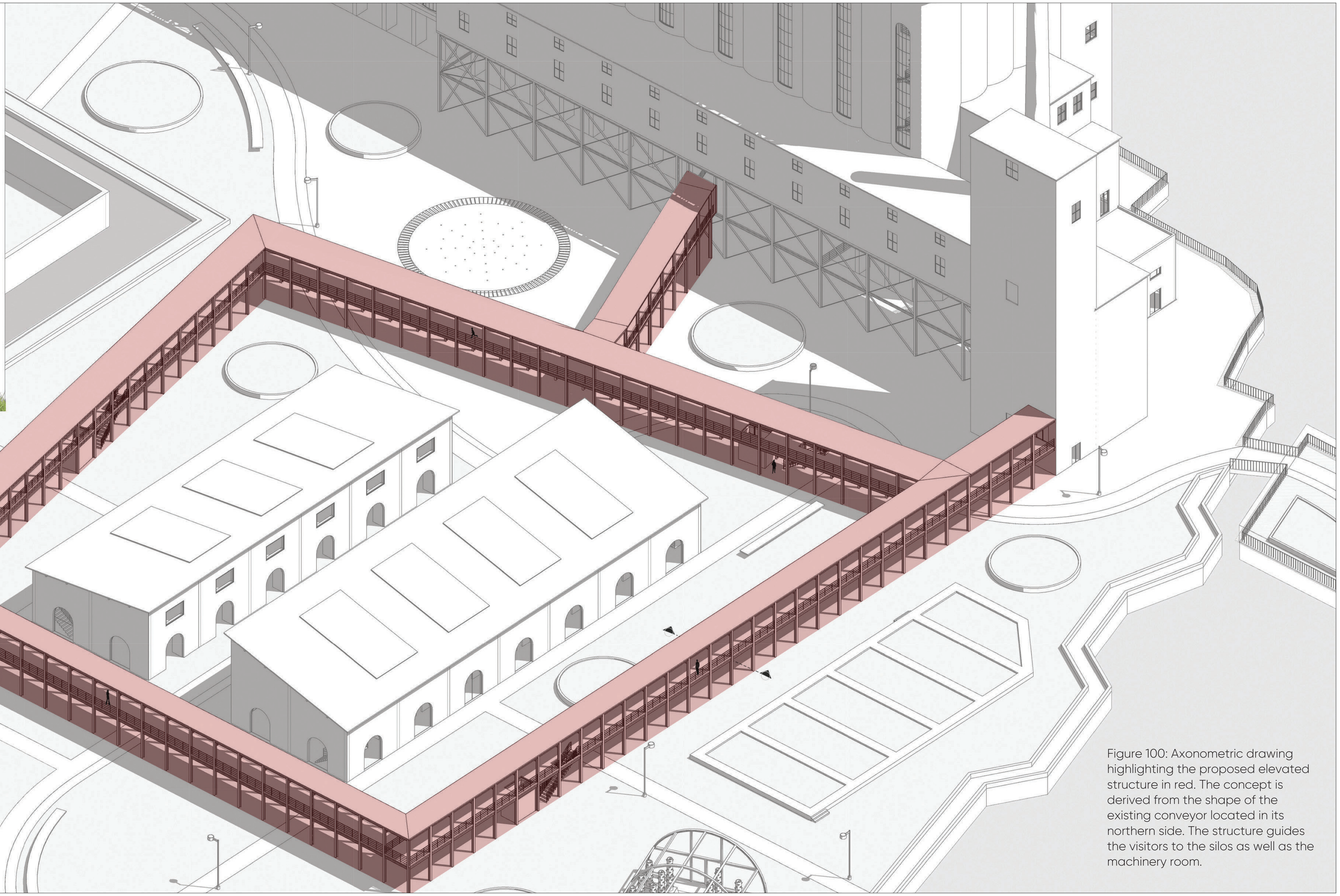


Figure 100: Axonometric drawing highlighting the proposed elevated structure in red. The concept is derived from the shape of the existing conveyor located in its northern side. The structure guides the visitors to the silos as well as the machinery room.

4.2.6 New Buildings

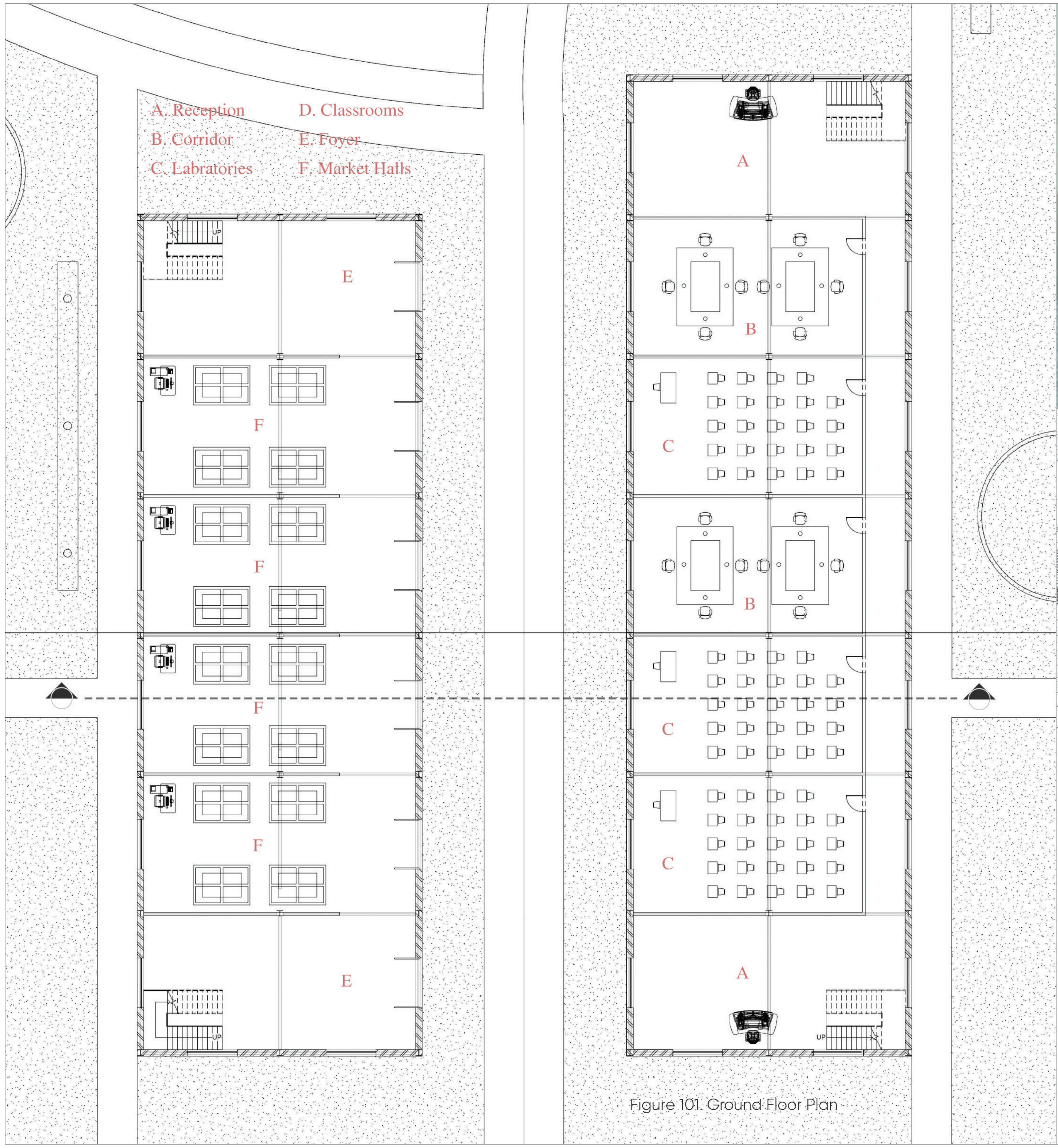


Figure 101. Ground Floor Plan

Figure 102. Geometrical Analysis of Architectural Elements, Western Facade of Rod Hook Merchant Stores, Brooklyn, New York City.

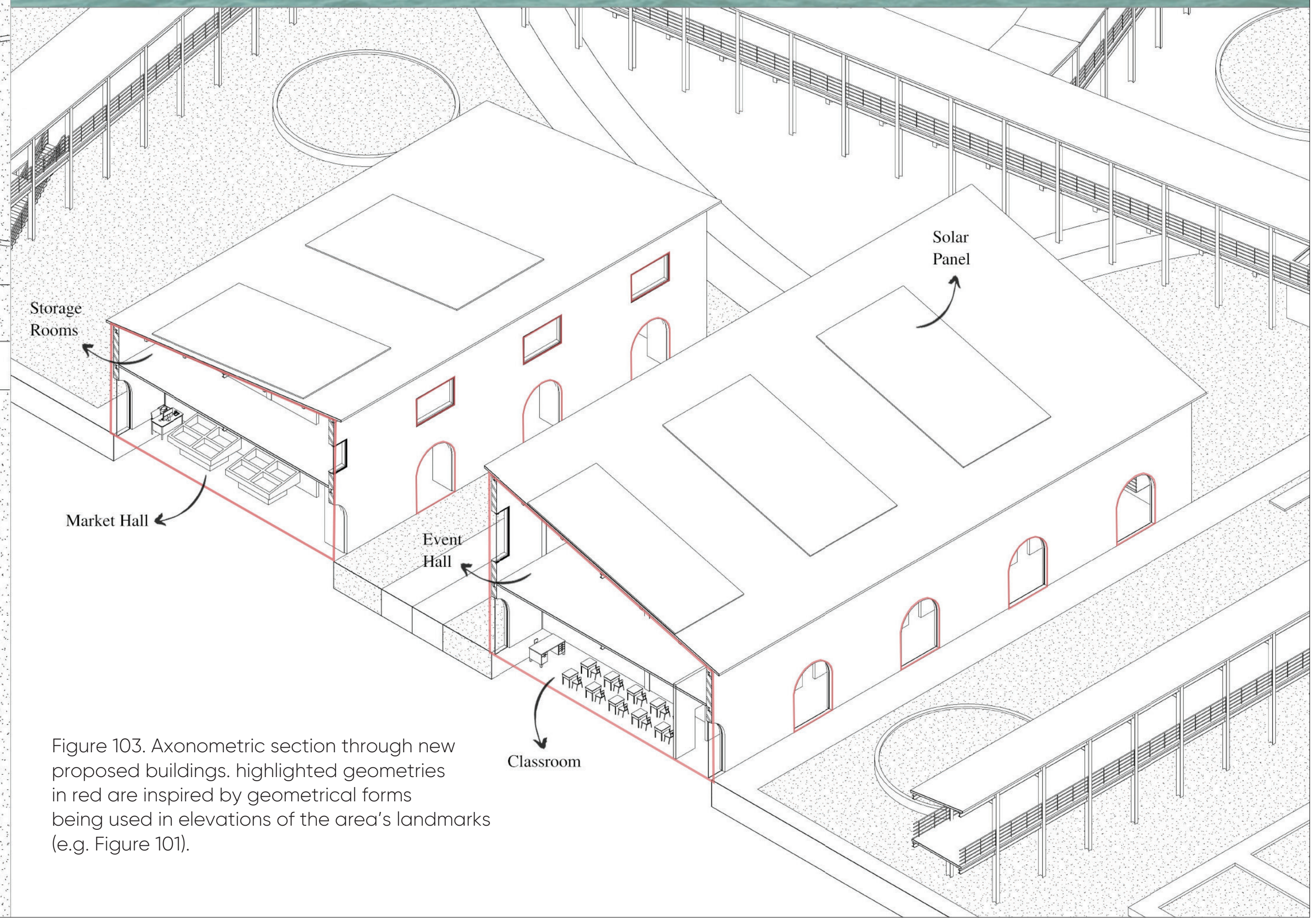


Figure 103. Axonometric section through new proposed buildings. highlighted geometries in red are inspired by geometrical forms being used in elevations of the area's landmarks (e.g. Figure 101).

Figure 104. View towards the Basin, showing the prposed design components including the Hydroponic Greenhouses, Aquaponic Structure, Elevated Structured and New Buildings with the Terminal in their background.

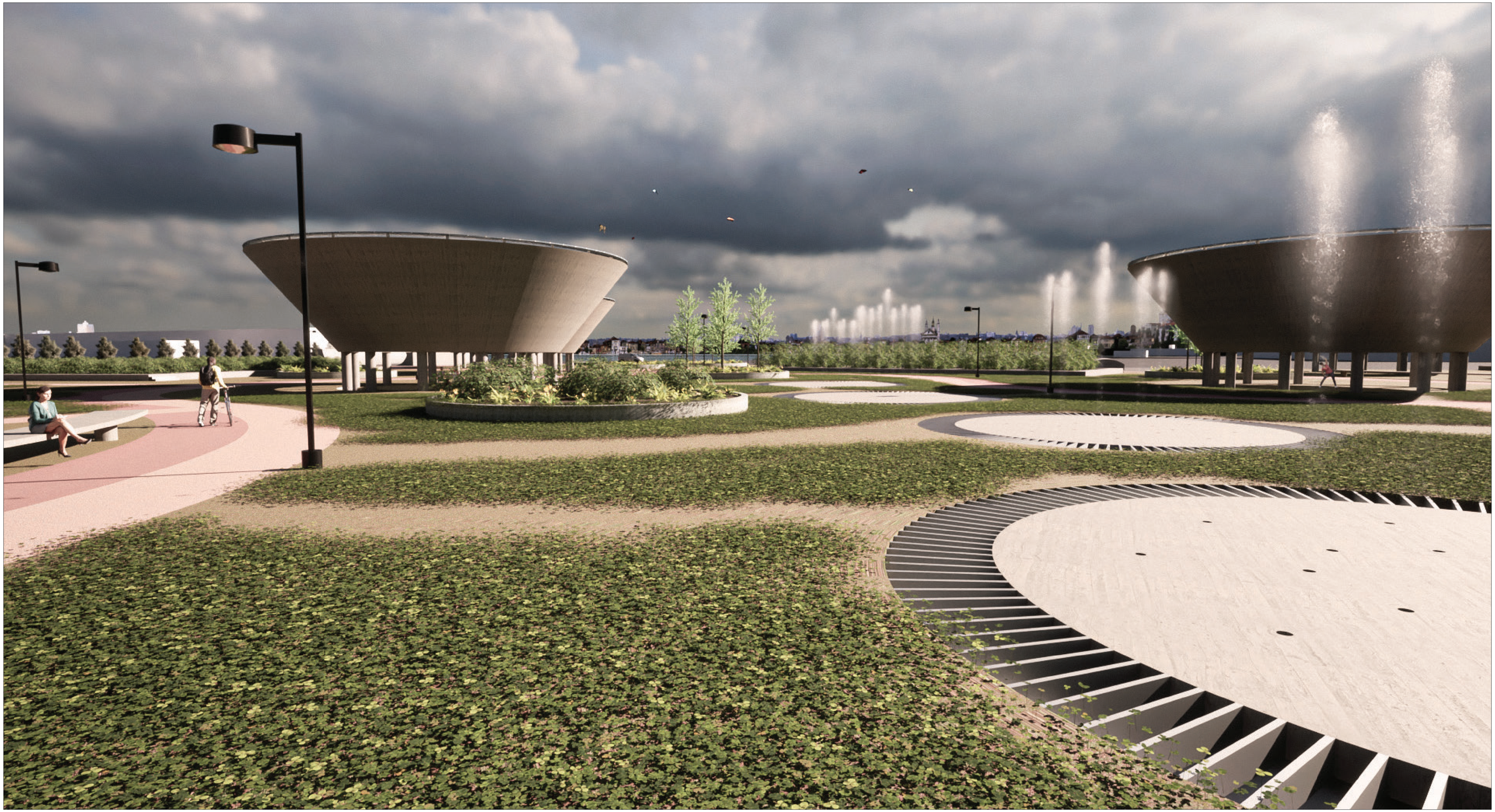


Figure 105. View towards the western edge where the main access to the main street is established, showing the fountains, Aquaponic Structures, pedestrian and bicycle roads and raised beds.

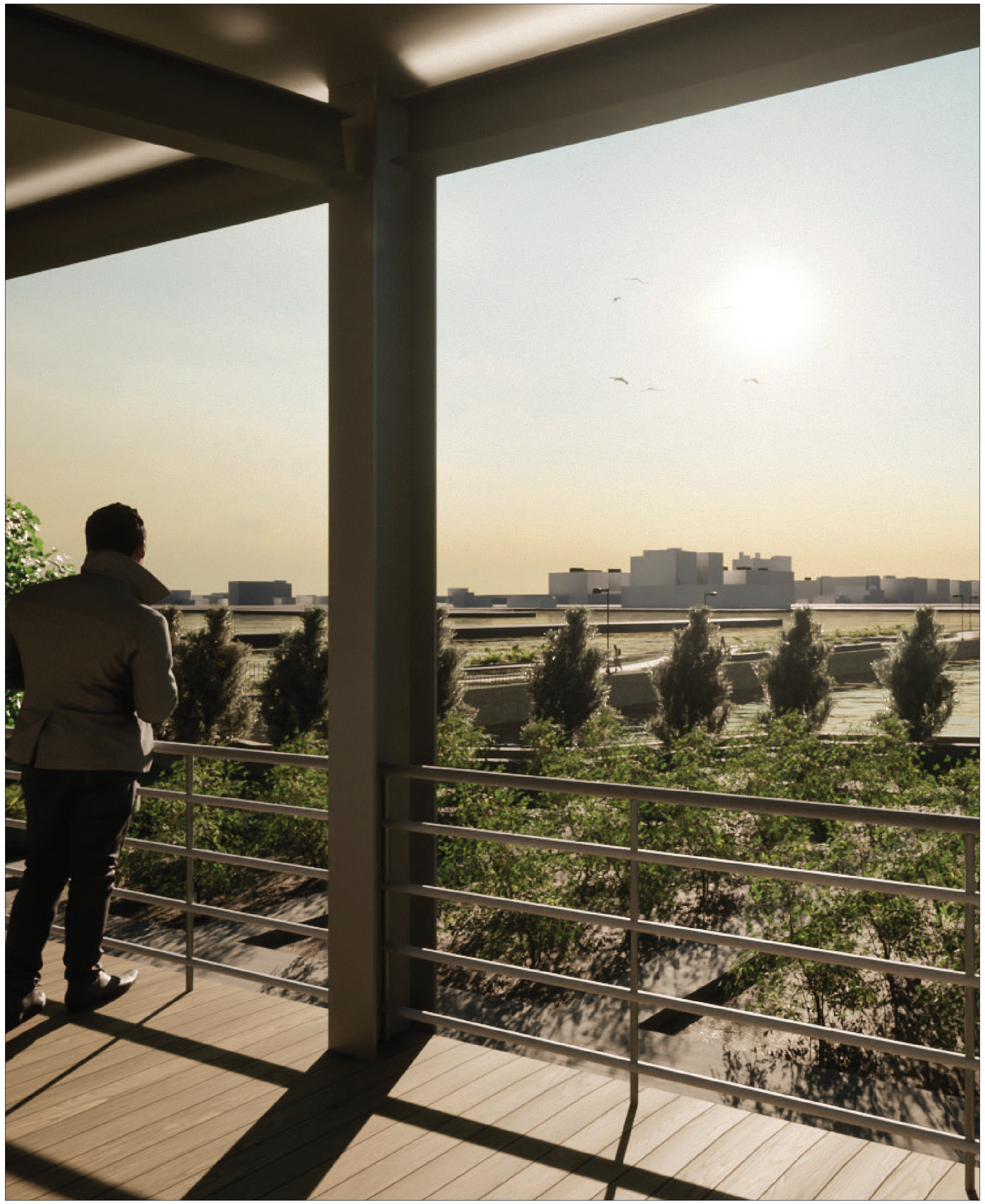


Figure 106. Human Eye view from the Elevated Structure towards the Pier, showing the Vegetation Belt and the Raised Bed for the agricultural products.

Figure 107. The space between New Buildings, showing the pedestrian and bicycle movement.

Figure 108. The Upper Greenhouse, showing the Hydroponic Beds and the sproouts belonging to Rain Harvest System.

Figure 109. The proposed Hydroponic Greenhouse.

Figure 110. Interior of one of the Silos with a proposed spiral staircase reaching wall mount Hydroponic Beds dedicated to research programs.

4.4 CONCLUSION

As it has been mentioned during different stages, this thesis tried to argue the possible adaptation of the CSA model (community-supported agriculture) within a dense urban scheme considering various environmental and social elements while proposing any sort of design hosting the mentioned practical model.

This paper also tried to integrate theory-based architecture and landscape design strategies throughout the concept development. By integrating landscape theories like Landscape Iconography (a symbolic representation of the surrounding architecture and landscape elements) and Temporal Perception (dynamic landscape elements being perceived through time), new literature has been defined which can be a starting point for any industrial revitalization and its future use as a host for large-scale urban agriculture projects.

Another important target was to execute a multi-criteria strategical design process while maintaining the aesthetical values. The first chapter explains the history of urbanization and agriculture on three different scales. It starts with New York City and then the borough of Brooklyn and finally the district of Redhook where the site of development is located. The analysis of the site is done in two phases; the social, environmental, and economic aspects of the site are evaluated in the first part of the second chapter, and the latter section talks more about the morphological and contextual characteristics of the site.

Most recent urban agriculture innovations and novelties are explicated in the third chapter along with sustainable development goals that have been considered in this project. At the end of this chapter, all the strategies are shown in various tables to be considered in the final concept.

All these consequent strategies are being used in the last chapter to come up with the final masterplan where its components are explained through a variety of design diagrams drafted architectural drawings and three-dimensional representations.

In a nutshell, what we can conclude is that consideration of social, environmental, and economic aspects is not an optional thing anymore but a necessity for future development of any sort of project. But at the same time, aesthetics is something that can't be taken away from designers. Creating a balance between these two factors by integrating both classical architectural and landscape theories and modern strategical approaches leads to outcomes that satisfy all the relative stakeholders.

CHAPTER 5

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Thesis Project

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