ABSTRACT

Title of Thesis:	CAYLER POINT THE REVITILIZATION OF BROWNFIELDS
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Our planet is becoming increasingly urbanized, with roughly half of the human population residing in urban areas. Equipped with infrastructure, public facilities, and sufficient job markets; urban areas attract migrants from all over the world. With such large populations that are continuously growing, the housing supply and infrastructure of urban areas cannot support its population. In an effort to create more housing, many urban areas continue to develop in ways that affect the social and physical well-being of human beings and the environment.

This thesis explores how the redevelopment of brownfields can provide a more sustainable solution for housing production in urban areas and demonstrates how these residential developments can be constructed and designed in a way that will benefit both the environment and residents of a community.

Through the use of a waterfront site located in the Greenpoint neighborhood of Brooklyn, this thesis demonstrates through design sustainable construction and

building practices, housing that will help meet the needs of the community through a mix of affordability rates, and inclusive design strategies that will help reduce segregation in urban areas.

CAYLER POINT:
THE REVITILIZATION OF BROWNFIELDS

by

Andrew Colin Walker

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Section 1: Introduction to Urban Areas

Chapter 1: Urban Areas

Our planet is becoming increasingly urbanized, with roughly 3 percent of the earth's surface being comprised of urban areas. Urban areas refer to densely populated human settlements that include large metropolitan centers and towns. These towns are characterized by urbanization, a process where humans form dense settlements comprised of buildings, roads, and supporting infrastructure. Fifty-five percent of the earth's population currently resides in urban areas and as the population continues to rise, the extent of urbanization will continue to grow[1].

1.1 Concept of Urbanization

The evolution of urban areas starts with the process of urbanization. As defined by Nsiah-Gyabaah, urbanization occurs when there is a large population immigration from rural areas to an urban society. People immigrate to urban areas primarily because of the large concentration of resources and facilities towns and cities have to offer. This results in a large portion of the population residing in cities and their surrounding suburbs[2].

The process of urbanization started as a result of industrialization. During the industrial revolution, manufacturing hubs developed in cities. With the numerous jobs theses hubs provided, a large proportion of the population immigrated to cities in order to work in

[1] (Johnson and Munshi-South 2017)

[2] ("Urbanization, Urbanization Problems, Solutions to Urbanization Problems" n.d.)

factories (**Figure 1**). This resulted in sharp decline of the agricultural workforce and population in rural areas.

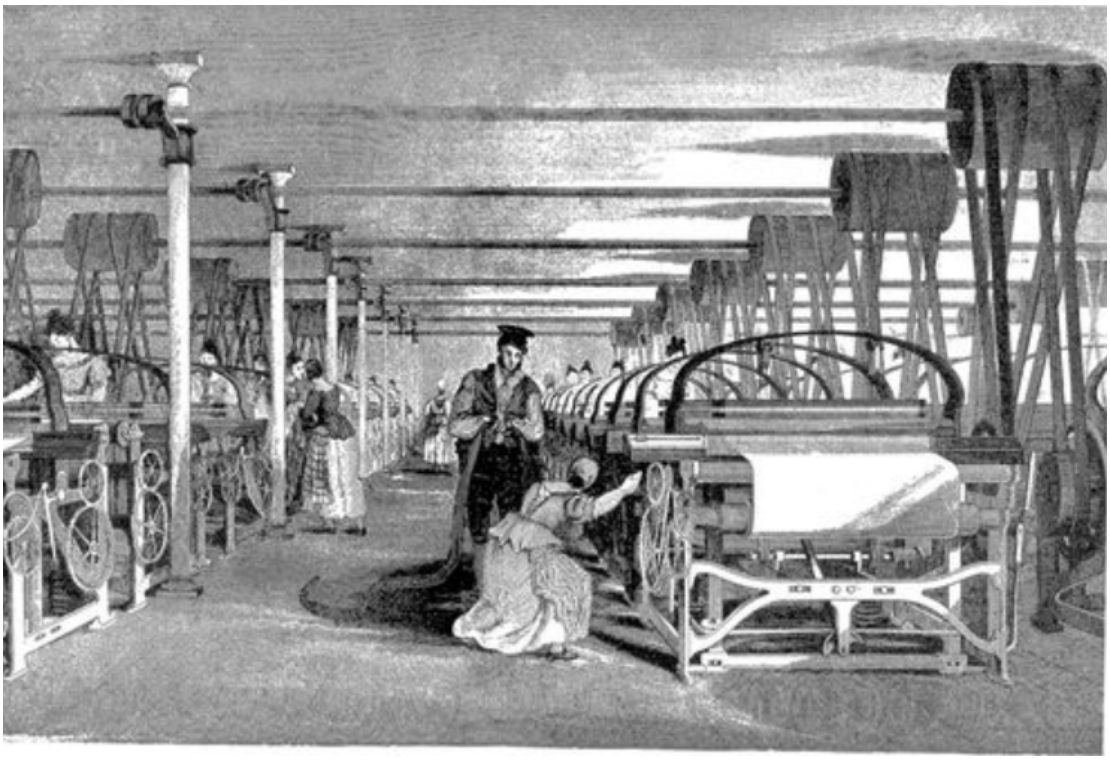

Figure 1: *A Roberts loom in a weaving shed in 1835. Textiles were the leading industry of the Industrial Revolution, and mechanized factories, powered by a central water wheel or steam engine, were the new workplace. (Source: T. Allom)*

1.2 Factors that lead to Urbanization

In Urban areas, there are more economic benefits that can be found than in rural areas. Urban areas provide a higher standard of living than most rural areas. With a large and diverse job market, it is easier to obtain work in a city. Often, these jobs provide higher wages than those found in a rural setting. The large job market and higher wages generally attract many people from rural areas and other countries to migrate to urban areas[3].

Compared to rural areas, urban centers have far superior infrastructure and utilities. These include roads, transportation, water, electricity, and many more. Along with these

[3] ("Urbanization, Urbanization Problems, Solutions to Urbanization Problems" n.d.)

factors, communication is made easier because of better access to internet and surrounding resources. This has shown to be a major factor in migration to urban areas.

Urban cities also offer better public facilities that cannot be found in rural areas. Urban areas provide more access to public facilities such as healthcare and education. Police stations, postal services are also provided to satisfy the needs of the public. Additionally, urban areas have a larger variety of entertainment facilities; including restaurants, clubs, movie theaters, and many others (**Figure 2**). These industry and services also increase and generate higher value jobs, leading to economic growth[4].

***Figure 2**: Broadway in New York City (Source: Shuttershock)*

[4] ("Urbanization, Urbanization Problems, Solutions to Urbanization Problems" n.d.)

1.3 Characteristics of Urban Areas

Urban Area

An urban area refers to a region surrounding a city. Urban areas include the city itself, and the surrounding areas such as suburbs. These areas are very developed, featuring structures such as houses, commercial buildings, roads, bridges, and railways. Most inhabitants of urban areas have jobs in nonagricultural related fields [5].

Locations of Urban Areas

Urban areas or cities emerge all over the world. Each city is unique in terms of their geography, accessibility, and surroundings. However, the specific locations of these cities were not chosen at random. There are many factors that determine the location of cities or large urban areas.

Environment is a critical factor in the formation of cities. Cities typically emerge in favorable environments. Some of the factors that determine a favorable environment include access to a water source and a suitable climate for crops and agriculture.

Accessibility is also another factor that influences the location of a city. Large cities are typically located in areas that are easily accessible for trading. Throughout history, large cities emerged along rivers or other bodies of water because they were easily accessible to ships and other water vessels. During the industrial revolution, the invention of railroads reduced transportation costs. This resulted in large manufacturing hubs emerging along railroads, which led to the migration of people to these areas (*Figure 3*). The invention of the

[5] ("Urbanization, Urbanization Problems, Solutions to Urbanization Problems" n.d.)

automobile also created trading routes via roads and highways, which led to the emersion of cities along these routes, as well [6].

Figure 3*:The Pennsylvania Railroad's Broad Street Station was a large presence on Broad Street near City Hall (background, right), and the train sheds, pictured here in 1882, buzzed with arriving and departing traffic that helped make Pennsylvania an industrial*

Organization of Urban Areas

Urban areas are organized by the use of urban structure. Urban structure refers to the arrangement of public and private spaces in cities, and also their connectivity and accessibility. Urban structure is arranged into four categories; central business districts, industrial areas, residential areas, and open space[7].

A central business district is typically the geographic and commercial heart of the city. It is commonly referred to as downtown. This district is home to the financial district of the city and also contains entertainment and retail (*Figure 4*). Typically, central business

[6] (Boundless n.d.)
[7] (Boundless n.d.)

districts have small resident populations. However, over the last decade younger business and professional workers are relocating to central city apartments located in this district. For residents that do resident in central business districts, they typically reside in mixed-use building typologies. These buildings typically feature commercial functions on the lower levels and transition to residential units on the upper levels.

Figure 4: *Financial District, Manhattan, as viewed from Governors Island (Source: King of Hearts)*

Industrial areas are districts within a city that are zoned excessively for industrial use and development. These areas require a distinct zone of environmental controls specific to the needs of industrial structures and activities. Cities typically zone a portion of the city for industrial uses to reduce the negative social and environmental impacts that they create[8].

Residential districts are for housing residents. These districts can be located in the downtown area of a city or can be located in the suburbs on the outskirts of a city. Typically, these areas accommodate for a wide variety of residential forms. These building forms can range from single-family homes to high rise residential buildings. In large cities, in order to regulate the diversity of housing forms, different residential zoning districts are formed that control the size, height, and density of residential buildings or single-family homes. In

[8] (Boundless n.d.)

addition to housing, residential districts permit most community facilities such as schools, churches, and medical facilities [9].

Urban open spaces are areas that provide recreational, ecological, and aesthetic value to the citizens and city. They can come in numerous forms, from extremely maintained environments to natural areas. These areas can be privately owned, but are commonly open for public use. These areas can provide aesthetic and cultural value for citizens. They are sometimes used for community functions or entertainment in the form of concert venues or art shows (*Figure 5*). Some open spaces also provide functional value, and are utilized to control runoff or for the prevention of flooding in certain areas[10].

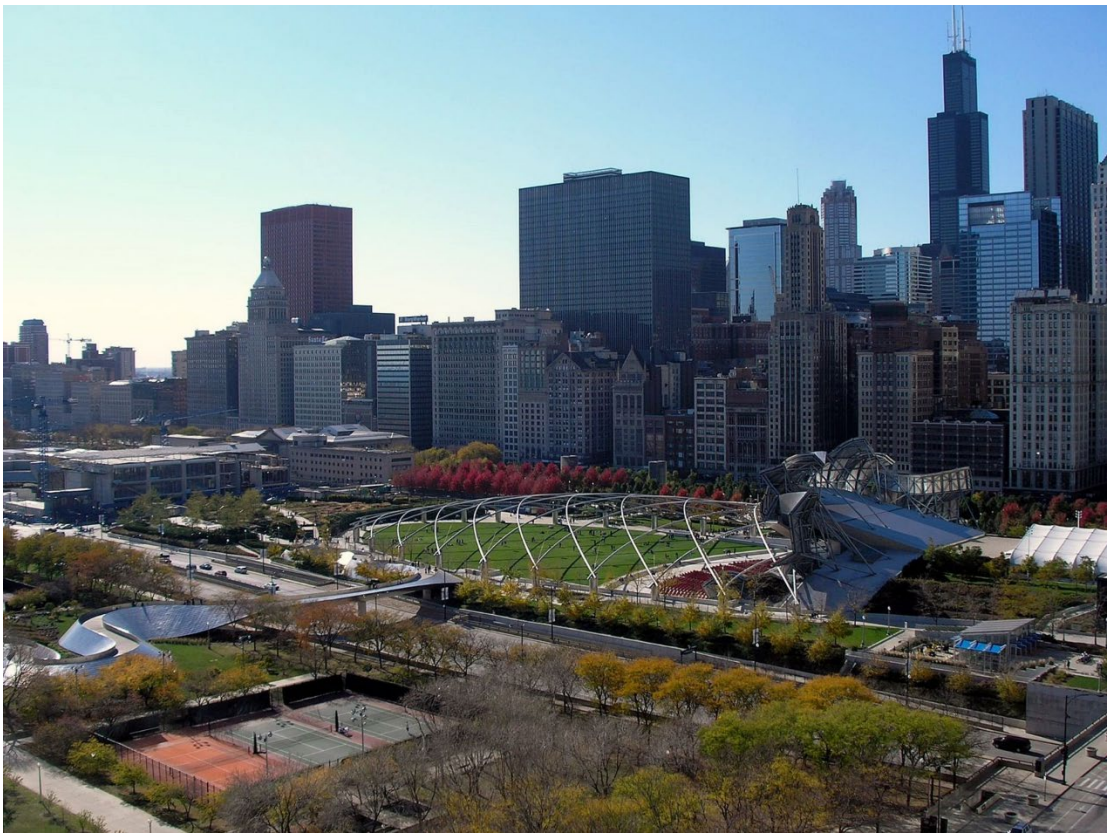

***Figure 5**: Millennium Park seen from 340 on the Park in 2007 (Source: DiscoverWithDima)*

[9] ("Zoning Districts & Tools Residence Districts (R1-R10) - DCP" n.d.)
[10] (Boundless n.d.)

Demographics

Urban areas have a very diverse demographic. There are numerous factors that contribute to the diverse demographic of urban areas. Due to the resources and opportunities urban areas provide, various people from different demographics move to cities.

Internal migration occurs when an individual migrates within their country from one area to another. Typically, these migrations result in an individual moving from a rural area to an urban area. Internal migration accounts for most of the native population or demographic within the urban areas. They are characterized as the middle to upper class and typically live in more developed and higher income areas of the city.

External migrations occur when an individual migrates from one country to another. These migrations can be forced or voluntary depending on the individual and their native country. Typically, external migrations occur when an individual migrates from a less development country to a highly developed country. This type of migration occurs because more developed countries offer more jobs, higher wages, and a better quality of life. Typically, these individuals are living in poverty. Typically, these residents reside in the inner city in less developed, low-income areas, characterized by crime and poverty.

Another portion of the demographic are individuals who are native to specific urban areas. These individuals typically are characterized as the upper class. Due to their continual access to resources and opportunities the city provides, they typically have been able to establish a comfortable financial and living situation. These individuals typically live in the suburban areas surrounding cities [11].

[11] ("Urbanization, Urbanization Problems, Solutions to Urbanization Problems" n.d.)

Neighborhoods

Urban Areas feature many different neighborhoods. These neighborhoods can be located within the downtown area of the city and the surrounding regions as well. The location of these neighborhoods correlates to the demographic and income levels of its residents. The neighborhoods typically fall into two categories; ghettos and affluent areas[12].

Ghettos are neighborhoods that are typically located in central city neighborhoods (*Figure 6*). They are characterized by pockets of deep concentrated poverty. In the United States, these areas are typically dominated by African Americans and non-white demographics. Typically, these areas feature infrastructure that is outdated and neglected. These areas are subject to higher crime rates and have limited access to resources and public facilities[13].

Figure 6*: Chicago ghetto on the South Side, May 1974(Source: John H. White)*

[12] Adelman, Robert, and Mele, Christopher, eds. *Race, Space, and Exclusion : Segregation and Beyond in Metropolitan America,* chap. 3.
[13] Adelman, Robert, and Mele, Christopher, eds. *Race, Space, and Exclusion : Segregation and Beyond in Metropolitan America,* chap. 2.

Affluent areas are neighborhoods that are the opposite of ghettos. They are characterized by power, affluence, and status. They have a dominant demographic of white Americans. These areas have great access to neighborhood resources and economic opportunities, putting them at a significant advantage. These areas are typically located in suburban areas surrounding cities (*Figure 7*), or in a highly-developed area within the city[14].

Figure 7*: Suburban development in a northeastern section of Colorado Springs, Colorado, looking largely eastward. The four-lane highway is Charlotte Parkway; Anna Lee Way joins it at the top center and Jackpot Drive at the far left. At the bottom center is Nature Trail; the coordinates are for the spot midway between the two cul-de-sacs, Malachite Court and Ophir Court. (Source: David Shankbone)*

[14] Adelman, Robert, and Mele, Christopher, eds. *Race, Space, and Exclusion : Segregation and Beyond in Metropolitan America,* chap. 2.

Section 2: Problems Associated with Urban Areas

Chapter 2: Housing

2.1 Popularity of Urban Areas

According to the United Nations' population projections, the world's population is expected to increase by 2.9 billion in the next three decades. With the migration towards cities expected to continue, almost 90 percent of people are expected to live in cities by the year 2100.

The transition from an industrial economy to a service-led economy has had many implications for the city. Outdated industrial zones are now becoming the focus of various strategies to foster the development of service, tourism, knowledge, and creative economies. Many of these industrial zones are being renovated and are being supported by a wave of investment in infrastructure, and cultural and recreational amenities. This has resulted in the increased popularity of these areas, drawing investment, jobs, and housing.

Cities are now attracting a new generation of city dwellers. Former suburban residents have now rediscovered the appeal of urban lifestyles and city living. Many businesses and industrial investors have also shifted their focus to urban areas, as well. Impacted by the rise of a shared economy and demand for flexibility, many cities are experiencing a rise in the proportion of renters as opposed to buyers[15].

Cities are not only attracting investors and former suburban residents, but they are also attracting migrants from all around the world. As a result, the urban demographics are changing rapidly. People migrating to cities come from numerous races and age groups. This has diversified not only the racial demographics but also the generations that are residing in

[15] (*Hot Property, The Housing Market in Major Cities* 2019)

cities, as well. Previously, families would leave cities when they had children, but now more families are staying in cities, with older people also remaining in cities post-retirement[16].

2.2 Change in Housing Demands

From the 1950s to 2000s, baby boomers dominated the market for new homes. With large household sizes, many of the homes built were situated on large lots, were large enough to meet the needs of a growing family, and were affordable. Now, in the present day, household sizes have significantly shrunk; going from 3.38 persons per household to just 2.59 today. With smaller household sizes and a more racially and ethnically diverse population, future generations seek a different form of housing. The demand for the next generation of households will be catered to more racial and ethnically diverse demographics, less-income producing inhabitants, and smaller household size. The demand for large homes on large lots is over. The future of American public policy will be geared to meeting the needs of households without children; yet our planning, zoning, and development codes remain rooted in a reality that is catered to a mass family and child-oriented market[17].

2.3 Housing Supply

The housing market is determined by the law of supply and demand. This law dictates the equilibrium price of a specific property. When there is a high demand for housing in a particular market combined with a low supply, the housing prices rise. As more buyers enter a specific market, the demand for housing increases and the supply decreases. If there remains a deficit in the housing supply inventory, then the

[16] (*Hot Property, The Housing Market in Major Cities* 2019)
[17] (De Souza Briggs 2005)

housing prices surge upwards, making them unaffordable to the lower and middle class. This in turn results in what is known as a housing shortage[18].

2.4 Housing Affordability

As the population of urban areas grows, primarily in large cities, there is a dramatic increase in the demand for housing. With large inflows of people, a mismatch between the demand for housing and supply for housing is created. Construction of housing units is not efficient or fast enough to satisfy the housing demand to accommodate the inflow of people. When this occurs, housing prices and the overall cost of living increases very rapidly. This not only leads to financial market risks, but also to a housing affordability crisis that drives the working class out of major cities.

Research conducted by Morgan Stanley Capital International found that only 4 out of the 97 countries analyzed, had affordable rental real estate that covered at least 50 percent of its urban population. Also, only six of these countries provided affordable mortgage conditions for middle-income populations. This unaffordable bubble for median income residents, which is estimated to be over 50 million by the end of 2020, could potentially be excluded from affordable options within some of the world's largest cities. In many of these large cities, high rental rates and housing prices means that younger people will not be able to save enough money to put down on the deposit required to qualify for a mortgage and purchase a property, leading to the rise of generational rent[19].

[18] (Hall 2020)
[19] (*Hot Property, The Housing Market in Major Cities* 2019)

Factors that influence Housing Affordability

Cause	Global	Europe	National	City
Global capital flows and investment into local cities	x	x		
Mobility and migration to cities	x	x	x	
Megatrends i.e. demographics and disruptive technology	x	x		x
Social preferences and change i.e urban vs. suburban lifestyle	x		x	x
Limited land supply			x	x
Housing shortage and demand			x	x
Commodity prices i.e. Construction material and labour costs	x		x	
Regulation				
• Planning and land use			x	x
• Building		x	x	
• Environmental		x	x	
• Tax and subsidies			x	
• Monetary and mortgage			x	x
• Private rental market				x

***Figure 8**: Multi-layered geographic causes of housing affordability. Note: x symbolizes the geographical level that creates the cause for housing unaffordability. (Source: ULI 2018)*

Increased Investment in Real Estate

Global capital and foreign real estate investment into cities is more focused on the investment in the residential market. This focus on the residential market is because investors are recognizing the benefits as a means to diversify their portfolios and focus on income returns. This growing focus puts a significant amount of pressure on housing prices and affordability. Recent research conducted by INREV shows that in the global market, real estate accounts for 8.9 percent of institutional investors' total assets, with half of these investors expecting their allocations to real estate to increase over the next two years. With more capital seeking real estate to invest in, real estate prices are pressured to rise[20].

[20] (*Hot Property, The Housing Market in Major Cities* 2019)

Limited Land Supply

In many urban areas, land for new development is in a limited supply. Many cities in the United States have very strict zoning, city development plans, and development laws. These various zoning plans and laws limit the land that can be developed on and make it difficult to seek any changes to zoning and public approval. In Europe, in order to prevent further urban sprawl and develop within the urban core of a city, new housing is created through large, complex urban regeneration projects. These developments require actors, large amounts of capital and a combination of infrastructure and real estate development. As a result, these development projects take a long time from conception to delivery.

Rising Costs

The cost for new development is significantly rising in urban areas around the globe.. The development costs are increasing because of a combination of strong demand and increasing land value. In addition to the rising land values, construction costs are largely determined by market forces including a gradually shrinking labor force, rising material and resource costs, and the market expectation of low-density housing. All of these factors play a role in the price of housing and what the population can afford to rent or buy.

Regulation

In order to accommodate for changing demand created by demographic shifts, requires new types of housing. These new types of housing include flexible micro-living spaces, affordable housing with more square footage for growing households, and housing tailored to the needs of the elderly. In most cases, the current regulations set by cities do not permit new and innovative housing typologies or significantly slow down the process of

developing these housing typologies. These regulations slow down the rates of new construction, the delivery of new housing stock, and raise the prices for new units[21].

[21] (*Hot Property, The Housing Market in Major Cities* 2019)

Chapter 3: Environmental Impact

3.1 Introduction

Urban areas account for about 3 percent of the earth's surface, however the environmental implications these urban areas have on the planet stretch far beyond their urban boundaries. With a strong concentration of pollution, industry, and energy use commonly found and used in urban areas; massive pollution and environmental degradation occur. Through emissions, consumption, and human activities, the ecological footprint of cities have an enormous impact on the surrounding rural, regional, and global ecosystems.

Urban areas have extremely high environmental impacts on our planet. These impacts can be felt on a local and global scale. The negative impacts urban areas have had on our planet have created many environmental challenges such as climate change, resource use, and protection of the natural environment. The human race must address these environmental challenges so that we can preserve our planet for future generations.[22]

3.2 Pollution and Resources

Environmental Problems in Urban Areas

The environmental problems that occur in urban areas continue to grow. These problems are the direct result of an excessive burden on the environment and its ability to clean itself. Some of the problems that these urban areas are facing include inadequate water supply, wastewater, solid waste, energy, loss of green and natural surfaces, urban sprawl, and pollution of the air and soil. Cities continue to consume increasing amounts of natural

[22] (Ksenija 2016)

resources, produce more waste, and emit harmful substances into the air, which all have a significant impact on both the regional and global environment.

Air Pollution

Air pollution is one of the main problems most large urban areas face. Air pollution is caused by the burning of fossil fuels. Fossil fuels are used for the production and consumption of a vast amount of energy used for traffic, industrial activities, and building climate control. The burning of fossil fuels results in the emission of dangerous chemicals into the air such as ground-level ozone, particular matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide[23] (*Figure 9*). When these dangerous pollutants are emitted into the air, it causes heat to be trapped in the earth's atmosphere. This heat causes global temperatures to rise and plays a large role in global warming and climate change[24]. It is estimated that on average, one million premature deaths are caused by air pollution[25].

Figure 9*: Shanghai at sunset, as seen from the observation deck of the Jin Mao Tower. The sun has not actually dropped below the horizon yet, rather it has reached the smog line. (Source: Suicup)*

[23] (Nunez 2019)
[24] ("Effects of Car Pollutants on the Environment" 2017)
[25] (Ksenija 2016)

Water

The effects urban areas have had on the hydrology cycle is profound. Humans are using water and for different purposes and return the water to the cycle contaminated. Developed areas use artificial impervious surfaces that reduce water surface supplies and do not allow for infiltration. These surfaces increase surface flow, permeability, and erosion and reduce evaporation as well.

Urbanization has resulted in many negative effects on the water quality and supply in urban areas. The effects that urbanization can have on the water can change result in a change in its hydrology, quality, availability, and aquatic habitats. The water consumption of the population and surrounding industries has caused the quality of ground and river water to deteriorate. Industrial activity and waste disposal lead to water pollution and contamination of a proportion of the city's and the surrounding area's water supply (*Figure 10*). The contamination and deterioration of bodies of water have also had many impacts on aquatic life and the surrounding ecosystem[26].

***Figure 10**: Pollution in the Lachine Canal, in Montreal (Source: Aarchiba)*

[26] (Ksenija 2016)

Energy Consumption and Waste Management

Cities are centers of consumption and require large inputs of energy, water, food, and a variety of raw materials. This consumption results in large quantities of goods which leads to waste production. These factors contribute to a large loss of the natural surrounding resources and energy. Urban areas are characterized by extremely high energy consumption and waste accumulation. Both of these characteristics are indicative of a degraded landscape which adversely affects the quality of water and the air.

Climate

In urban areas, the development of infrastructure is dense and plentiful. When development occurs, natural vegetation and soil it is replaced with heat-absorbing materials. These materials absorb and re-radiate heat and emissions of artificial heat from developed areas creating a phenomenon known as the Heat Island Effect (*Figure 11*). The heat island effect is caused by the absorption and release of heat in dark colored surfaces such as roofs and roads. This is common in urban areas because of the abundance of roads and dark surfaces and lack of sufficient trees and vegetation to offset these temperatures. The soaring temperatures in these urban areas intensify air pollution by creating smog; a dangerous air pollutant that damages the human respiratory and cardiovascular systems[27]. This results in the temperatures of cities to be higher than in rural areas[28].

[27] (Rasheed 2020)
[28] (Ksenija 2016)

***Figure 11**: What is an Urban Heat Island? (Source: American Forests)*

Ecological footprints

Urban areas are the center for consumption, greenhouse gas production, waste, and emissions of pollutants in water and air. The size, rate, and connections of modern metropolitan areas are all factors that have negative environmental implications on the environment on a global scale. In order to measure these effects, ecological footprints are used.

Ecological footprints of urban areas are defined as the total amount of land needed in order to maintain a city's current activities and waste removal (*Figure 12*). Ecological footprints of cities have expanded over increasingly large areas and have resulted in the creation of rural continuum of communities. In cities like New York and Tokyo, the ecological footprint is significantly larger than the city's actual size. This has resulted in negative environmental effects such as acid rain, smog, and the reduction of the ozone layer[29].

[29] (Ksenija 2016)

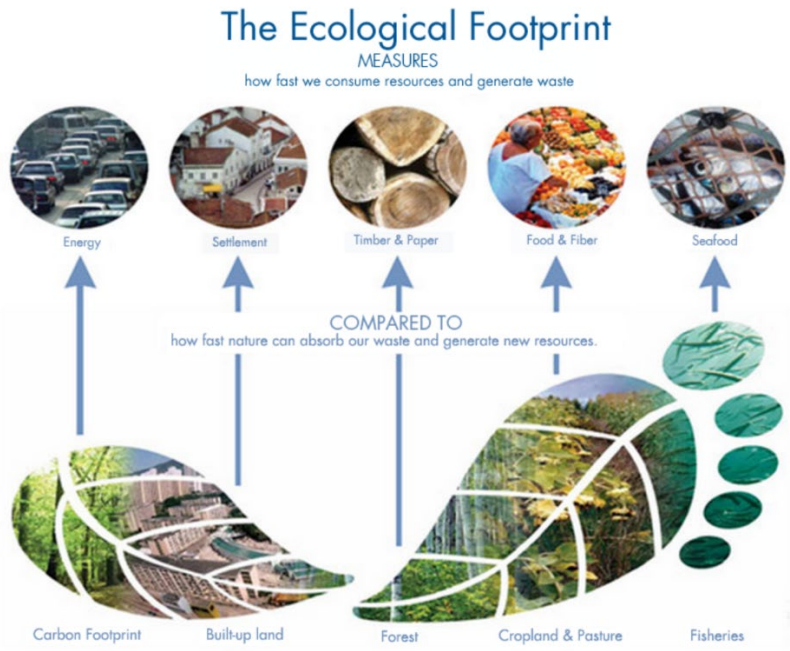

***Figure 12**: The Ecological Footprint (Source: Global Footprint Network)*

Developing Countries

In developing countries, population growth is increasing so quickly that these countries cannot provide adequate infrastructure and services to all of their residents. As a result, a large majority of these country's populations live in poverty. This portion of the population is subject to insufficient water supply, waste accumulation, and unhygienic conditions that could result in death or illness. These developing countries are also faced with severe air pollution resulting from rapid industrialization and increased automobile use.

Developed Countries

In developed countries, urban populations have some of the highest rates of per capita resource consumption in the world. On average, a city in the US with 650,000 inhabitants uses consumes approximately 30,00km, while a less developed country consumes about 2,800 km2. Along with resource consumption, the urban population of developed countries produces six times more waste than urban residents in developing countries.

However, as developing countries accumulate more wealth, their levels of consumption and waste production rise. As a result, they rapidly and significantly contribute to global resource depletion and climate change[30].

Human Activity

In urban areas of both developing and developed countries, policies and technologies have been adopted to improve their local environmental problems. However, growing recognition has indicated that human activities have also caused significant environmental impacts at the global level. Human activity in urban areas in the world accounts for a disproportionate share of resources than rural areas, 75 percent of global energy consumption, 80 percent of greenhouse gas emissions, and 78 percent of carbon emissions.

Human activity has also influenced the quality of water resources. Urban wastewater which is collected on impervious surfaces collects waste, chemicals, residues, pesticides, and biocides. This contaminated water then will pass through the surface and become groundwater which is absorbed into the soil, which containments the soil. Freshwater resources located in urban areas are also threatened by waste from transport, tourism, and military activities.

The soil is also affected by human activity. Through the use of chemicals and mechanization for agricultural purposes and the soil's exposure to polluted air and precipitation, the soil is being contaminated. Land development also is affecting soil quality. The replacement of soil for hard impervious surfaces not reduces the amount of natural vegetation in urban areas and directly affects the natural ecosystem within cities[31].

[30] (Ksenija 2016)
[31] (Ksenija 2016)

3.3 Land Use

Urban settlements all share a common problem; irregular and unsound development. Developments should be planned and developed where the economy and ecology of the area is of equal importance. However, development in the present day is driven by economics at the expense of the surrounding environment and ecology. Urban growth in recent years has been increasing in order to support the growing population. This urban growth leads to a disappearance of a very limited number of natural resources, damage to agricultural land, and unsound urban areas.

Urbanization gained momentum as the industrial revolution started to boom. As large factories and complexes began to open and provide jobs, people moved from rural to urban areas. This created a large concentration of the population in a singular location and led to large scale development in the area due to an increase in residents and financial resources. As development continued to occur along with a continuous population increase, the city rapidly began to change and transform. This development has continued to the present day and as cities develop new living spaces and areas of use to meet the demand of the growing population. This continual development has upset the ecological balance and has attributed to the process of rapid degeneration of natural resources. This process of degeneration has seriously altered the ecosystem's ability to function due to new development.

Ecosystems since the industrial revolution have constantly been rearranged or destroyed in order to make space for urban-industrial societies. These societies rely on the use of nonrenewable energy sources and resources from the surrounding environment for their day-to-day existence. The continual use of these resources and energy sources will continue to degenerate the ecosystem. This degeneration process is one that can not be reversed. It is

impossible to make up for or replace the natural resources that have been destroyed due to urbanization and new development[32].

3.4 Wildlife

Animal and vegetation populations in urban areas face many obstacles that deteriorate their health and supply. These populations are exposed to many different toxic substances and pollutants through run off water. Impermeable surfaces located in urban areas do not allow water to flow through them and cause the water to collect harmful toxins that are then exposed to vegetation and wildlife. Development also threatens animal and vegetation populations. New development replaces areas that were once thriving ecosystems for wildlife and vegetation[33].

[32] (Esra 2013)
[33] (*National Geographic* 2009)

Chapter 4: Segregation

4.1 Segregation

In large urban areas, segregation is a common occurrence. Segregation refers to the separation of blacks from whites in residential neighborhoods, workplaces, and in public spaces and places. Segregation has been occurring in the United States for many decades and manifests a series of issues[34].

A common form of segregation is residential segregation. Residential segregation is the separation of two or more racial or ethnic groups into different neighborhoods. This type of segregation typically results in a disproportionate separation of wealth and resources that puts one side at a significant disadvantage.

Residential segregation occurs because of class-based and social factors such as income, education, and generational wealth. This type of segregation results in the creation of different neighborhoods; ghettos and affluent areas.

Ghettos are pockets of deep concentrated poverty. These neighborhoods are typically located in central city neighborhoods. They are dominated by African Americans and non-white demographics and have limited access to education and essential resources. People who live in these neighborhoods are more vulnerable to economic and social disparities because of their limited access to economic opportunities and neighborhood resources. These areas are characterized by high crime rates and low poverty.

Affluent areas are neighborhoods that are the opposite of ghettos. They are characterized by power, affluence, and status. They have a dominant demographic of white Americans. These areas have great access to neighborhood resources and economic opportunities, putting them at a significant advantage.

[34] (Adelman and Mele 2014)

Residential segregation is the result of many factors. One of the most significant factors is spatial assimilation. As one experiences an increase in socioeconomic standings, this commonly results in a move from the city to the suburbs. As most of the white families relocated from the city to the suburbs, industries and business followed, leaving behind the African Americans in the city. Most of these African Americans lost their jobs that had brought them to the city in the first place, which increased poverty and crime rates in the inner-city areas[35].

4.2 Gentrification

Another form of segregation occurs with the revitalization and new development within the city; known as gentrification. Gentrification is the process of transforming a poor urban area through new development to attract wealthy people. This process improves housing, attracts new business, and results in the influx of wealthy residents and business while displacing the current residents[36].

Gentrification increases attraction from higher income people, business, government, and investors to a certain area. This causes a flurry of redevelopment in both residential and commercial space. Thus redefining the character, identity, and demographic of an area.

Gentrification leads to population migration and displacement. As more affluent people move into this once poor neighborhood, housing prices and the price of living rise. Eventually, the native residents of this area cannot afford their rents and are forced to move out of the neighborhoods in the more low-income areas[37].

Gentrification produces areas known as urban enclaves. These are areas that are pockets of affluence that are surrounded by poor-inner city residential communities. Urban

[35] (Adelman and Mele 2014)
[36] (Harrison and Jacobs 2017)
[37] (Freeman 2005)

enclaves are created when cities deploy urban and social control measures to reclaim urban space in order to create redevelopment sites that are hospitable to investment capital and consumers.

Urban enclaves are most of the time self-contained secure spaces that promote exclusivity. They revolve around destination focused purposes intended to attract certain social groups. Typically, these enclaves have distinct boundaries and limited access. These are intended to separate the surrounding impoverished areas and contribute to a sense of privilege and exclusivity that appeals to visitors and developers. Much of the space that appears to the public is owned by private, public, or private-public entities who have hired security and surveillance in order to control how and who uses this space. These urban enclaves distill in visitors and the more privileged that the city outside is undeveloped, poor, and threatening[38].

[38] (Adelman and Mele 2014)

Section 3: Proposed Design Solution/Framework

Chapter 5: Proposed Solution to Housing

5.1 Affordable Housing Developments

What is Affordable Housing?

Affordable Housing refers to housing units that are made affordable to a specific demographic that has an annual income below the median household income. These housing unit are made available to lower-income households and are listed below the normal market value[39]. Typically, this type of housing addresses the housing needs of lower or middle-income households. Affordable housing is a key issue in metropolitan areas because the majority of the population is not able to afford housing at the market value[40].

Who is Eligible for Affordable Housing?

The purpose of affordable housing is to provide housing for the low-income demographic. Typically, for an individual or household to qualify for affordable housing they must make less than 50 percent of the Area Median Income in their specific area[41]. Typically, four groups are in need of affordable housing.

Seniors and People with Disabilities

People age 65 or older, and people who are disabled, account for a large portion of the United States Population. Over the next three decades, the number of seniors and disabled individuals is expected to rise significantly. People that are in this demographic need special living accommodations to survive. These accommodations include close proximity to public

[39] ("Affordable Housing" n.d.)
[40] ("Affordable Housing" n.d.)
[41] ("What Is an Income Limit?" n.d.)

resources and building modifications such as ramps, handicap accessible bathrooms, handrails, and modified cabinetry and closet space.

Students

Students are prevalent in almost every urban area. The number of adult and non-traditional college and university students is growing and has created an increased need for off-campus housing. Adult students with families need private housing in close proximity to their university's campus. International students need housing that is available year-round because it is more convenient and less expensive than frequent international travel on summer breaks and holidays.

Military

Active military staff and personnel are in need of two housing options; on-base and off-base. On-base housing requires construction, management, and maintenance while off-base housing requires additional location assistance, custom construction, and purchase financing methods. Off-base housing also needs to be close to military bases and easy for tenants to move in and out of [42].

Rehabilitation and Re-Entry Programs

Transitional housing is required by a certain demographic of society. This demographic includes the homeless and families, recovering addicts, and individuals that have recently been released from correctional facilities. Adults and children in state protective services and mental health programs also require group homes and neighborhood-based housing[43].

[42] (Finney 2020)
[43] (Finney 2020)

Benefits of Affordable Housing

Affordable housing has many positive effects on residents of urban areas and surrounding communities. Affordable housing improves the quality of life for residents by influencing better health, adequate jobs, financial stability for people earning less income, security, and diversification of the population. People that reside in affordable housing units are given the resources they need to succeed socially, academically, and professionally. These effects are profound and are capable of transforming communities.

Health

Affordable housing has been proven to provide health benefits on people's health and their physical and mental well-being. These benefits include the freeing up of important financial resources for health care and nutrition, residential stability, allowing families to better manage their day-to-day lives, relieving of stress leading to improved mental health, reducing the health risks associated with poor housing quality, increasing hygiene and exposure to disease, promoting social and community well-being, improving financial well-being through home ownership, and increasing the resident's sense of security[44].

Child Development

Children raised in poverty and in poor living conditions leads detrimental problems in their development. A study conducted by Boston College, concluded that poor housing and residential instability are the strongest predictors of behavioral problem in children below the poverty line. Poor housing quality exposes children to are unclean environments, which have

[44] (AD&V 2017)

been proven to cause increased behavioral and emotional problems. Quality Housing is critical for children's health and well-being.

Research conducted by John Hopkins University showed the benefits that raising children in a clean environment and in quality housing has on their development. Paying too much or too little for housing is shown to have negative effects on children's cognitive development. Children living in households that spend close to 30 percent of their annual income on housing are shown to have better intellectual and cognitive abilities than children being raised in households that spend 50 percent or more of their income on housing.

Sustainable Community Development

Affordable housing developments that are well-designed can have a positive impact on the surrounding communities and urban environment. Affordable housing has the potential to instill positivity in its residents, it encourages social connections, reduces overcrowding, increases property values of surrounding lots, attracts new business and jobs, and lowers crime rates.

Designers, developers, housing organizations, and advocates for the community work together in order to create vibrant communities in affordable housing developments. Architects and urban planners have the opportunity and ability to design projects that stimulate and support the physical, mental, and social well-being of the residents and workers in these urban areas and provide innovative solutions to problems that already exist and will occur in the future[45].

[45] (AD&V 2017)

Job Creation

The place and quality of resident's housing influences where they work and the amount of annual income, they take in. Affordable housing development both stimulates the local economy and provides more opportunities for the community. Some of the ways affordable housing development is able to do this is by creating both short- and long-term employment, attracting diverse employers and employees, increases consumer spending, creates tax revenue for both the state and local governments, increases job security through stable housing, creates better transportation options, lowers the risk of foreclosures and evictions, and supports social networks that can be the catalyst for employment opportunities.

In a study done by the New York State Association for Affordable Housing found that in New York alone, affordable housing projects created roughly 330,000 jobs in the state between the year 2011 and 2015. Of the 330,000 jobs that were created, 47,000 of them were long term. Most of these jobs were in the areas of construction, architecture, engineering, property management, maintenance, and retail.

Diversity

Through the creation of affordable housing development, communities are created that bring together people of different educational, professional, cultural, and socio-economic backgrounds; thus, promoting diversity. It has been shown that in diverse communities that increase the exposure and interaction between people of different ethnic and socio-economic backgrounds have a reduction in the amount of both racial tension and discrimination. It also increases the amount of cultural sensitivity, fairness, and tolerance as well[46].

[46] (AD&V 2017)

How Affordable Housing Can Help Mend the Housing Crisis

With the demand for housing rising rapidly in urban areas, the price to obtain housing is becoming increasingly unaffordable to the majority of the population. The Harvard University Joint Center for Housing Studies and Enterprise Community Partners has estimated that the number of households that spend 50 percent or more of their annual income on housing will increase from 11.8 million in 2015 to 13.1 million by 2025. This means that the demand for affordable housing will rise significantly.

With the various positive impacts affordable housing developments have on communities listed above, more affordable housing development will also help lower the price of housing in the residential real estate market. However, many urban areas are hesitant to provide more affordable housing developments. This is due to financial and zoning reasons, and also from community disapproval as well.

5.2 Relax Zoning and Developing Rules

Zoning regulations often provide many obstacles in the development of multifamily buildings and affordable housing. Zoning restrictions often limit the size, density, and height of most buildings. Due to these restrictions, multifamily developers tend to provide the least amount of affordable housing required or none at all[47].

In Austin, Texas, a newly implemented program was created by the Austin City Council that waives specific zoning rules, such as height and density restrictions, and minimum parking requirements. With these rules waived, developers can now take advantage of 50 percent density, previously 35, for mixed-income projects for rent or sale. Developers will now be able to build larger developments that include larger and denser developments. With the ability to construct larger developments, developers will be more inclined to provide

[47] (Sukumaran 2019)

affordable units because they can increase the amount of market rate units in order to make the dwelling as cost efficient as possible.

The waiving of these zoning rules also will give significant advantages for low-income housing developers, as well. These new rules will help reduce the need for these developers to hire lawyers and reduce the long approval process by the city council. Low-income housing developers can now include more affordable units onto lots than they were previously allowed; granting them 75 percent density. This means more affordable units, and less demand in the residential real estate market.

Other cities in the United States are also adopting new zoning and development rules. In Charlotte, North Carolina, the City Chamber is pushing for a faster zoning permitting process, easing building restrictions, and allowing for more developers to build without going through long, costly rezoning processes. New Orleans City Council is adopting new zoning strategies that would give developers incentives to provide low-income housing in their projects. The city recently approved a new rule which allows residential developers to build on smaller lots if they provide space for low-income housing units[48].

How these Policies Would Help

If large urban areas would adopt new zoning and development rules that allowed for less restriction in density, lot coverage, and height than larger developments would be able to occur. These developments could require or incentivize with additional density a certain percentage of affordable units. Also, urban areas and cities could expand their affordable housing districts and require the inclusion of affordable units on development of smaller lots.

[48] (Sukumaran 2019)

5.3 Incentives and Tax Breaks

Tax Breaks

State incentives issue credit for developers for the acquisition, rehabilitation, and construction of affordable housing developments. These incentive programs encourage private developers to increase the amount of affordable housing in their developments. This can result in economic developments in urban areas and centers[49].

In St. Paul, Minnesota, the city recently approved tax breaks in order to get landlords to preserve affordable housing units. This program requires landlords to make at least one fifth of a building's units affordable to lower-income tenants for 10 years and in return, they receive a 40 percent property tax break. These affordable units are reserved for households making 60 percent or less of the median income[50].

Low-Income Housing Tax Credits

Low-Income Housing Tax Credits (LIHTC) are credits that give real estate developers and investors incentives to build or renovate buildings in order to increase the amount of affordable housing units for low-income Americans in return for tax deductions. This process of allocating taxes with the LIHTC is guided by federal regulation, uses federal dollars, and is state controlled.

LIHTC works by taking federal government money given to each state, and gives the tax credit money to developers according to a plan developed by the state. In return for the tax credit money, developers agree to construct affordable housing developments. Developers

[49] (Sukumaran 2019)
[50] (Walsh 2019)

then sell these credits to investors to raise the money for construction. LIHTC can account for as much as 70 percent of the project funding[51].

Land Incentives

Land incentives are when land is gifted to a developer to develop a specific development. This can be a useful method to ensure the production of affordable housing Units. An example of a land incentive occurred in Anaheim, California. In this agreement, the city gave a vacant site valued at roughly $10 million to a non profit developer called Jamboree Housing. The city gifted the site to the developer as part of an agreement to create a $52 million 102-unit affordable housing development on the land[52] (*Figure 13*).

***Figure 13**: Rendering of Jamboree Housing's 102-unit affordable housing project in Anaheim. (Source: City of Anaheim)*

[51] (Murray n.d.)
[52] (Pimentel 2019)

5.4 Neighborhood Revitalization

Neighborhood revitalization motivates change and stimulates the socioeconomic characteristic of communities. Neighborhoods and land that is under utilized or run down should be developed or renovated to meet the needs of the surrounding community. Instead of revitalizing a neighborhood with high end retail, business, and housing, these neighborhoods should be developed in a way that helps the local economic community and provides needed affordable housing options for the current residents.

In Philadelphia, a nonprofit organization called Esperanza, renovated the abandoned Roberto Clemente Middle School into a 38-unit affordable housing development (*Figure 14*). This renovation will provide housing for members of the local Latino community. This project was just one part of Esperanza's neighborhood revitalization plan which focuses on education, arts and culture, community economic development, and social change for the Latino population in this community [53].

***Figure 14**: A juxtaposition of Roberto Clemente Homes (bottom right) and the condition of the former school. (Source: Esperanza)*

[53] (Sukumaran 2019a)

5.5 Reduce Exemptions from Inclusionary Zoning Laws

Many municipalities have laws requiring a certain number of units in a new development to be affordable. However, some buildings are granted an exemption from the inclusion of affordable housing. Some of the buildings or developments that are granted an exemption from including affordable units are buildings with fewer than 10 residential units, certain neighborhoods with historic designations, and other building restrictions. Tightening of these affordable housing exemptions must be made. Certain buildings or new developments should have a requirement to provide a certain percentage of affordable units no matter the size or neighborhood it is located in. The period that affordable units remain affordable should be extended or they should remain affordable throughout the building's life.

Chapter 6: Proposed Solutions to Environmental Impact

As hot spots of production, consumption, and waste generation, cities are the main source for environmental issues such as global warming, air pollution, and water contamination. However, cities also possess the potential to come up with solutions to mitigate their harmful effects on the environment. Finding solutions and best practices to reduce the ecological footprint of urban areas is imperative. This can be done through the installation of urban green spaces, green building and construction practices, and better waste management practices.

6.1 Installation of Urban Green Spaces

The spread of a new urban green ecosystem provides many advantages and potential solutions to the environmental problems urban areas face. Cities must move towards greener urban systems within their boundaries to improve the quality of life for their residents and surrounding areas. By committing to the innovation of urban green spaces, cities will begin to mitigate the harmful effects and experience the benefits of installing green spaces have on the environment and the well-being of their inhabitants. These benefits are detailed below [54].

Biodiversity

Creating new green spaces directly contributes to the creation of new layers of biodiversity. The presence of various plants and other vegetation creates a habitat and food source for different species, thus creating different wildlife corridors (Figure 15). These corridors are essential for improving the quality and well-being of life in urban areas today.

[54] ("The 8 Benefits of Spreading Green Spaces in Cities" 2019)

***Figure 15**: Horticulture merges with architecture replacing part of Milan's concrete jungle with a "vertical forest." Bosco Verticale is part of a grand-scale green space eco-project aimed to make everyday life more responsible, sustainable, and Earth-friendly. (Source: Plflcn)*

Pollution Reduction

One of the most prevalent problems in urban areas is increased pollution. Plants that are installed on roofs and line streets and sidewalks can act as filters for some of the most harmful pollutants that contaminate the air. One square meter of green space can retain up to about 200 grams annually of tiny contaminating particles that are harmful to human and environmental health[55] (*Figure 16*).

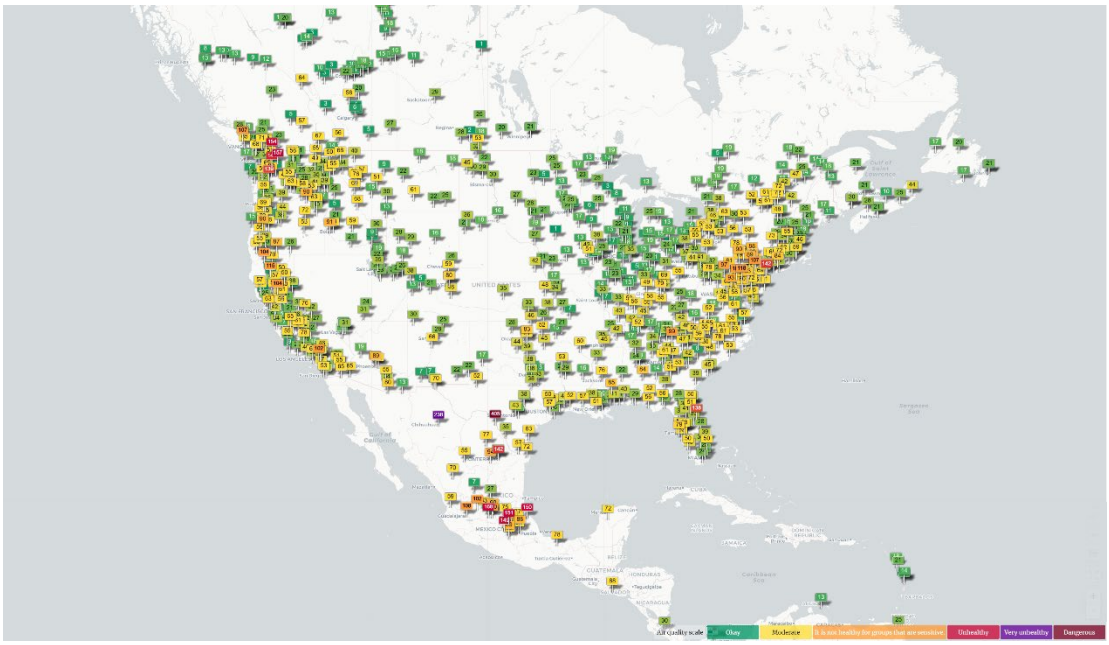

***Figure 16**: World Air Pollution: Real-Time Air Quality Index. (Source: waqi.info)*

City Water Management

Green spaces within urban areas have many benefits regarding water management. Through greenspaces, rainwater can be collected and retained. This can increase humidity inside urban boundaries. Green roofs can also absorb rainwater, reducing runoff that could

[55] ("The 8 Benefits of Spreading Green Spaces in Cities" 2019)

flood urban sewer systems and also prevents the runoff water from collecting harmful toxins from impermeable surfaces.

Mitigates the Effects of Global Warming

In urban areas, the consequences of global warming become prevalent within the urban boundaries. Some of these consequences include increased temperatures, increased number of heavy rainstorms, increased heat waves, and the spread of certain diseases. With the creation of new urban green ecosystems, these consequences can be mitigated and can have a positive effect on the health and welfare of a city's residents.

Improvement of Thermal Insulation

The installation of green roofs on commercial buildings and private homes provides these structures with increased thermal insulation. This results in cooler temperatures in the warm summer months and warmer temperatures in the cold winter months. This in turn reduces the consumption of energy used for seasonal heating. In the summer months, the energy consumption is reduced by 25 percent and in the winter months energy consumption is reduced by 10 percent.

Climatic and Acoustic Comfort

In urban areas, green space can reduce the conditions caused by the heat island effect due to increased hard scape, cars, and light. The presence of green spaces in urban areas and on building surfaces can help lover the city's temperatures by about one degree [56] (*Figure 17*).

[56] ("The 8 Benefits of Spreading Green Spaces in Cities" 2019)

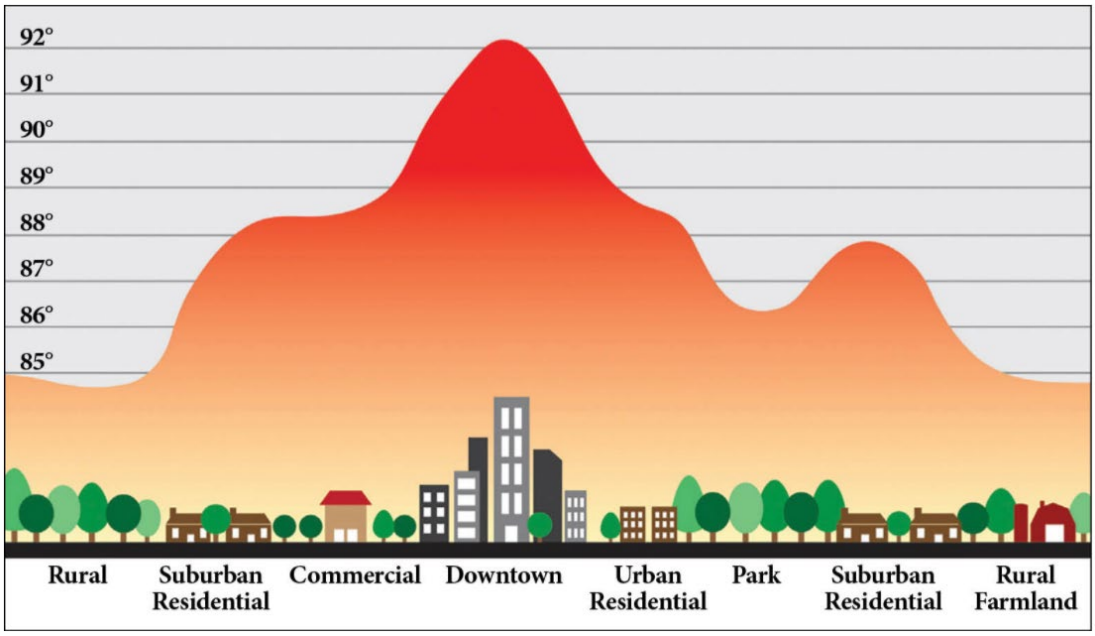

***Figure 17**: On a sunny summer afternoon, city air can be several degrees warmer than in nearby rural areas. Higher temperatures of these resulting urban heat islands force air conditioners to work harder, and also accelerate the formation of smog, contributing to worse air quality. (Source: Leslie Stewart)*

Improvement in Quality of Life

Green space's presence within the urban environment helps foster the connection between humans and the environment and leads to increased well-beings of its residents. Many studies have indicated that the beneficial effects of the presence of green space in the urban environment leads to reduced stress, decreased respiratory and cardiovascular diseases and alignments, and an increase in concentration[57].

[57] ("The 8 Benefits of Spreading Green Spaces in Cities" 2019)

6.2 Green Building Practices

In many urban areas around the world, green initiatives are gaining momentum. One of the main initiatives being adopted by cities is green building practices. These practices seek to preserve the environmental value of limited resources. If these practices are followed correctly, they can also offer economic benefits as well. Developers, architects, and construction teams are utilizing these practices green building practices that protect the environment and cut down construction costs. These practices are explained below.

Net-Zero Buildings

Buildings whose energy consumption is relatively equal to their energy output are known as net-zero buildings. Many developers and contractors in the present day aim to create buildings under this categorization. The main goal of net-zero buildings is to cut back on carbon emissions, water consumption, and solid waste production that is exported to landfills.

In order for a building to be net-zero, they must look for ways to create renewable energy. This can be done on and off site. Some of the most popular on site energy generation tactics include the use of wind turbines, solar water heating, and photovoltaics systems (*Figure 18*). Off-site energy options include large scale wind farms, solar and geothermal plants, and hydropower facilities[58].

***Figure 18**: Photovoltaic system at the roof of the event center KOM in Altach, Vorarlberg, Austria. (Source: Asurnipal)*

[58] (Matthews 2019)

Climate Resiliency

Climate change is a growing concern for urban areas. With climate change, extreme weather patterns and natural disasters are more prevalent. Incorporating construction measures in order to withstand these extreme weather patterns brought about by climate change is one of the top green initiatives.

Developers and construction teams are constantly seeking construction methods to increase weather durability. Their main goal is to build stronger building structures and frames that increase reliance to the extreme weather patterns, mitigate weather and erosion damage, and to cut down on insurance costs.

Green Building Certifications

Green Star Certification

Green Star Certification is a building certification system that promotes integrated building design that reduces environmental impact. In order for a building to achieve a Green Star Certification, the building documents are reviewed by a panel of sustainability experts. This panel rates a building on nine different categories, ranging from the building design to construction operations. Each of the nine categories assess the sustainability of a project and determines and potential building optimizations[59].

LEED Certification

LEED is another sustainable building certification system. However, it is the most commonly used sustainability rating system in the world. This certification system accounts for 1.85 million square feet of construction on a daily basis.

[59] (Matthews 2019)

Achieving a LEED certification has been beneficial. It holds builders accountable through a very structured and detailed point-based rating system, showing lending parties the credibility of an organization's ability to develop and stay true to sustainability practices. Through the certification process, advice is given to designers and construction teams for material use on both the interior and exterior of buildings. It also helps developers reduce operational costs by the encouragement of the use of reduced and renewable energy sources. When an organization is able to achieve a LEED certification it demonstrates their commitment to both sustainability and new green building initiatives.

EDGE Certification

Excellence in Design for Greater Efficiencies (EDGE), is a certification system that aims to increase the efficiency of construction in three areas; energy, water, building materials, and waste. This certification system is primarily used by developers. Currently operating in over 130 different countries, this certification system requires developers to commit at least a 20 percent reduction in energy and water use.

To use EDGE certification, developers utilize a downloadable software system that allows them to determine the ideal combination of building strategies in order for them to receive the most optimal return on their initial investment. Upon completion of a development project, an independent panel of experts audits the project in order to determine if it has met the required EDGE standards[60].

Alternative Building Materials

Activities from construction and building consume enormous amounts of raw material each year, totaling almost 3 billion tons globally. The reliance on these non-

[60] (Matthews 2019)

renewable raw materials has had a large impact on the number of available resources and the environment. Today, developers are investigating the use of alternative materials for construction to mitigate these negative effects on the environment.

The year 2020, has experienced a surge in the use of more sustainable methods and building materials. Some of these alternative materials include the following [61].

Grasscrete

Grasscrete is a building technique that involves the layering of concrete flooring in such a way that allows for grass and plants to grow and thrive (*Figure 19*). By utilizing this practice, a natural bio-filter is created that improves storm water-water absorption, making a building less susceptible to flooding or drainage issues. This material is used mostly for driveways, parking lots, and garages instead of concrete[62].

Figure 19*:Grasscrete stone filled system at Plum Way II Commercial Building. (Source: Sustainable Paving Systems, LLC)*

[61] (Matthews 2019)
[62] ("5 Most Commonly Used Alternative Building Materials" 2018)

Bamboo

The utilization of bamboo is a rapidly growing material that is a preferred product for builders (*Figure19*). This material is more environmentally friendly than other types of wood because bamboo grows very rapidly when harvested, as opposed to trees that can take years to reach maturity. The use of bamboo also lowers the rate of deforestation which can disrupt the natural habitat of animals and other forms of life [63].

***Figure 20**: This experimental bamboo home is helping to set the pace for sustainable growth in China. Milan-based Studio Cardenas designed Energy Efficient Bamboo House, a home with a minimal carbon footprint and Feng Shui-inspired construction. Located in the Longuan International Bamboo Commune in Zhejiang, the enrgy-saving adobe uses locally available natural materials to create a cost-effective building that saves substantially on energy use. (Source: Lucy Wang)*

Recycled Plastic

Recycling plastic is a great alternative material to use in construction. Plastic is a very energy efficient product and is also cost effective and ecofriendly, as well. When plastic

[63] ("5 Most Commonly Used Alternative Building Materials" 2018)

is discarded, it sits in landfills and takes an extremely long period to deteriorate. Reusing plastic for construction takes an otherwise discarded material and puts it to use. Plastic also has an extremely long lifespan, which guarantees the durability of this material in a building for years to come.

Steel Metal

Steel is another alternative building material that is more environmentally friendly when compared to standard building materials like concrete (*Figure 21*). This material is environmentally friendly because it can be pre-cut and delivered directly to the construction site, reducing the amount of labor in building. Also, steel is known to be an extremely durable material and can withstand extreme weather patterns and prevent damage. Another benefit of steel metal is that it is also mold and mildew resistant[64].

***Figure 21**: China Prefab Industrial Steel Buildings. (Source: Hangzhou FAMOUS Steel Engineering Co., Ltd.)*

Mass Timber

Developers and builders are commonly adopting the use of mass timber for its many benefits. Mass timber is a more cost and time effective construction method, and is also more

[64] [64] ("5 Most Commonly Used Alternative Building Materials" 2018)

environmentally friendly than standard building construction practices (*Figure 22*). Some of the main benefits that the use of mass timber provides are explained below.

***Figure 22**: Wood innovation and design at the University of Northern British Columbia. (Source: Ema Peter)*

Mass Timber is a great natural insulator. When compared to standard building materials such as steel and concrete which expands when exposed to heat and weakens its structural integrity, mass timber does the opposite. When timber is exposed to heat, it dries and becomes denser. This results in less energy leakage and will save money on cooling and heating expenses[65].

Mass Timber is also utilized because it is typically faster to build than other standard building materials. When compared to other building materials such as brick, stone, or concrete, construction takes longer to finish and has to be halted during harsh weather conditions such as rain, snow, or ice. The faster construction of a building will also save money in construction costs, as well.

One of the largest benefits of mass timber construction is that it is environmentally friendly. Trees are a sustainable source because they are a renewable source of raw material.

[65] (WMSH Team 2018)

Another environmentally friendly aspect of timber is its ability to absorb atmospheric carbon dioxide emissions. Timber is carbon neutral, and is the only carbon neutral building material that exists today.

Another benefit of mass timber is its aesthetics. With over 5,000 different species of timber to choose from, there is more of a variety to choose from than standard building materials. Some wood specifics are best for insulation, some for acoustic, some have finer grains, and different colors and appearances[66].

6.3 Waste Management

Material is classified as waste when it is destined for a landfill or other means of disposal. Until a material is destined for disposal, each item or product is a resource that has value and the potential for other uses. This value has been made through the steps of a product's life; from raw material extraction, delivery, and manufacturing and distribution. When products are consigned to landfills or combusted, all of the raw materials and energy that was used in the manufacturing of the product is lost[67].

In most cities, communities recycle some of their solid waste. However, fourth fifths of their solid waste ends in a landfill or combustion. Typically, waste generation outpaces recycling. Even the most advanced recycling programs cannot support the amount of non-recyclable products and packaging entering the waste stream. In the state of New York alone, the Greenhouse gas (GHG) emissions estimates that the solid waste disposal system generates 9.8 million tons of GHG emissions annually. GHGs are created primarily from two steps in the solid waste management cycle; transportation and handling and landfilling or combusting.

[66] (WMSH Team 2018)
[67] (Jha n.d.)

Transportation and handling is the collect and moving process of solid waste. Most solid waste management systems collect, move, and process large amounts of solid waste through the use of fossil fuel-powered vehicles and equipment. These vehicles and equipment emit harmful toxins that pollute the air including carbon dioxide, nitrous oxide, and methane.

Landfilling or combusting is two ways solid was discarded. Landfills are places where trash is collected and combusting is the removal of trash through burning. Both of these disposal methods have serious impacts on the environment. In the anaerobic environment of a landfill, the decomposition of organic materials gives off methane; a greenhouse gas that is 22 times more potent than carbon dioxide. Combusting landfill gas or waste generates heat-trapping carbon dioxide and nitrogen compounds. However, overall GHG emissions from combustion waste are typically lower than the GHG emissions of waste when it is left to decompose in a landfill.

Conserving resources and lower GHG emissions are two of the most important waste management practices. Some of the practices that can be done to help conserve resources and cut down GHG emissions are waste prevention, reuse, beneficial use, comprehensive recycling, recovery of waste organics, energy recovery, and best residual management. These practices are described below[68].

Waste Prevention

Waste prevention involves avoiding solid waste generation that is transported to landfills or combusted. Some examples of the waste prevention can be producer responsibility, incentives for waste prevention, and recycling. Waste prevention will have some very beneficial effects on the environment and cost of waste removal. With waste prevention, GHG emission will be avoided from transportation, handling, and disposal of

[68] (Jha n.d.)

wastes that are not generated. Some other benefits of waste prevention would be avoiding the cost of disposal and the conservation of raw material.

Reuse

The practice of reuse involves the redirecting of produced materials to new users' items that would still have value for their original purpose. Some examples of this practice would be giving usable waste such as clothes and furniture to other uses for the product's original purpose. This would avoid GHG from raw material extraction, GHG emissions from delivery, manufacturing, and distribution, and from the GHG emissions from waste disposal. This would save money for uses of the redirected materials, would recover the material energy and value, avoid costs, and would reduce GHG emission from disposal.

Beneficial Use

The practice of beneficial use involves the redirecting of items that would have value for other uses than their original use. By using this practice, GHG emissions from disposal, material extraction, and manufacturing would be reduced[69].

Comprehensive Recycling

The practice of comprehensive recycling involves the recycling of goods so that they can be repurposed. This would need to be done in businesses, at large venues for entertainment, and in private homes as well. Some examples of this practice would include the addition of recycling at new venues, workplaces, and public spaces. By using the practice of comprehensive recycling, GHG emissions from material extraction, delivery, and disposal would be reduced. Some other benefits this practice would have would be cheaper raw

[69] (Jha n.d.)

materials for manufacturers, avoiding the cost of disposal, and the sale of recovered materials could help fund solid waste management.

Recovery of Organic Waste

The practice of the recovery of organic waste involves the making of nutrients in organic wastes available for people, soil organisms, and plants. This could be done by distributing excess prepared food to institutions or agricultural users, using food remains for compost and other functions. By using this practice, it would avoid GHG emissions from disposal of waste and would sequester carbon in the soil.

Energy Recovery

The practice of energy recovery involves the burning of waste that can not be recycled under controlled conditions. With this practice, properly equipped combustors could convert water into steam that could be used to heat buildings and generate electricity. By using this practice, energy would be recovered from waste and could be used as a substitute to fossil fuels, and would eliminate the amount of carbon dioxide the burning of fossil fuels emits into the air[70].

Best Residual Management

The practice of best residual management involves the disposal of remaining waste in a way that would be environmentally sound and sustainable. This could be done by landfills using liners to prevent waste from contaminating the surrounding environment, leachate collection and removal, and groundwater monitoring. By using this practice, it will reduce the amount of methane that landfills generate and emit into the air[71].

[70] (Jha n.d.)
[71] (Jha n.d.)

Chapter 7: Proposed Solutions to Segregation

7.1 Mixed-Income Housing

Mixed-income housing is housing that includes diverse types of housing units at different affordability levels. Mixed-income housing development can have a large spectrum of different building typologies from apartment buildings, townhomes, and single-family homes (*Figure 23*). Mixed-Income housing has many advantages that benefit its residents[72].

***Figure 23**: Mixed-Income, Grand: Shops and Lofts at 47. (Source: Barbara Ballinger)*

How Does Mixed-Income Housing Work?

Mixed-income housing developments are created in order to serve numerous households at different income levels. These developments use the income created from market rates units to provide affordable units to low-and moderate-income families. This reduces the need for public funds to subsidize affordable housing. This is also a form of cross

[72] ("Mixed-Income Housing Promotes Exciting Neighborhoods and Social Equity" n.d.)

subsidization in which the revenue from higher-priced units is used in order to subsidize lower-priced units.

Mixed-income housing relies on the concept of cross subsidies. Cross subsidies relay the concept that mixed-income developments can use the market to subsidize part or all of the financing gap created by selling or renting housing below the market value. Mixed-income house developments are typically used by nonprofit or mission-driven developers. These developers utilize this type of development because it is more financially feasible than creating a development of all affordable units.

Mixed-income housing developments work best when the specific market has a high demand for market-rate rentals. In areas where there is high demand for market rate units, mixed-income developments can work without public subsidies, however this can be the opposite in markets that do not have strong demand for market units. Determining the ratio of affordable to market-rate units and the right incentives for each market requires adequate knowledge of the specific market and real-estate development fundamental strategies[73].

Benefits of Mixed-Income Housing

Mixed-income neighborhoods strengthen and diversify their resident's social networks and expand on social capital. The suburbs, unlike mixed-income housing, tend to have little diversity in terms of socio-economic class. These neighborhoods create segregation based on income and isolate themselves from income circles. Mixed-income housing alternatively has many advantages to have a diverse community that benefit the lower, middle, and high class. These benefits are explained below[74].

[73] ("Mixed-Income Housing: The Basics" 2017)
[74] ("Mixed-Income Housing Promotes Exciting Neighborhoods and Social Equity" n.d.)

Social Benefits

Mixed-income housing increases social capital of a community. The concept of social capital is that different networks will benefit by having people who connect across the networks. These can increase social benefits and help create acquaintanceship among the different social networks.

Higher and middle-income associates are critical for many lower-income people to raise themselves out of poverty. In order for this to happen, lower-income people need positive influences and successful acquaintances. However, in order for this to happen, many of the neighborhoods in urban areas have to be willing to accept lower income households. If this happens then these lower income households will have a stronger chance at raising themselves out of poverty[75].

Benefits for Lower-Class

Mixed-income housing provides quality housing and housing security for people earning significantly less than the average median income for that area. These mixed-income housing developments often allow lower-income people the opportunity to escape from poverty and enter a higher-income neighborhood.

Mixed-income housing allows for a lower-income person to have access to an abundance of resources that were not available to them before. These resources include schools, health care, and many other public facilities. Also, the lower-income residents in mixed-income housing also experience an increase in productivity. This is because they have positive influences and better role models in terms of building wealth. Also, the diversity of these housing developments also allows for a lower-income person to create larger social networks, which can be very beneficial for employment.

[75] ("Mixed-Income Housing Promotes Exciting Neighborhoods and Social Equity" n.d.)

Benefits for Middle-Class

Middle income families in mixed-income housing are able to diversify the social networks. They benefit from knowing higher-income people and are able to gain insight on achieving economic success. On the other end of the spectrum, they also benefit from having lower-income people in their social networks because they are able to observe the cautionary tales of how lower-income people got in their current financial situation. They also learn to appreciate what they have and how fortunate they have been to be in their current position.

Benefits for Upper-Class

Higher Income people also benefit from living in mixed-income housing. Just like the middle-class, they gain an appreciation for their blessings and financial status. This also allows the higher-income people the opportunity to experience socio-economic diversity, and use their position to service the community[76].

7.2 Urban Planning

Housing Diversity

Cities must be able to provide adequate housing that allows workers to be relatively close to their place of employment. Developers must work with local governments to establish programs that create affordable housing for the workforce. Housing diversity should include housing that is affordable to multiple socio-economic groups. This should include subsidized housing for lower-income and younger workers, and creative professionals[77].

[76] ("Mixed-Income Housing Promotes Exciting Neighborhoods and Social Equity" n.d.)
[77] (Harvard Business Review 2017)

Transportation

Accessibility to transportation is very critical. Proximity to public transportation allows for greater and more efficient access to jobs, essential business, and other public institutions. Transportation options enable residents to search for secure jobs in areas that are accessible to the residents. Accessibility to transportation provides job security, and improves financial stability by eliminating the need for cars. Transportation should be accessible, affordable, safe, and easy to use[78].

Inclusive Design

Inclusive design is extremely important in reducing segregation and discrimination. Inclusive design uses design methods that do not exclude a certain person or demographic and is open for the use of the entire community. Inclusive design takes into account people that are from different cultures, different ethnicities, and people with disabilities and creates a thoroughly crafted and managed environment for all.

Parks and Green Spaces

Parks and green spaces that are well-maintained provide people with a setting to unwind and relax (*Figure 24*). These open spaces and parks are good for both our health and sociability across communities. Inclusive design provides people with an open space that is safe, accessible, practical, and brings enjoyment when using. Good open space design creates an inclusive space to relax and exercise, and takes into account everyone. These open spaces create a public domain where mixing between different groups is encouraged [79].

[78] (AD&V 2017)

[79] (Commission for Architecture and the Built Environment n.d.)

***Figure 24**: Eau Claire area and visitors attend a concert in Phoenix Park. (Source: Eau Claire Community Parks Association Fund)*

Community Buildings

Community buildings is another aspect of inclusive design that promotes equality. These buildings are public and accessible for everyone. These buildings provide necessary resources that are needed in the surrounding community. These buildings are accessible, inviting, and exciting to use. These types of community buildings instill in people the sense of belonging. Some examples of community buildings include libraries, cultural centers, community centers, and many more (*Figure 25*)[80].

[80] (Commission for Architecture and the Built Environment n.d.)

***Figure 25**: View of Austin, Texas' Central public library from Cesar Chavez. (Source: Mike Russell)*

Housing

Inclusive design promotes housing that is adaptable, practical, secure, and somewhere where the residents are comfortable settling down in. Housing should be affordable, have enough space for families to live comfortably, be easily adaptable, designed for everyday use, durable, does not waste essential resources, close to public facilities, and has a balance between privacy and community vigilance[81].

Public Space

A public space is an area within a city that is accessible and open to everyone, regardless of race, income, gender, or ethnicity. Public spaces come in the form of squares, parks, and plazas (Figure 26). Public space that is well designed and maintained stimulates good health for the residents and environment. These public spaces are used for gathering,

[81] (Commission for Architecture and the Built Environment n.d.)

social mixing, civic participation, recreation, and a sense of community. These spaces should be open and accessible and should not have any natural or architectural barriers so that they are easy to be seen[82].

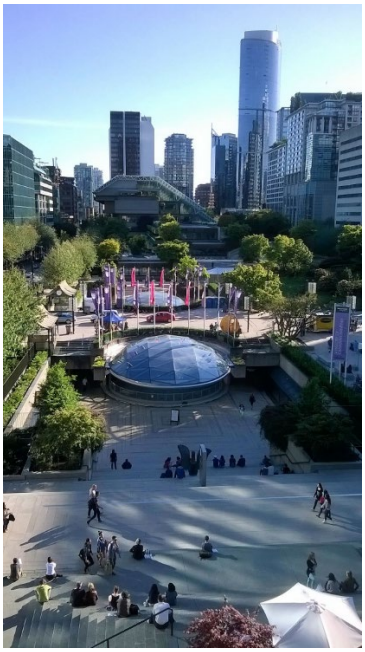

***Figure 26**: Robson Square Plaza. (Source: UBCRobs)*

Pedestrian - Friendly Streetscapes

Pedestrian-friendly streetscapes are a type of streetscape that features a walkable street design which makes it easily navigable by foot *(Figure 27*). These types of streetscapes can transform an urban area, making it more loveable for its residents. Pedestrian-friendly streetscapes also promote walkability, which encourages interaction among the residents of a community, strengthening community ties.

The components of pedestrian-friendly streetscapes are different from one city to the next based. They are typically based on factors such as accessibility, visibility, financial resources, and the ability to renovate the existing infrastructure. The components of this type

[82] ("Inclusion through Access to Public Space" n.d.)

of streetscape include smaller blocks, sidewalk entrances, hidden parking, reliable mass transit system, comfort feature, bike and pedestrian paths, visible landmarks, and physical barriers to protect pedestrians from traffic[83].

Figure 27*: The plan transforms a bleak streetscape that discouraged pedestrian activity into a safe avenue. Among the features proposed are green medians and boulevards, healthy street trees, lush planting beds, pedestrian lighting, wider sidewalks, new bicycle lanes, and areas for seating. (Source: Janet Rosenburg & Studio)*

[83] ("Pedestrian Friendly Streetscapes" 2012)

Section 4: Development Site and Proposal

Chapter 8: Brownfield Redevelopment

8.1 Brownfields

According to the Environmental Protection Agency, brownfields are defined as real property, where the expansion, redevelopment, or reuse may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Brownfields are most commonly land that was previously developed for industrial purposes and have left hazardous materials in the soil or water[84]. In the United States, brownfields are extremely common. The United States General Accounting Office estimates that there are almost 425,000 brownfield sites in the country.

***Figure 28**: Soil contamination caused by underground storage tanks containing tar. Encountered during remediation works at a disused gasworks. (Source: Dumelow)*

[84] (Guest 2014)

8.2 Negative Effects of Brownfields

Brownfield sites are most often abandoned and left vacant. Brownfields are dangerous because they expose humans and the surrounding ecosystem to harmful pollutants. It is very common for these sites to not only pollute the soil, but surrounding bodies of water because of their location along waterfronts.

Brownfield sites also have negative impacts on surrounding neighborhoods. These sites often lead to neighborhood decay because they have been forgotten about and left vacant. Because of this, residents leave communities because of these properties are eye sores. These sites typically will lower the property value of the surrounding real estate, so it is common for the lower income demographic to live around these sites leading which leads to human exposure[85].

8.3 Redevelopment Opportunities

Brownfield sites offer unique development opportunities. Brownfields are normally abandoned; therefore, the land is vacant and can be obtain by developers. Brownfields have great locations; commonly located along waterfronts near major transportation hubs and close proximity to workers and consumers[86].

Benefits of Brownfield Redevelopment

The redevelopment of these sites offers many social, environmental, and economic benefits. Socially, these sites offer the opportunity to create open public spaces which will draw new members to a community. Environmentally, they clean up and remove hazardous chemicals from the soil. Economically, the redevelopment of these sites can raise the property

[85] ("Brownfields" n.d.)
[86] (Cotton n.d.)

value of the surrounding buildings, create more jobs, and also create great investment vehicles, seeing an average return of $17.50 for every $1 invested[87].

Chapter 9: Brooklyn's Greenpoint Waterfront

9.1 Site Context

History

In Brooklyn, New York, along the East River, lies a 2 mile stretch of land known as the Greenpoint Waterfront. This waterfront has a experienced a large amount of brownfield redevelopment after a 2005 zoning amendment changed the waterfront's use from industrial to residential.

Figure 29: *Greenpoint Waterfront Map (Source: Author)*

[87] (Cotton n.d.)

The Greenpoint Waterfront has a very rich history. In the 16th century, the site was used by the Native Americans for farmer and hunting. However, with the arrival of European settlers in North America, the site's function quickly changed. With urbanization occurring in Manhattan, land in New York City became dominated by business and settlements, forcing shipbuilders to move across the East River to Brooklyn.

In the 1850s, the waterfront was home to Continental Iron Works (CIW), an American shipbuilding and engineering Company. In 1861, CIW constructed the first ironclad ship, which was instrumental in the north's victory during American Civil War. This led to CIW becoming a pioneer in the welding industry, where the site was used for manufacturing equipment for the growing gas lighting industry. CIW would become the leader in manufacturing and supplying gas equipment throughout the eastern United States.

At the turn of the 20th century, Brooklyn's East River waterfront replaced all the existing farmland with industrial factories where a wide variety of products were fabricated. CIW and the rest of the Greenpoint waterfront were responsible for manufacturing many products that were used in World War 1. In the 1930s, CIW closed its doors for good, where the site would remain vacant and idle till the turn of the 21st century.

In the 1970s, the waterfront fell into economic decline. As a result, many of the factories that once thrived in this area began to leave the area. By the 2000s, the waterfront was filled with many vacant and idle factories that became the home for many homeless people, crime, and art.

In 2005, the Greenpoint-Williamsburg Waterfront Zoning Amendment was adopted. This zoning amendment rezoned roughly 200 waterfront blocks along the East River from industrial to residential. A deal was made with the major of Brooklyn that allowed for developers to construct taller buildings, roughly 30 to 40 stories, in exchange for keeping industrial buildings out of the area.

With the adoption of the Greenpoint-Williamsburg Waterfront Zoning Amendment, in 2005, the site has experienced a surge in development. Since 2011, nearly 6 high-rise, residential developments have emerged along the waterfront. This has brought nearly 4,600 new units to the area and has revitalized the once run-down waterfront[88].

Figure 30: *Greenpoint Waterfront's recent development activity. (Source: CoStar.com)*

9.2 Greenpoint-Williamsburg Waterfront Master Plan

The Greenpoint-Williamsburg Waterfront Master Plan was established in 2005 along with the zoning amendment that changed the use of the area from industrial to residential. The master plan was created to provide a framework for designing, developing, and maintaining open public space along the Greenpoint-Williamsburg Waterfront.

[88] (Cobb, 2019)

Figure 31: *Greenpoint-Williamsburg Waterfront Masterplan. (Source: City of New York, Parks & Recreation)*

Goals of Masterplan

The Greenpoint-Williamsburg Waterfront Masterplan has six main goals. The first goal is to create a publicly accessible waterfront. The second goal is to create a balance between active and passive recreation opportunities to serve the needs of the community. The third goal is to identify opportunities for direct interaction with the East River. The fourth goal is to create sustainable design practices, habitat enhancement, and public education opportunities. The fifth goal is to create specific design guidelines to unify the waterfront. The sixth goal is to reflect the character, heritage, and culture of the community in both public and privately developed open spaces.

This master plan strives to create many amenities for the community along the waterfront. The first amenity is a shore public walkway. This walkway will be a continuous pedestrian-only trail that will stretch the entire length of the waterfront. The second amenity is the inclusion of various public open spaces, that will be built by both public and private developers. The third and final amenity will be Bushwick Park, a 30-acre park set to take 15 to 20 years to complete[89].

[89] (NYC parks and Recreation, 23)

Chapter 10: Proposed Development Site

10.1 Development Site Location

Given the recent development activity along the Brooklyn's Greenpoint Waterfront, the proposed development site will be located within this 2-mile stretch. The site is a former brownfield site, that has been underused and idle since the mid-20th century. This site offers a unique opportunity to redevelop a site that is vacant and has a prime location in Brooklyn, New York.

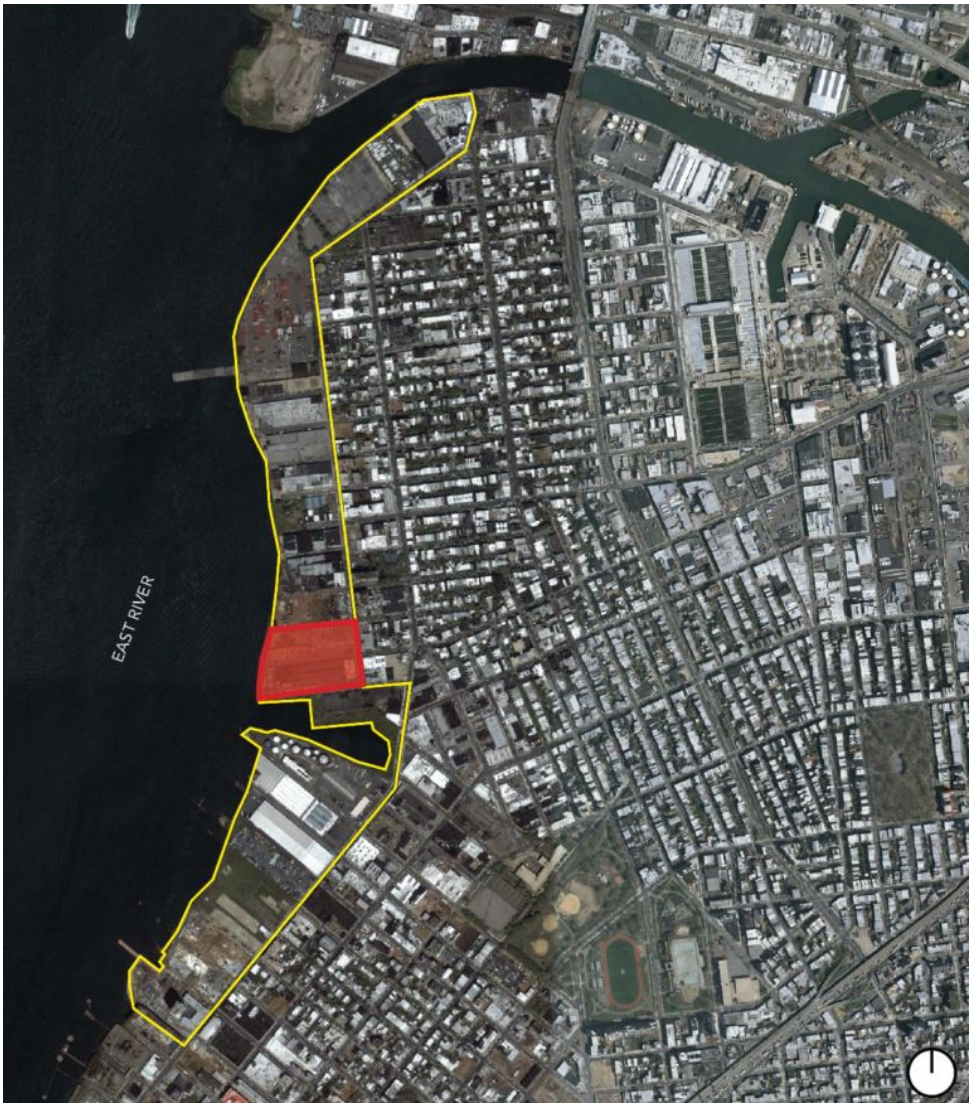

Figure 32: *Proposed Development Site's location on the Greenpoint Waterfront. (Source: Author)*

10.2 Site Area and Value

The proposed development site consists of 2 waterfront lots that have been subdivided into 8 parcels. In total, the site has an area of 449,041 square feet, or 10 acres. The 8 parcels have a combined value of $24,021,990. M & H Reality is the current owner of 7 of the parcels, while 24 Oak LCC is the current owner of one of the parcels.

Figure 33: *Development Site parcels. (Source: Author)*

10.3 Site Zoning

The site currently sits in 3 different zoning districts; R8, R6, and R6/C2-4. R8 allows for residential uses, a floor area ratio of 6.02 and a height limit of 400 feet. R6 also allows for residential uses, has a floor area ratio of 2.43 and a height limit of 150 feet. R6/C2-4 is a mixed-use district. This district allows for residential and commercial uses. The floor area ratio for this district is 2.43, with a maximum commercial floor area ratio of 2.0 and a height limit of 150 feet[90].

[90] ("Zoning: Districts Guide -Residence Districts - R6 - R6A - R6B - DCP" n.d.)

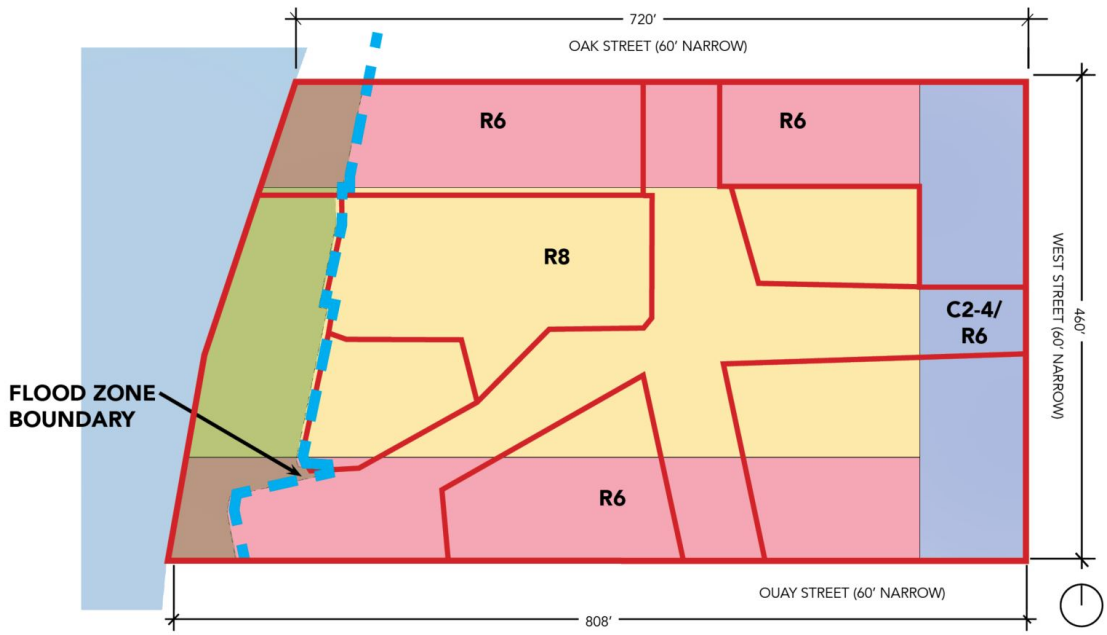

Figure 34: *Development Site Zoning Districts. (Source: Author)*

10.4 Existing Site Conditions

The development site not in great physical condition. Due to the strong currents of the East River, the infrastructure along the shoreline is damaged and needs immediate repair. The currents are also currently causing the shoreline to be subject to erosion.

The site is currently vacant. The last remaining infrastructure on the site was demolished in 2010 by the site's current owner. The soil on and around the site has been remediated. However, soil tests must be conducted before the development can be approved and also at random intervals during construction to ensure that all of the hazardous materials have been completely removed from the soil.

Figure 35: *Development Site existing infrastructure. (Source: www.Greenpointers.com)*

10.5 Site Amenities

The proposed development site has many amenities that will attract many people to this location. The site has fantastic views of downtown New York City, Queens, Brooklyn, and many well-known landmarks such as the Williamsburg Bridge and Roosevelt Island.

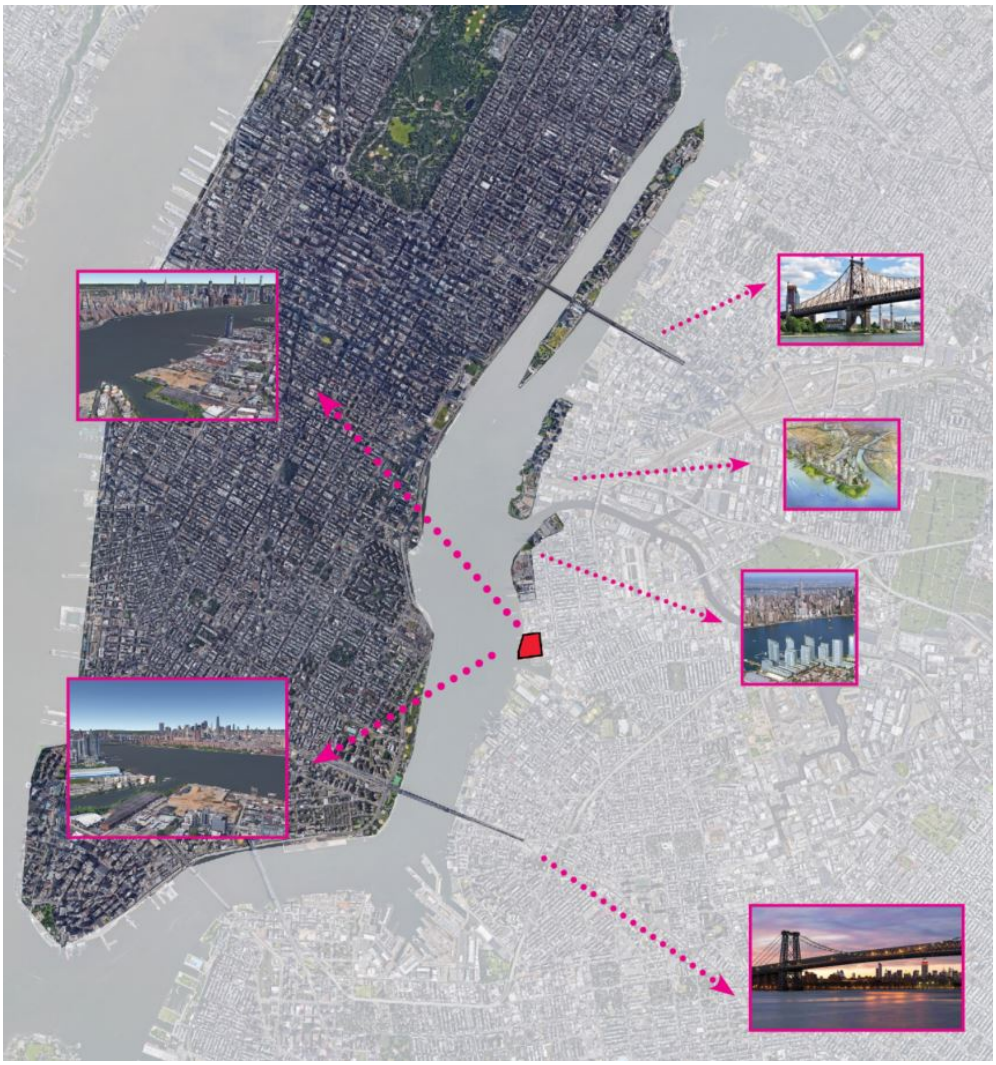

Figure 36: *Views from site. (Source: Author)*

Another site amenity that is beneficial to the site is public transportation. Since the average household in this area does not own a vehicle, public transportation is their main source of getting around the city. According to Redfin.com, the site has a public transit score of 80 out of a possible 100 points. Within one mile of the site are 3 different metro stations and 2 bus stops.

Directly adjacent to the site across the Bushwick Inlet is a proposed 30-acre park, called Bushwick Park. Upon completion, this park is set to be a total of 30 acres and will

feature athletic fields, open green spaces, and a network of pedestrian paths along the waterfront. The development timeline for this park is about 10 to 15 years.

These site amenities make the development site extremely unique. These amenities will attract many visitors and consumers to the site that will help the local economy flourish.

Figure 37: *Proposed Bushwick Park. (Source: Author)*

Chapter 11: Development Proposal

Cayler Point, a mixed-use, mixed-income development, is the development proposal for this thesis project. The development will feature both residential and commercial retail space, along with studio, 1-, 2-, and 3-bedroom units at three different affordability rates.

Figure 38: *Rendering of Cayler Point. (Source: Author)*

11.1 Development Phasing

Cayler Point will be developed in 3 phases. The total build out of the development is estimated to take about 8 years. Each phase will a residential tower to the site that will feature ground floor retail and a series of roof terraces, and public urban space.

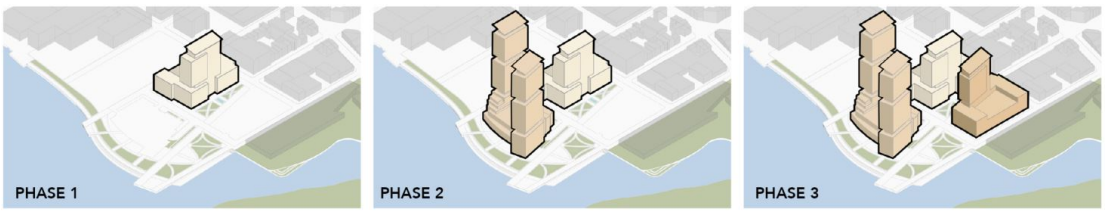

Figure 39: *Cayler Point Development Phases. (Source: Author)*

Phase 1

Phase 1 will bring the first tower to the site. This tower will be 278,624 square feet in total. This phase will bring 44 3-bedroom units, 144 2-bedroom units, 54 1-bedroom units, and 30 micro units to the site. This phase will also bring 22,220 total square feet of retail to the site and 129 parking spaces.

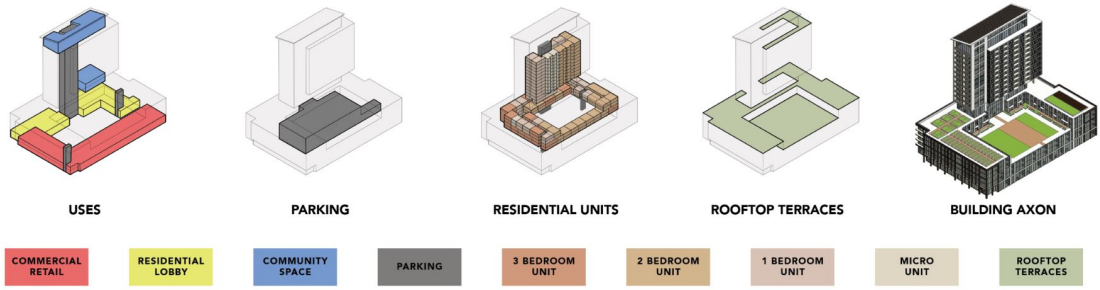

Figure 40: *Phase 1 building uses. (Source: Author)*

Phase 2

Phase 2 will bring 2 towers with a shared podium to the site for a total of 524,990 square feet. This phase will bring to the site 56 3-bedroom units, 197 2-bedroom units, 70 1-bedroom units, and 24 micro units for a total of 547 units. Phase 2 will also feature ground floor retail and will include 20,561 square feet of retail space.

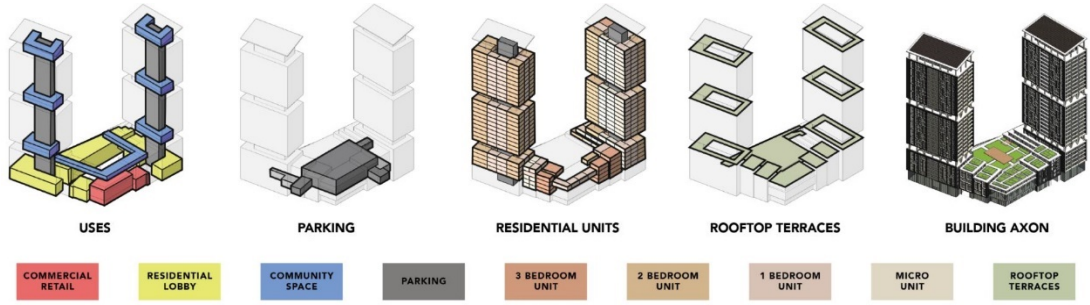

Figure 41: *Phase 2 building uses. (Source: Author)*

Phase 3

Phase 3 will bring the third and final tower to the site for a total of 255,611 square feet. This phase will bring to the site 44 3-bedroom units, 144 2-bedroom units, 54 1-

bedroom units, and 29 micro units for a total of 547 units. Phase 3 will also feature ground floor retail and will include 15,035 square feet of retail space.

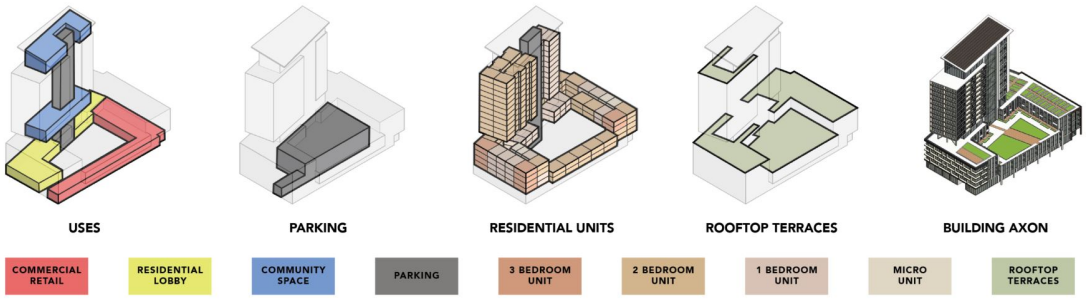

Figure 42: *Phase 3 build uses. (Source: Author)*

Total Development Buildout

After the completion of phase 3, the site will have a total of 1,077,225 square feet. There will be 1,003 total units with a unit mix of 83 micro units, 378 1-bedroom units, 485 2-bedroom units, and 144 3-bedroom units. Along with these residential units, the total site build out will also have a total of 57,816 square feet of ground floor retail space.

11.2 Residential Uses

Cayler Point will feature 1,003 total units at three different affordability rates; luxury rate, market rate, and affordable. The luxury rate units will be located exclusively on the top 3 floors of each tower, totaling 150 units. The market rate units will be dispersed throughout the middle and podium of each of the towers, totaling 461 units. The affordable units will be dispersed throughout each level of the development and will have a total of 391 units.

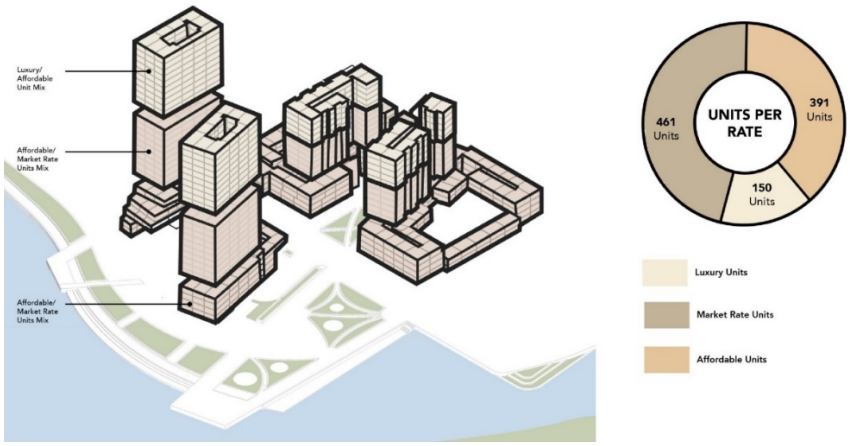

Figure 43: *Unit Rate Mix. (Source: Author)*

11.3 Commercial Uses

Cayler Point will feature a total of 57,816 square feet of commercial space which will all be used for retail. All of this retail space will be located on the ground floor along the outside streets of the site. The retail space will be leased out for tenants in the food and beverage industry and community services industry. These tenants will include a pharmacy, grocery, barbershop, dry cleaning service, and many more.

Figure 44: *View of complete development from East River. (Source: Author)*

Section 5: Proposed Solutions Implementation in Design

Chapter 12: Proposed Solution to Housing

12.1 Affordable Housing

The demographic of the submarket located around the site is a predominately wealthy group. The median income of the population located within a 2-mile radius of the site is $103,000 per year. This is extremely high for any submarket in the country. Therefore, the demand for affordable housing in this area will be high. In order to meet this demand, Cayler Point has allocated 391 units for residents who have an annual median income of 50% or less. In other words, these units will be reduced in price by almost 50% so that lower-income residents can have quality housing options.

By providing 391 affordable units out of 1,003 total units, the development can use Low Income Housing Tax Credits (LIHTC) to help fund the development costs. These credits are determined by taking the eligible basis of the property, which is the ratio of regular priced units to affordable units, and granting cash to help construct the property.

12.2 Mixed-Income Housing

Providing mixed-income housing is extremely beneficial for the community and for developers as well. Mixed-income housing provides residents of all different income groups to option of quality housing. By providing mixed-income housing, Cayler Point is increasing the supply of housing units in the Brooklyn area, which is thus lowering the demand. In turn, when the demand for housing is lowered the price of housing in the area will begin to lower, as well.

Cayler Point uses the benefit of mixed-income housing to create a diverse community of tenants, and also to help fund the project as well. Providing affordable units takes away from the gross rental revenue of a development. In order for this lost revenue to balance out, other units are priced higher. Cayler Point uses two different rates to help make cover this gap; market rate and luxury rate units. The luxury rate units are included in this development strictly to help cover the lost rental revenue from the affordable housing.

12.3 Neighborhood Revitalization

The proposed development site for Cayler Point has been vacant and idle for many decades. This has resulted in the surrounding buildings to reduce in value. By revitalizing this brownfield site, Cayler Point will help to revitalize the Greenpoint neighborhood in Brooklyn.

Cayler Point will help motivate change and stimulate socioeconomic characteristics of the neighborhood. The former site that has been underutilized will now be redeveloped to meet the needs of the surrounding community. This development is being developed in such a way that it will help stimulate the local economy by attracting various users from outside the community to the site. These users will then give local businesses and restaurants business. On top of this, this development will also provide much needed affordable housing options for the residents of the Greenpoint neighborhood.

Chapter 13: Environmental Impact Solutions

13.1 Installation of Urban Green Spaces

Cayler Point will bring many urban green spaces to this former brownfield site. These green spaces will help improve the quality of life for the residents of the Greenpoint Neighborhood and surrounding areas. By providing urban green spaces, Cayler Point will help mitigate the harmful effects of various forms of pollution on both the environment and the health of its individual residents. These green spaces can be seen in the site plan below.

Figure 45: *Cayler Point site plan. (Source: Author)*

Pollution Reduction

Providing urban green spaces helps reduce the amount of pollution around the site. Cayler Point helps reduce pollution by limited the amount of hard impermeable surfaces around the site. This is done through the incorporation of various green roofs filled with vegetation, and by lining sidewalks and pedestrian paths with trees and plants to help absorb pollutants and reduce the heat island affect around the site.

Figure 46: *One of the Various Green roofs at Cayler Point. (Source: Author)*

City Water Management

Another benefit of the installation of urban green spaces is city water management. Limiting the amount of hard surfaces around the site and providing many green spaces at various locations and heights allows Cayler Point to collect and retain rainwater. By doing so, the amount of rainwater runoff is significantly reduced. This prevents rainwater runoff from collecting harmful toxins from impermeable surfaces and also reduces the amount of potential flooding around the site.

13.2 Green Building Practices

Cayler Point features many sustainable design features that help reduce the buildings energy consumption, carbon emissions, and water consumption.

PV System

The 4 towers of this development are located on the site to receive maximum sunlight on their largest façade and to also reduce the amount of shadows they cast on the other towers throughout the day. The roof of each tower is sloped at a 40-degree incline and features a 457-kilowatt PV System with a solar panel size of 2.5 feet by 5 feet. In total, all for towers have 2,576 solar panels, covering roughly 32,200 square feet. These PV panels produce 1,545,600 KWH per year and save the towers an estimated $121,000 dollars each year.

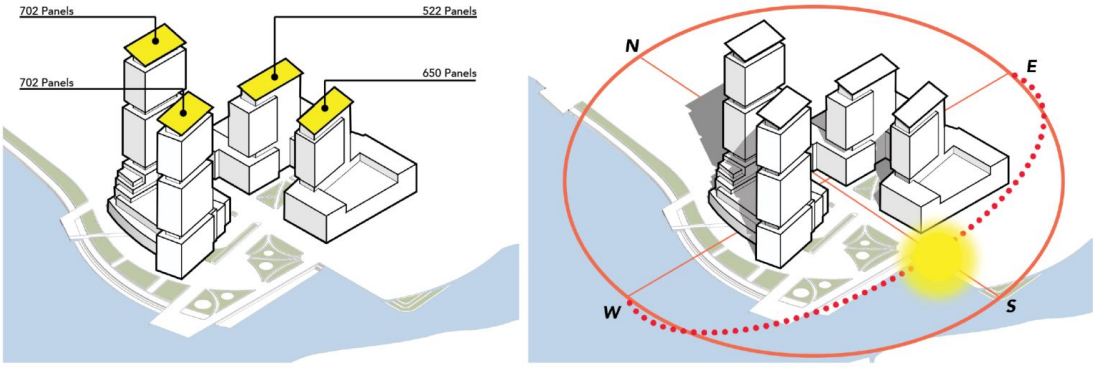

Figure 47: *Cayler Point's Solar Orientation and PV paneling. (Source: Author)*

Climate Resiliency Factors

The site is located on the East River Waterfront. With any waterfront property, the infrastructure of the waterfront is a major concern. On the site, three different waterfront conditions are incorporated into the design to prevent erosion.

The first condition uses riprap. Riprap is a common and cost-effective way of protecting against waterfront erosion. This method involves the placing of large rocks along

the water's edge to help combat erosion. This is an effective design approach because it creates a gradual slope down to the water and eliminates the need for a railing.

The second waterfront condition involves the insertion of a bulkhead wall where the waterfront meets the East River. Bulkhead walls provide great protection against erosion and are cost-effective as well. These walls also provide a hard edge on the waterfront to help define the property boundaries and allow the waterfront to hug the edge of the water, as well.

The third and final edge condition is a stepped gabion with a terrace or a low wall with riprap and an overlook. This edge condition is used in areas that will have the most impact from the river's current, where riprap and a bulkhead wall are simply not to prevent erosion. This edge conditions are a combination of the first two edge conditions mentioned earlier.

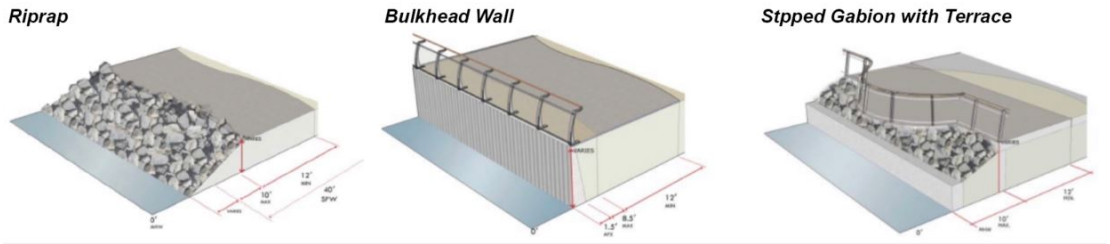

Figure 48: *Different waterfront edge conditions. (Source: City of New York, Parks & Recreation)*

Figure 49: *Edge conditions incorporated in design. (Source: Author)*

Alternative Building Materials

The process of construction and building relies on large quantities of raw material. These materials most commonly are non-renewable and have a negative on the supply of

available resources and the environment. Cayler Point uses building materials that are more sustainable than most other buildings.

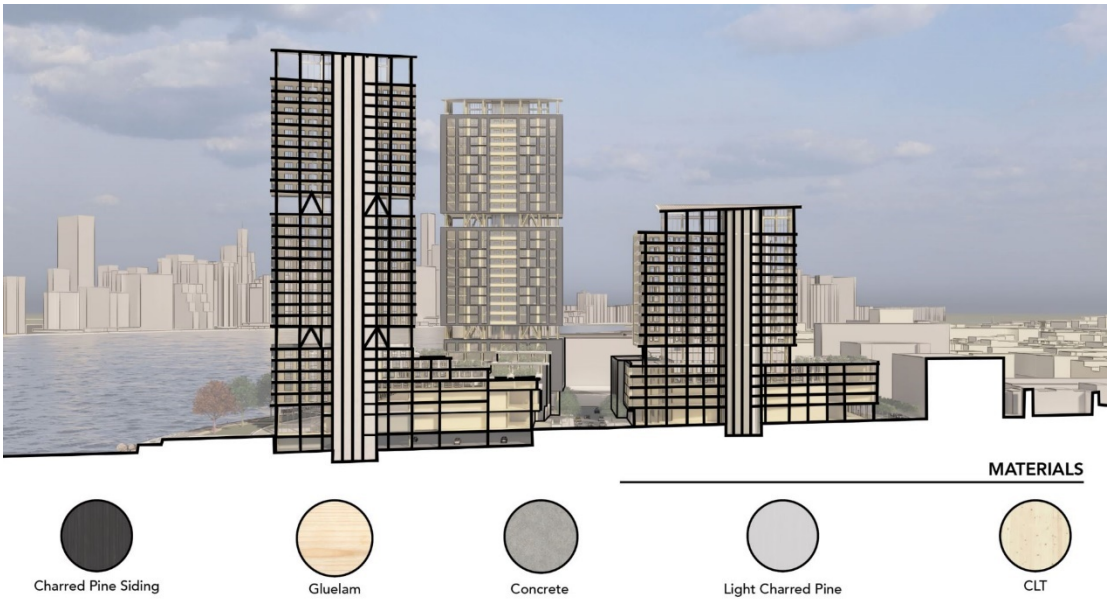

Figure 50: *Section Perspective of Cayler Point. (Source: Author)*

Mass Timber

Cayler Point utilizes mass timber as its primary building and construction material. CLT floor panels, CLT structural walls, CLT wall panels, glulam structural columns and beams, and charred pine siding finishes comprise the majority of materials in this development. These materials were selected because they are a more cost and time effective material in terms of construction, and because of the various environmental benefits they provide.

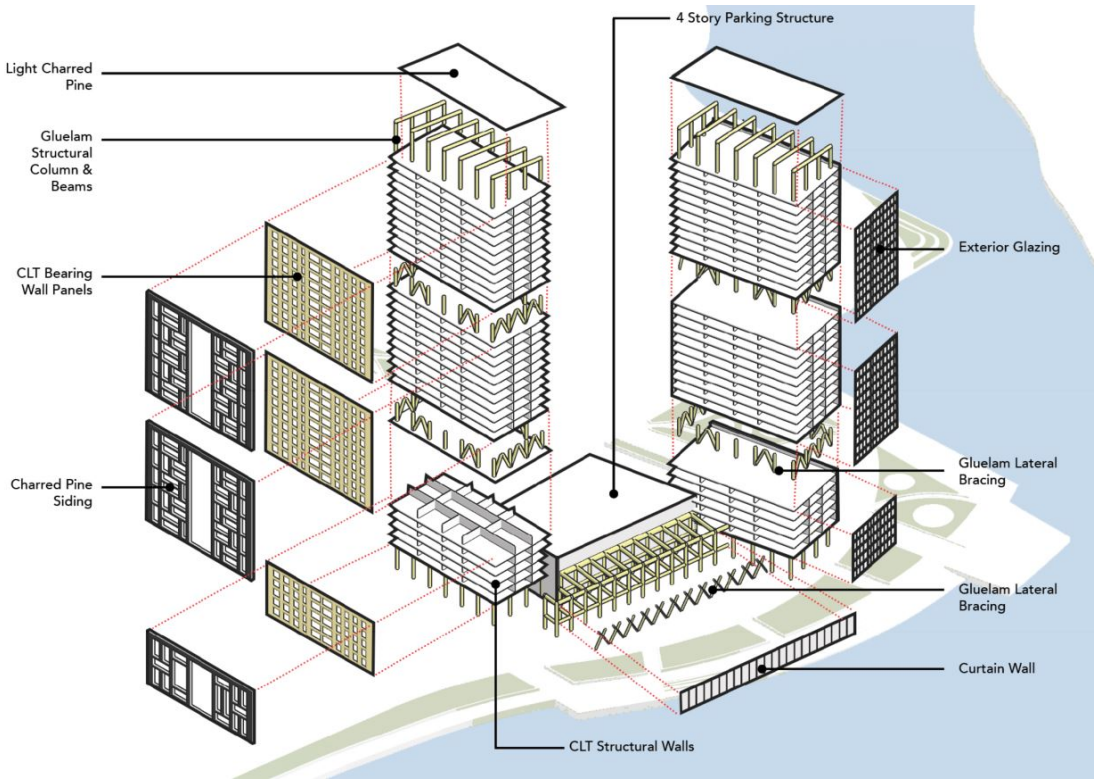

Figure 51: *Cayler Point structural diagram. (Source: Author)*

Cayler Point uses mass timber for its primary building material because it helps speed up the construction period. This 3 phased development is set to be developed in 8 years, so any factor that will speed up the construction period will be extremely important. Also, by increasing the speed of construction, stabilization for the building can occur faster which will result in an increase in financial returns for rental revenue.

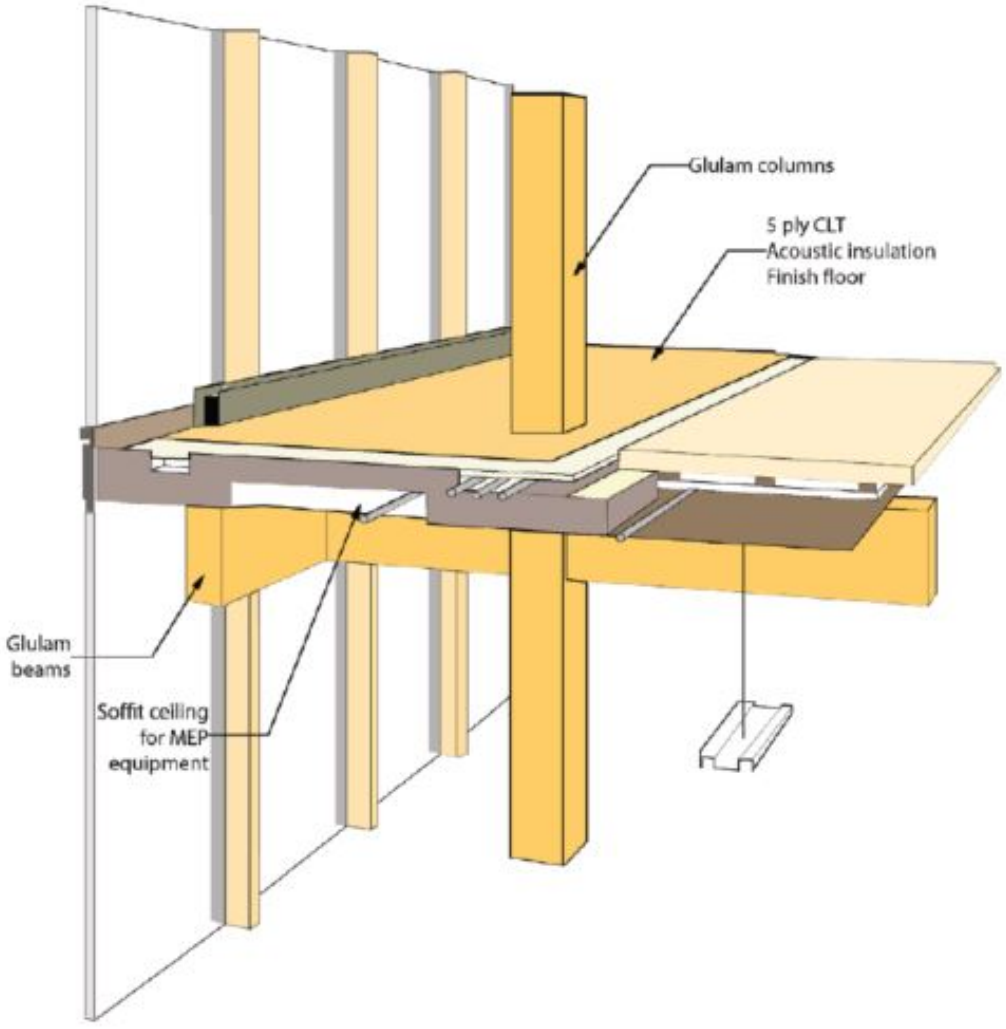

***Figure 52**: Structural diagram illustrating the modular construction of CLT systems. (Source: Author)*

From an environmental standpoint, this development uses mass timber because this material is renewable and also because of the increased air quality it provides. The timber from this development will sequester carbon emissions from the air, thus removing pollutants that can be harmful to the human health.

Chapter 14: Design Elements to Mitigate Segregation

14.1 Mixed-Income Housing

Mixed-income housing promotes inclusivity and rejects segregation. This is done by providing housing units in the same building at different affordability levels. Cayler Point uses mixed-income housing in the hopes that it will diversify its residents' social networks and expand the social capital for every tenant.

By evenly dispersing affordable units throughout all 4 towers, Cayler Point forces interaction between all tenants, not matter what socio-economic class they fall under. Another aspect of this development that helps mitigate segregation is the amenity space. Each tower will have amenity space both interior and exterior at various levels. This amenity space is shared by all residents throughout the building. By incorporating shared amenity space throughout the development, Cayler Point's goal is to promote and instill a sense of equality and community among its residents.

14.2 Inclusive Design Strategies

Inclusive design is another strategy that helps reduce segregation in communities and neighborhoods. This design strategy uses various design methods that do not exclude a certain person or demographic from using the space. Cayler Point uses many different strategies to promote inclusivity for both its tenants and the surrounding community.

Parks and Green Spaces

Green Spaces

Cayler Point provides numerous green spaces throughout the development site. These green spaces are located on the ground and site level and are for the use of everyone in the

community and surrounding area. These spaces are located all around the site and range in size from small to large. These spaces provide the public with a safe, accessible, and practical area that can be uses for various purposes such as relaxation, exercise, and socializing. These green spaces create a public domain where mixing between different groups is encouraged and acceptable.

Figure 53: *Cayler Plaza. (Source: Author)*

Resident Green Spaces

Cayler Point provides many green spaces at multiple levels of each tower. These green spaces are for the use of tenants only because they accessed from inside the building. These spaces use inclusive design because they create a public space for each building's tenants, which come from various socio-economic backgrounds. Each of these green spaces will be surrounded by a roof terrace that will also feature shared amenities for tenants such as grills, tables, seating, and much more. These green spaces are meant to provide the residents a place for relaxation, a social setting, and a setting to enjoy the views of the New York City Skyline.

Figure 54: *Resident Green Spaces. (Source: Author)*

Bushwick Park

Once completed, Bushwick Park will provide the Greenpoint Waterfront a 30 acre public park. This park will provide people with an open space that is safe, accessible, practical, and will bring enjoyment to its users. This park will feature numerous athletic fields that will be shared by the neighborhood and surrounding community. The park will also feature many passive and active recreation opportunities that will serve the need of the community and will be designed in a way so that the culture, heritage, and character of the community will be reflected.

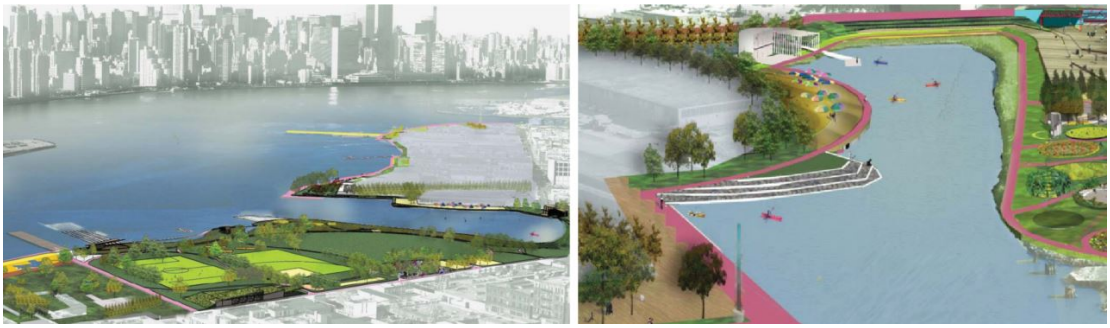

Figure 55: *Bushwick Park Rendering. (Source: NYCPlanning.gov)*

Public Space

Public spaces are designated areas within a community that are accessible and open to everyone regardless of race, income, gender, or ethnicity. Public spaces that are well designed and maintained stimulates good health for both residents and the environment. These spaces can be used for social mixing, civic participation, recreation, and also provide a sense of community. In Cayler Point, public space exists along the waterfront edge. Here, there is a gathering area that features a stepdown edge condition to the waterfront, and 2 piers on each side. These areas will provide the community with public space for various community uses.

Figure 56: *Waterfront Public Space. (Source: Author)*

Pedestrian-Friendly Streetscapes

Pedestrian-friendly streetscapes are walkable streets that make certain areas easily navigable by foot. These streetscapes can transform an urban area, making it more loveable for it's the residents of a community. These streetscapes promote walkability, and encourage resident interaction, strengthening community ties.

In Cayler Point, the site design favors the pedestrian and strives to give the site back to the pedestrian. This is done through the inclusion of pedestrian only areas that cut through the site all the way to the waterfront. This is also accomplished by hidden the parking component of each building in the center of each tower and through the use of a street cutting perpendicularly through that will allow access to these garages.

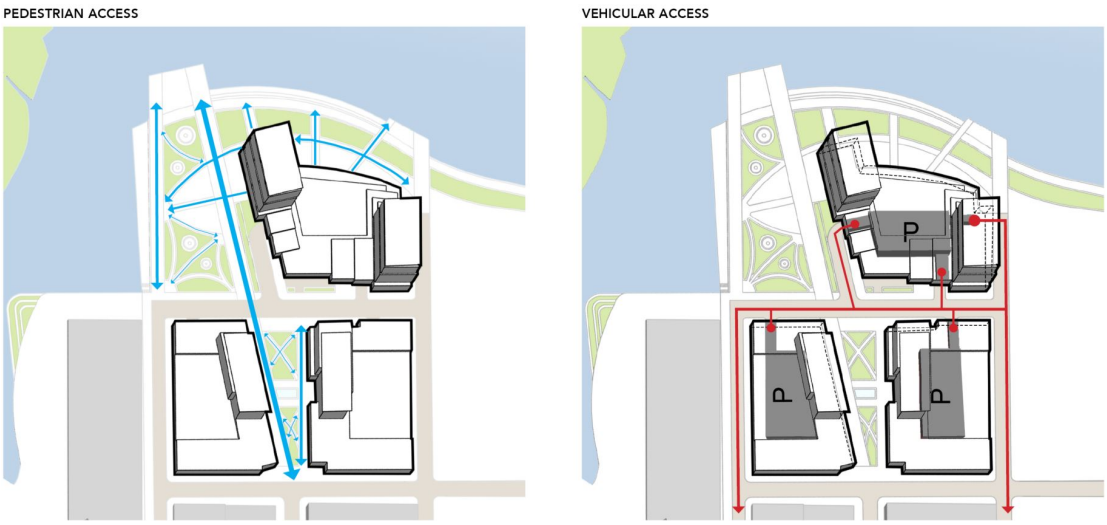

Figure 57: *Site pedestrian and vehicular accessibility. (Source: Author)*

Upland Connection

Cayler Point features an upland connection, which cuts diagonally through the development site and connects West Street to the East River Waterfront. This connection will be a pedestrian only walkway that will be about 30 feet wide. This walkway will provide a view corridor to the site that will allow for unobstructed views of the waterfront through the development from West Street.

Figure 58: *Cayler Point's Upland Connection. (Source: Author)*

Shore Public Walkway

The Shore Public Walkway is a pedestrian walkway that runs continually along the 2 mile stretch of shoreline on the Greenpoint Waterfront. This walkway is a feature of the Greenpoint-Williamsburg Waterfront Masterplan, and which strives to unify the waterfront through the creation of a publicly accessible waterfront. This walkway cuts through the development site where it intersects the Upland Connection, and will also allow for access to the Bushwick Park upon completion.

Figure 59: *Shore Public Walkway. (Source: Author)*

Chapter 15: Conclusion

Figure 60: *View of Development from East River. (Source: Author)*

As more people continue to migrated to urban areas, overcrowding will continue at a pace where the housing supply and existing infrastructure cannot support its population. In an attempt to produce housing and other developments to accommodate the growing populations, urban areas will continue to develop precious areas filled with vegetation and wildlife in a way that will harm the environment. As it becomes more evident how we are harming our environment, the human race needs to take a step back and evaluate development and construction methods that are sustainable and promote equality for all people.

This thesis asks the question of why we continue to harm our planet through certain development and building methods and explores sustainable alternatives to development and construction that are beneficial for the well-being of both the environment and human race. The site of this thesis explores how the remediation and redevelopment of abandoned

brownfield sites can provide a sustainable alternative to urban sprawl and the development of vacant land that is home to precious vegetation.

This thesis strives to demonstrate how urban areas can develop more housing to support the needs of the community rather than the financial gain for developers. Through demonstration in design, this thesis shows how developments can be sustainable through construction and the entirety of its existence. This thesis also demonstrates certain methods of design that will promote inclusivity and help end the segregation of racial, social, and economic demographic groups.

The proposed development for this thesis, Cayler Point, is located at the heart of the Greenpoint community on a site that has been abandoned and forgotten for decades. This project shows how one development can be a catalyst for revitalization of a neighborhood in a way that benefits and addresses the existing community needs, through housing, brownfield site remediation, sustainable building and construction methods, and inclusive public space design.

Figure 61: *Perspective of Cayler Point depicting the public spaces throughout the site. (Source: Author)*

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Figure Reference