ABSTRACT

Title of Thesis:	URBAN SPRAWL & CRITTER CRAWL: IMAGINING A MORE-THAN-HUMAN WAY OF LIVING
	Ramisa Maisha Islam, Master of Architecture & Community Planning, 2023
Thesis Directed By:	Brittany Williams, AIA LEED AP, Clinical Assistant Professor, School of Architecture, Planning and Preservation

Over half of the world's population lives in urban areas and that number is projected to double by 2050. Cities and urban transects have an important role in addressing climate change. As urban population and development grows, we also see a decline in biodiversity. Humans are not the only species being displaced. Native species lose their natural habitats due to development and seek refuge in urban areas. The complexity of cities allows for urban biodiversity to find a home, but these urban habitats are still human centered, forcing species to fit within a human designed environment. This thesis explores the balance between human living and urban biodiversity to integrate into our cities. Implementing urban biodiversity strategies and more than human design in urban neighborhoods can help to restore biodiversity and strengthen human relationships with the natural environment. Combining these concepts can reimagine the city as a shared ecosystem that serves all species. An ideal shared ecosystem can support urban living, embrace coexistence, and foster a symbiotic relationship between humans and nature.

URBAN SPRAWL & CRITTER CRAWL:
IMAGINING A MORE-THAN-HUMAN WAY OF LIVING

by

Ramisa Maisha Islam

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Chapter 1: Introduction

Introduction

Urbanization shapes the natural and human landscape at a rapid rate, and with global urbanization, which is projected to increase even further. Over half of the world lives in urban areas, expanding cities further and disrupting more of the natural environment. Urbanization leaves a lasting mark on the natural environment, its habitats, and the plants and animals that live within it. Urban development drastically changes land use and habitat fragmentation that native species cannot adapt to. The transition between natural and urban realms blurs, leaving behind fragmented built and natural habitats. Native species are displaced from their natural environment and lose resources. This makes it difficult for plants and animals to adapt to the changed landscape, displacing them further or pushing them towards extinction. The consequences of this hurt established ecological systems for native species, and for humans. Humans rely on natural systems for resources as well, disruptions in habitats and loss of biodiversity can negatively impact those systems. This can lead to consequences like loss of food production, polluted water systems or more severe climate change impacts.

Urban life relies heavily on natural resources and systems and urbanization causes a severe impact on those resources, because of this cities and urban areas have a significant role in the environment and addressing climate change. Cities have the potential to integrate solutions for the problems they create. Urban areas offer unique

habitats and networks that can house other species besides humans. In many areas, urban biodiversity is already established within cities. The urban environment offers unique complexities and can help some animals and plants adapt to and thrive within it. Animals like insects, birds, and small mammals, along with plant species, find refuge in cities. Existing biodiversity in urban areas shows signs that the built environment can cater to more than just people, but not without its challenges. The species that thrive in cities are often non-native, introduced either intentionally or inadvertently by human activities. These newcomers, often resilient and adaptable, may outcompete native species, disrupting the delicate balance of urban ecosystems. The issue is the urban environment, designed primarily for human needs, often fails to accommodate the unique requirements of native non-human species.

By shifting our anthropocentric views, cities and urban areas can become places for all species and natural systems. To reconcile the competitive forces of urbanization and biodiversity conservation, a paradigm shift is required. Urban design and architecture must move beyond the traditional human-centric approach and embrace a more-than-human perspective, one that recognizes the intrinsic value and interconnectedness of all living beings. This shift necessitates the integration of urban biodiversity strategies into the very fabric of our cities and highlights its value to urban living. By creating green infrastructure, restoring habitats, and adopting sustainable practices, we can foster coexistence between humans, plants, and animals within urban environments. Creating more-than-human cities also requires reframing how residents experience nature in urban areas and making the natural presence and value known. It calls for a fundamental rethinking of our relationship with the natural

world, a shift from exploitation to stewardship. It requires collaboration between humans and nonhumans to design cities that are not only livable for humans but also welcoming to a multitude of species. Exposure to other species and their natural systems can begin the shift in how humans view their place within nature. Integrating more-than-human and urban biodiversity strategies to cities at the urban, neighborhood, and building scale can ensure that cities can make a holistic approach towards fostering a symbiotic and biodiverse urban environment.

Chapter 2: Urbanization (The People Chapter)

Growth of Global Urbanization

Urbanization is the process by which people move from rural to urban areas. Urbanization and the migration to urban areas is considered recent in human history, appearing significantly within the last 200 years.[1] As reported by the United Nations in 2018, over half of the world's population already lives in urban areas and cities. That number is projected to increase to two thirds of the global population by 2050.[2]

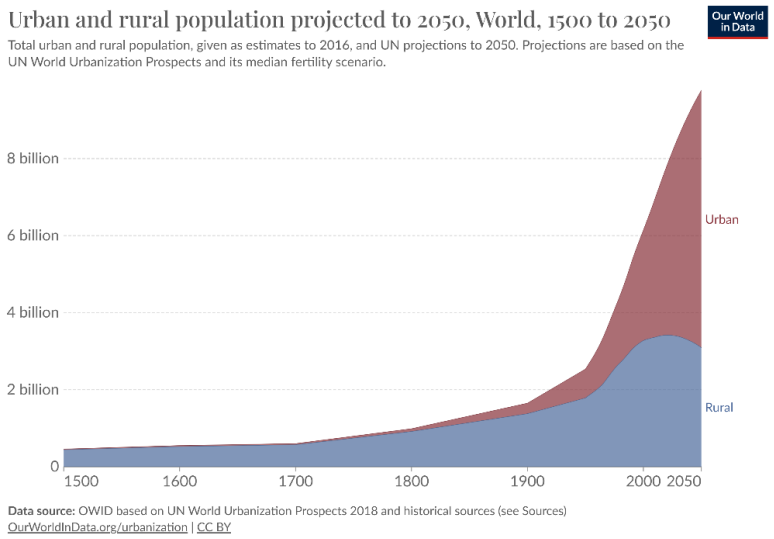

Figure 2.1 Urban and rural population projected to 2050, World, 1500 to 2050. (Source: Our World in Data)

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[1] Zack Taylor. *Shaping the Metropolis: Institutions and Urbanization in the United States and Canada*. McGill-Queen's Studies in Urban Governance. Montreal: McGill-Queen's University Press, 2019. https://search-ebscohost-com.proxy-um.researchport.umd.edu/login.aspx?direct=true&db=nlebk&AN=2117309&site=ehost-live.

[2] Hannah Ritchie and Max Roser, *Urbanization* (OurWorldInData.org, 2019) https://ourworldindata.org/urbanization

While urbanization is clearly recognized by the United Nations and the World Bank, these projections can vary due to the inconsistent definition of what is "urban."[3] Most countries establish their own definition of an urban area. Some definitions simply contrast to their rural areas, and others based the designation on data and metrics. The United States defines it based on data, where a territory needs to "encompass at least 2,000 housing units or have a population of at least 5,000."[4] For the purposes of this thesis, urban areas are defined more broadly and accept variety, including dense urban areas, urban transects, and surrounding suburbs.

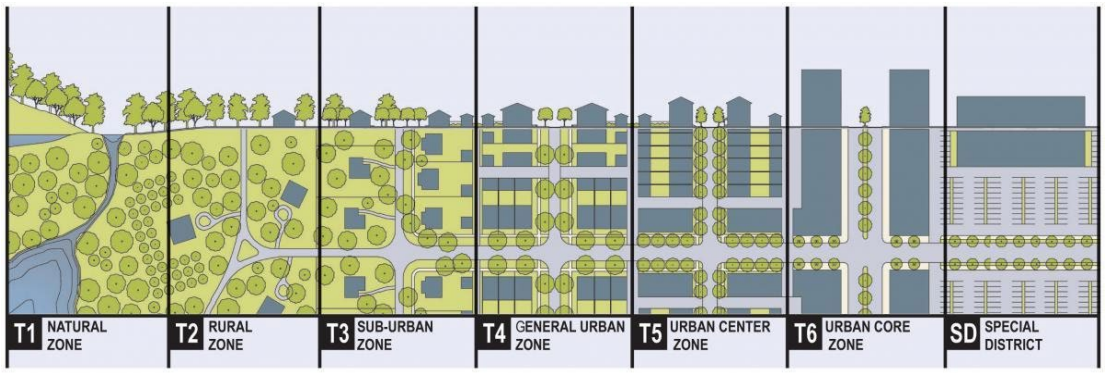

Figure 2.2 Transect Diagram (Source: DPZ)

People migrate to cities and surrounding urban areas for a variety of reasons, many of which are related to economic growth and benefits. There is a strong relationship between the rate of urbanization, in both developed and developing

[3] Neil Khor, Ben Arimah, Raymond Otieno Otieno, Matthijs van Oostrum, Mary Mutinda and Judith Oginga Martins. *World Cities Report 2022: Envisaging the Future of Cities.* (United Nations Human Settlements Programme, 2022), https://unhabitat.org/sites/default/files/2022/06/wcr_2022.pdf
[4] "Urban and Rural," United States Census Bureau, accessed November 16, 2023, https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural.html

countries, and with economic growth. Urban areas provide economic benefits through reducing poverty, offering employment opportunities, and overall providing a better quality of life for residents.[5] Likewise, cities and regions with higher economic growth and development show signs of increased urbanization.[6] Urbanization allows agglomeration economies where the concentration of individuals produce more economic output.[7]A larger concentration of individuals provides a wider scope of skills and collaboration that can contribute to new ideas and production.[8] This economic growth can come in different forms, including better living standards, technological development, and better education.[9] These factors depends on the location and country, but typically offers greater financial opportunities for those coming from rural areas, reducing overall poverty. While this can have a positive impact on people's lives, there are still environmental risks and consequences. Urban agglomeration processes can lead to overconsumption of resources and land, resulting in negative impacts on the environment, like climate change and loss of biodiversity.[10]

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[5] "Urbanization: expanding opportunities, but deeper divides," *United Nations Department of Economic and Social Affairs*, February 21, 2020.

[6] Mingxing Chen, Hua Zhang, Weidong Liu, Wenzhong Zhang, and Alejandro Raul Hernandez Montoya. "The Global Pattern of Urbanization and Economic Growth: Evidence from the Last Three Decades." *Plos One* 9, no. 8 (2014). doi:10.1371/journal.pone.0103799.

[7] Michail Fragkias, "Urbanization, Economic Growth and Sustainability," In *The Routledge Handbook of Urbanization and Global Environmental Change* Edited by Karen C. Seto, William D. Solecki and Corrie A. Griffin. 9-26. Routledge: Taylor & Francis Group, 2016.

[8] Michail Fragkias, "Urbanization, Economic Growth and Sustainability."

[9] Neil Khor, Ben Arimah, Raymond Otieno Otieno, Matthijs van Oostrum, Mary Mutinda and Judith Oginga Martins. *World Cities Report 2022: Envisaging the Future of Cities.* (United Nations Human Settlements Programme, 2022), https://unhabitat.org/sites/default/files/2022/06/wcr_2022.pdf

[10] Michail Fragkias, "Urbanization, Economic Growth and Sustainability,"

Urbanization in the DC Metropolitan Area

In 2020, the United States Census Bureau redefined an urban area as a territory that "encompasses at least 2,000 housing units or [has] a population of at least 5,000."[11] In the United States alone, about 275 million people lived in urban areas in 2021. The Northeast corridor is the second most urban region in the United States, with 84% of its population living in urban areas. This census designated region, also referred to as a megalopolis, stretches from Boston, Massachusetts to Washington D.C, including other major cities such as New York City and Baltimore. The industrial revolution and other factors contributed to the Northeast Corridor's rapid growth. Now the region is home to various industries, major corporations, and institutions and the continued innovation calls for continued urbanization.

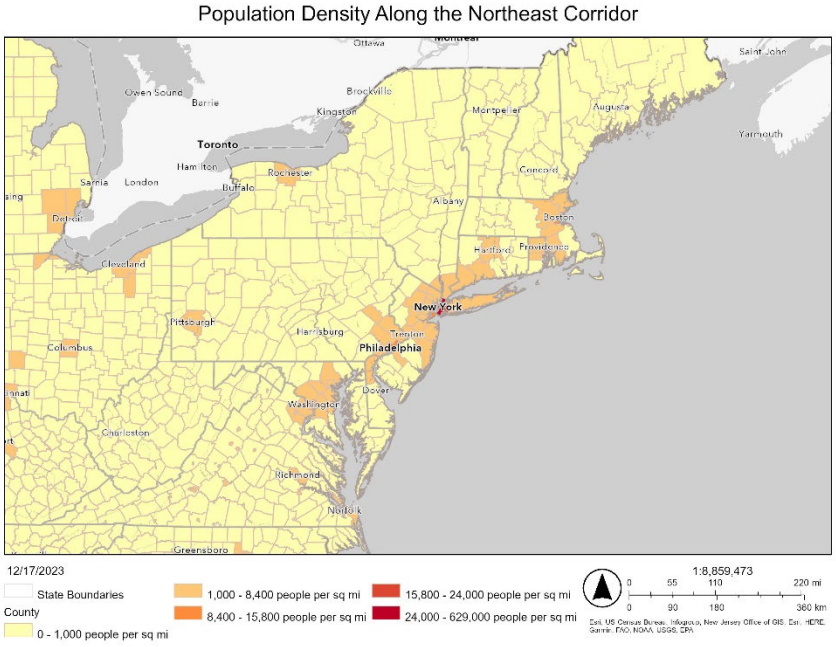

Figure 2.3 Population Density along the Northeast Corridor (Source: U.S Census)

[11] "Urban and Rural," United States Census Bureau, accessed November 16, 2023, https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural.html

The DC Metropolitan area consists of Washington D.C and parts of Maryland, Virginia, and West Virginia. The presence of multiple federal government offices and institutions encourages employment opportunities throughout the metropolitan area and its surrounding suburbs. D.C public transportation systems provide increased access to those opportunities and ease of travel to the suburban areas. Access to other economic hubs like Baltimore offer economic variety to the surrounding areas as well. In recent years, the surrounding suburban areas have seen increased development. There is a desire to live in cities, and areas like Prince George's County and Montgomery County that border DC recognize that. In response, local planning develops downtown type districts, and additional multifamily housing is built around those areas and metro stations.

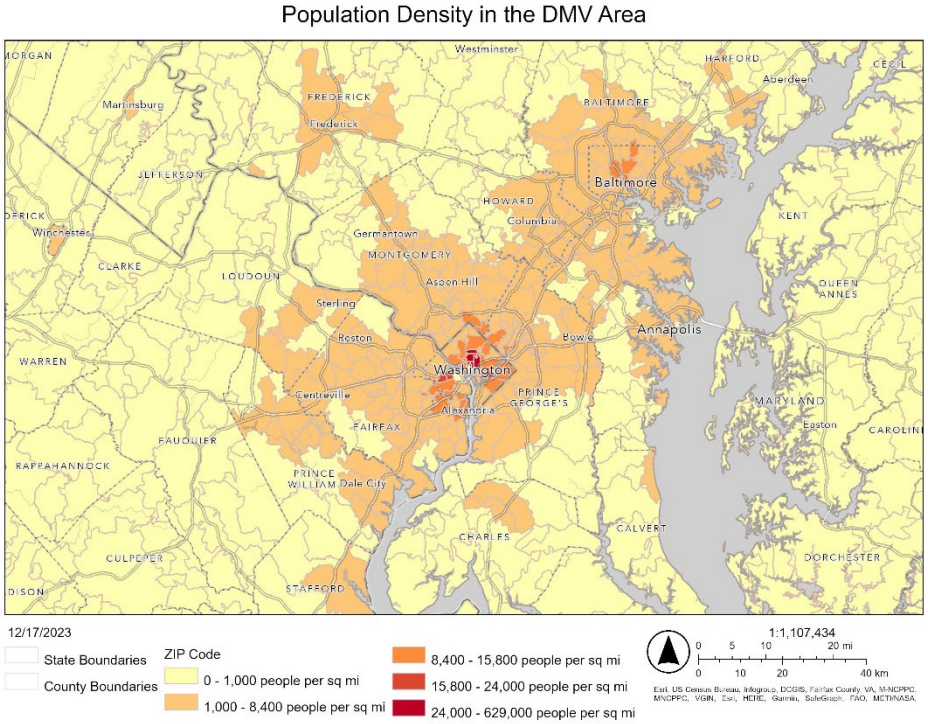

Figure 2.4 Population Density in the DMV Area (Source: U.S Census)

Living in Urban Areas

Needs of a City

Cities need to be places for people to live, work, and gather. Urban areas provide residents with an environment to socialize and grow as people. Sufficient housing is a significant demand for urban areas as American cities have shifted away from traditional central business districts to more flexible, live-work settings.[12] The desire to live in cities puts a strain on existing housing options and drives more urbanization in the surrounding areas.[13] Not keeping up with the demand for housing, increases costs and limits affordable housing.[14] Within the American context, housing is a significant measurement for urban areas as seen with the Census Bureau's definition of urban. This emphasizes the importance of housing in urban areas and their role in urban life. As cities become more desirable to live and work in, they also become a social space for residents. Cities can provide gathering spaces and socializing opportunities for their residents. Urban areas offer more cultural diversity and mixed income development, creating more unique experiences in the cities.[15] Exposure to different lifestyles and incomes can increase opportunities and social

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[12] Carla M. Kayanan, "A Critique of Innovation Districts: Entrepreneurial Living and the Burden of Shouldering Urban Development." *Environment & Planning* A 54, no. 1 (February 2022): 50–66. doi:10.1177/0308518X211049445.

[13] Loretta Lees, Tom Slater, and Elvin Wyly. *Gentrification*. New York: Routledge, 2008. https://search-ebscohost-com.proxy-um.researchport.umd.edu/login.aspx?direct=true&db=nlebk&AN=653933&site=ehost-live.

[14] Ibid.

[15] Morgan Bulger, Mark Joseph, Sherise McKinney, and Diana Bilimoria. "Social Inclusion through Mixed-Income Development: Design and Practice in the Choice Neighborhoods Initiative." *Journal of Urban Affairs* 45, no. 2 (February 2023): 168–90. doi:10.1080/07352166.2021.1898283.

benefits for residents.[16] Post Covid-19, younger adults continue to move to cities for their labor markets and for a diverse range of social experiences.[17] Public spaces and various events throughout cities provide residents opportunities to relax, socialize, and learn. Natural spaces provide added health benefits within a man-made environment, emphasizing the importance of gathering spaces in urban areas.

Human Consequences

With the rate of urbanization, it is important to understand the consequences that come with it. Current urbanization trends demand urgent urban planning and infrastructure that governing and planning bodies cannot always adequately provide.[18] Poorly planned cities impact the people's quality of life as it can increase risk of inequality in urban areas.[19] The benefits of urban wealth and development are not shared. An increased desire to live in certain areas increases the cost of living and housing demand, shifting development towards disinvested, urban, and suburban transects.[20] This increased demand risks gentrification and displacement, forcing

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[16] Morgan Bulger, Mark Joseph, Sherise McKinney, and Diana Bilimoria. "Social Inclusion through Mixed-Income Development: Design and Practice in the Choice Neighborhoods Initiative." *Journal of Urban Affairs* 45, no. 2 (February 2023): 168–90. doi:10.1080/07352166.2021.1898283.

[17] Sands, Gary, Laura A. Reese, Chade Saghir, and Pierre Filion. "Planning for Post-Pandemic Downtowns of Mid-Size Urban Areas." *Planning Practice & Research* 37, no. 3 (June 2022): 393–405. doi:10.1080/02697459.2021.2016200.

[18] "Urbanization: expanding opportunities, but deeper divides," *United Nations Department of Economic and Social Affairs*, February 21, 2020.

[19] Florida, Richard L. *The New Urban Crisis: How Our Cities Are Increasing Inequality, Deepening Segregation, and Failing the Middle Class-- and What We Can Do About It*. New York: Basic Books, 2017.

[20] Nicholas Finio. 2021. "Measurement and Definition of Gentrification in Urban Studies and Planning." Journal of Planning Literature 37, no. 2 (November): 249–264. https://doi-org.proxy-um.researchport.umd.edu/10.1177/08854122211051603.

existing residents out of their neighborhoods due to rising costs and increased development.[21] Displacement can push people toward lower quality housing or unhouse them entirely, risking human health and leaving its population vulnerable. Displacement may also push urban residents to the surrounding, more affordable areas, creating a cascading effect on urban outskirts.[22] In the case of Washington DC, many residents move to Maryland and Virginia. These suburban areas may not have the capacity or infrastructure to house a sudden influx of residents, so that increases their own urban development.

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[21] Ibid.

[22] Loretta Lees, Tom Slater, and Elvin Wyly. *Gentrification*. New York: Routledge, 2008. https://search-ebscohost-com.proxy-um.researchport.umd.edu/login.aspx?direct=true&db=nlebk&AN=653933&site=ehost-live.

Chapter 3: Biodiversity (The Critter Chapter)

Definition

Biodiversity is a measure of the variation of life on Earth. It encompasses all living things, from plants, animals, and microorganisms to the genes they contain and the ecosystems they form. Biodiversity is essential for the health of the planet and all its inhabitants, as it contributes to natural systems and how they work. There are three levels of biodiversity that work in tandem which each other. Genetic diversity refers to the variation of genetic makeup within a species.[23] This variation is essential for a species to adapt to environmental change and disease.[24] Species diversity or richness refers to the number of different species within a community.[25] A greater number of species means that there are more ecological niches available, which can lead to a more stable and resilient ecosystem. Ecosystem diversity refers to the variety of different ecosystems within a region. Different ecosystems provide different services, such as water filtration, pollination, and carbon storage. Human intervention plays a major role in biodiversity levels and loss. Cities in particular have a larger impact on

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[23] Ya-ping Zhang, Xiao-xia Wang, Oliver A. Ryder, Hai-peng Li, He-ming Zhang, Yange Yong, and Peng-yan Wang. "Genetic Diversity and Conservation of Endangered Animal Species." *Pure and Applied Chemistry* 74, no. 4 (2002): 575–84. doi:10.1351/pac200274040575.

[24] Ibid.

[25] Fernando P. Gaona, Iñiguez-Armijos Carlos, Gunnar Brehm, Konrad Fiedler, and Espinosa Carlos Iván. "Drastic Loss of Insects (Lepidoptera: Geometridae) in Urban Landscapes in a Tropical Biodiversity Hotspot." *Journal of Insect Conservation: An International Journal Devoted to the Conservation of Insects and Related Invertebrates* 25, no. 3 (2021): 395–405. doi:10.1007/s10841-021-00308-9.

global biodiversity as many cities are located along rivers and coastlines, habitats with higher proportions of biodiversity.[26] Other human actions like climate change and introduction of invasive species can contribute to biodiversity loss as well. In October 2023, the United States Fish and Wildlife Service delisted 21 species from the endangered species act, due to extinction caused by human intervention.[27]

Figure 3.1 Symbiotic Relationship between Biodiversity and Humans (Source: Author)

[26] Robert McDonald, "Integrating Biodiversity and Ecosystem Services into Urban Planning and Conservation," In *The Routledge Handbook of Urbanization and Global Environmental Change* Edited by Karen C. Seto, William D. Solecki and Corrie A. Griffin. Routledge: Taylor & Francis Group, 2016.

[27] The U.S Fish and Wildlife Service, "Fish and Wildlife Service Delists 21 Species from the Endangered Species Act due to Extinction," news release, October 16, 2023. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction.

There is a clear interconnected relationship between humans and biodiversity, as biodiversity supports the natural systems humans rely on. Biodiversity impacts ecological functions that contribute to food production, clean water, and other natural resources.[28] Species play a role in multiple natural functions, increasing the importance of biodiversity for overall ecosystem functioning, as the loss on one species can impact the entire system.[29] This can be seen through the current pollinator crisis. Agricultural land use has pushed out native pollinator habitats and forced monoculture, leaving limited flowering plants available for pollinators.[30] This has reduced pollinator populations, like bees and butterflies, which can impact agriculture and food production. A decrease in food production can then affect food supply and economic growth, impacting people's daily lives.[31] Biodiversity can also play a role in addressing climate change and its consequences. Plant biodiversity is important in the soil carbon sequestration, has more variety of vegetation improves of the quality of carbon sequestration in soil and organic matter.[32] This can play a significant role in reducing carbons emissions and combating climate. Biodiversity has ethical,

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[28] Ingrid J. Visseren-Hamakers, and Marcel T. J Kok, eds. *Transforming Biodiversity Governance.* Cambridge, United Kingdom: Cambridge University Press, 2022. 6-8.

[29] Lars Gamfeldt, Helmut Hillebrand and Per R. Jonsson. "Multiple functions increase the importance of biodiversity for overall ecosystem functioning." *Ecology*, 89 5 (2008): 1223-31. https://doi.org/10.1890/06-2091.1.

[30] Neal M. Williams, Kimiora L Ward, Nathaniel Pope, Rufus Isaacs, Julianna Wilson, Emily A May, Jamie Ellis, et al. "Native Wildflower Plantings Support Wild Bee Abundance and Diversity in Agricultural Landscapes Across the United States." *Ecological Applications* 25, no. 8 (2015): 2119–31. doi:10.1890/14-1748.1.

[31] Robert McDonald, "Integrating Biodiversity and Ecosystem Services into Urban Planning and Conservation," In *The Routledge Handbook of Urbanization and Global Environmental Change* Edited by Karen C. Seto, William D. Solecki and Corrie A. Griffin. Routledge: Taylor & Francis Group, 2016.

[32] Marie Spohn, et al, "The positive effect of plant diversity on soil carbon depends on climate." *Nature Communications*, Vol. 14 6624, 2023. https://doi.org/10.1038/s41467-023-42340-0

economic, and life-supporting values, and its extinction is a major threat to these values and the survival of human civilization.

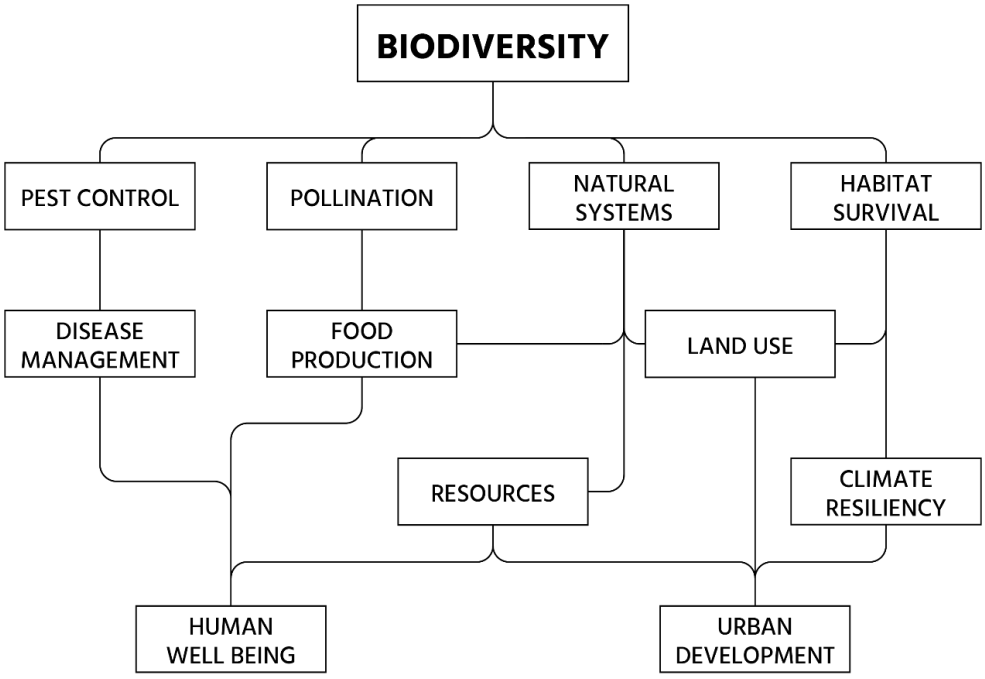

Figure 3.2 Impact of Biodiversity (Source: Author)

Impact of Urbanization on Biodiversity

Urbanization and the rapid rate that it grows does not only affect people, but also other plant and animal species. Urban development directly disrupts the existing ecosystems at all scales, impacting existing natural systems that maintain habitats, such as water and food sources. The most severe consequence of urbanization on biodiversity is habitat loss and fragmentation.[33] Habitat fragmentation is the breaking up of a large, natural habitat into smaller, more isolated patches of ecosystems. This

[33] Thomas Elmqvist, Wayne Zipperer, and Burak Güneralp, "Urbanization, habitat loss, biodiversity decline: solution pathways to break the cycle." In *The Routledge Handbook of Urbanization and Global Environmental Change* Edited by Karen C. Seto, William D. Solecki and Corrie A. Griffin. Routledge: Taylor & Francis Group, 2016.

extreme change in the environment impacts biodiversity as native plant and animal species suddenly lose the natural systems that they rely on. The fragmented pieces left behind do not offer enough resources to support species long enough for them to adapt, impacting natural selection and species' long term survival.[34] Urbanization also introduces outside factors that negatively impact the environment, such as pollution. Pollution in various forms can hurt the quality of surrounding habitats and their natural systems.[35] This also contributes to climate change, creating severe long term effects on ecosystems and making them uninhabitable. Urban areas and cities also risk introducing non-native and invasive species to the existing ecosystem. Invasive species can compete with native species for resources and displace them from their habitats, risking native biodiversity.[36] All of these human-caused interventions threaten biodiversity and have already contributed to biodiversity loss.

This urban growth impacts natural ecosystems and biodiversity at various scales, depending on the intervention. Current United Nations projections estimate that about 68% of the world's population will be living in urban areas by 2050.[37] Urbanization occurs at disproportionate rates and places, that it is a serious threat to

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[34] S.A Elias. "Rise of Human Influence on the World's Biota." *Encyclopedia of the Anthropocene,* Vol 3 2018, 53-65. https://doi.org/10.1016/B978-0-12-809665-9.09144-8

[35] Garrard, Georgia E., Nicholas S. G. Williams, Luis Mata, Jordan Thomas, and Sarah A. Bekessy. "Biodiversity Sensitive Urban Design." *Conservation Letters* 11, no. 2 (March 2018): 1. doi:10.1111/conl.12411.

[36] Elias. "Rise of Human Influence on the World's Biota." 53-65.

[37] Neil Khor, Ben Arimah, Raymond Otieno Otieno, Matthijs van Oostrum, Mary Mutinda and Judith Oginga Martins. *World Cities Report 2022: Envisaging the Future of Cities.* (United Nations Human Settlements Programme, 2022), https://unhabitat.org/sites/default/files/2022/06/wcr_2022.pdf

biodiversity.[38] Cities are often along riparian areas and coastline, risking higher amounts of biodiversity.[39] Urbanization is one of the main land use changes that is causing global insect collapse and the loss of insect biodiversity.[40] Urban land and expansion estimates to drive over eight hundred species to species imperilment, with habitat loss as a predominant factor in this.[41] Land use change favors impervious urban areas and removes native vegetation from ecosystems. The loss of vegetation density can destroy the homes of animals and insects, displacing them from their natural habitats.[42] Urban runoff, increased by impervious surfaces, pollutes water systems, hurting native aquatic or semi-aquatic animals that rely on them.[43] As an example, stormwater runoff increases the amount of nitrogen, phosphorus and sediment pollutants in the Chesapeake Bay, lower the bay's water quality.[44] In 2022,

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[38] Thomas Elmqvist, Wayne Zipperer, and Burak Güneralp. "Urbanisation, habitat loss, biodiversity decline: solution pathways to break the cycle." In *The Routledge Handbook of Urbanisation and Global Environmental Change* Edited by Karen Seto, William Solecki, Corrie Griffith, 139-151. Routledge, London, UK, 2016.

[39] Robert McDonald, "Integrating Biodiversity and Ecosystem Services into Urban Planning and Conservation," In *The Routledge Handbook of Urbanization and Global Environmental Change* Edited by Karen C. Seto, William D. Solecki and Corrie A. Griffin. Routledge: Taylor & Francis Group, 2016.

[40] María Silvina Fenoglio, Ana Calviño, Ezequiel González, Adriana Salvo, and Martin Videla. "Urbanisation Drivers and Underlying Mechanisms of Terrestrial Insect Diversity Loss in Cities." *Ecological Entomology* 46, no. 4 (2021): 757–771. Accessed October 13, 2023. https://onlinelibrary.wiley.com/doi/abs/10.1111/een.13041.

[41] Rohan D. Simkin, et al. "Biodiversity Impacts and Conservation Implications of Urban Land Expansion
Projected to 2050." *Proceedings of the National Academy of Sciences* 119, no. 12 (2022). doi:10.1073/pnas.2117297119.

[42] Jose Antonio Puppim de Oliveira, Christopher N. H. Doll, Raquel Moreno-Peñaranda, and Osman Balaban. "Urban Biodiversity and Climate Change." In *Global Environmental Change*, edited by Bill Freedman, 461–468. Handbook of Global Environmental Pollution. Dordrecht: Springer Netherlands, 2014. https://doi.org/10.1007/978-94-007-5784-4_21.

[43] Ibid.

[44] Chesapeake Bay Program. "2025 Watershed Implementation Plans (WIPs)." Chesapeake Bay Program, accessed December 17, 2023. https://www.chesapeakeprogress.com/clean-water/watershed-implementation-plans.

stormwater runoff caused by development contributed to 17% of nitrogen pollution, 17% of phosphorus, and 9% of sediment to the Chesapeake Bay.[45] Climate change risks aquatic habitats even further with more intense storms and flooding.[46] Urban areas need to change in how they expand in order to protect biodiversity and prevent species from being pushed to extinction.

Urban Biodiversity

While urbanization displaces many native plant and animal species, some manage to find refuge in urban areas. Urban biodiversity is the variety and amount of living organisms found in cities and urban areas, along with the ecological systems they live in.[47] Urban biodiversity offers a unique perspective on how we see the environment as it considers both biogeographic and anthropogenic factors, like land use and pollution.[48] As previously mentioned, urban areas can negatively impact natural systems like destroying habitats or polluting waterways. Despite this, some species have been able to adapt to urban environments. The types of species commonly considered a part of urban biodiversity include insects, birds, small

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[45] Ibid.

[46] Jose Antonio Puppim de Oliveira, Christopher N. H. Doll, Raquel Moreno-Peñaranda, and Osman Balaban. "Urban Biodiversity and Climate Change." In *Global Environmental Change*, edited by Bill Freedman, 461–468. Handbook of Global Environmental Pollution. Dordrecht: Springer Netherlands, 2014. https://doi.org/10.1007/978-94-007-5784-4_21.

[47] Georgia E. Garrard, Nicholas S. G. Williams, Luis Mata, Jordan Thomas, and Sarah A. Bekessy. "Biodiversity Sensitive Urban Design." Conservation Letters 11, no. 2 (March 2018): 1. doi:10.1111/conl.12411.

[48] Jose Antonio Puppim de Oliveira, Christopher N. H. Doll, Raquel Moreno-Peñaranda, and Osman Balaban. "Urban Biodiversity and Climate Change." In *Global Environmental Change*, edited by Bill Freedman, 461–468. Handbook of Global Environmental Pollution. Dordrecht: Springer Netherlands, 2014. https://doi.org/10.1007/978-94-007-5784-4_21.

mammals, and some aquatic species.[49] Trees and other forms of vegetation can be considered as well. In Washington DC, the city has 240 species of birds, 32 species of mammals, and over a thousand species of invertebrates.[50] The city also has 289 acres of wetlands in the District, which are hubs for more biodiversity that can extend into the city.[51] Cities also introduce invasive or non-native species to urban areas, and tend to be able to support these species.[52] The existence of urban species also does not guarantee that the species prefer urban areas, as some cities can become ecological traps.[53] Urban biodiversity, while affected by human development, offers a valuable lens through which to examine the complex interplay between human activities and the natural world.

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[49] Stephanie Panlasigui, Erica Spotswood, Erin Beller, and Robin Grossinger. 2021. "Biophilia beyond the Building: Applying the Tools of Urban Biodiversity Planning to Create Biophilic Cities" Sustainability 13, no. 5: 2450. https://doi.org/10.3390/su13052450

[50] "Sustainable DC 2.0 Nature Section." Department of Energy & Environment, District of Columbia. 109.
https://sustainable.dc.gov/sites/default/files/dc/sites/sustainable/page_content/attachments/SDC2%20Nature.pdf

[51] "Sustainable DC 2.0 Nature Section." 109.

[52] Rohan D. Simkin, Karen C Seto, Robert I McDonald, and Walter Jetz. "Biodiversity Impacts and Conservation Implications of Urban Land Expansion Projected to 2050." Proceedings of the National Academy of Sciences 119, no. 12 (2022). doi:10.1073/pnas.2117297119.

[53] Erica N Spotswood, Erin E Beller, Robin Grossinger, J Letitia Grenier, Nicole E Heller, Myla F J Aronson, "The Biological Deserts Fallacy: Cities in Their Landscapes Contribute More than We Think to Regional Biodiversity," *BioScience*, Volume 71, Issue 2, February 2021, Pages 148–160, https://doi.org/10.1093/biosci/biaa155

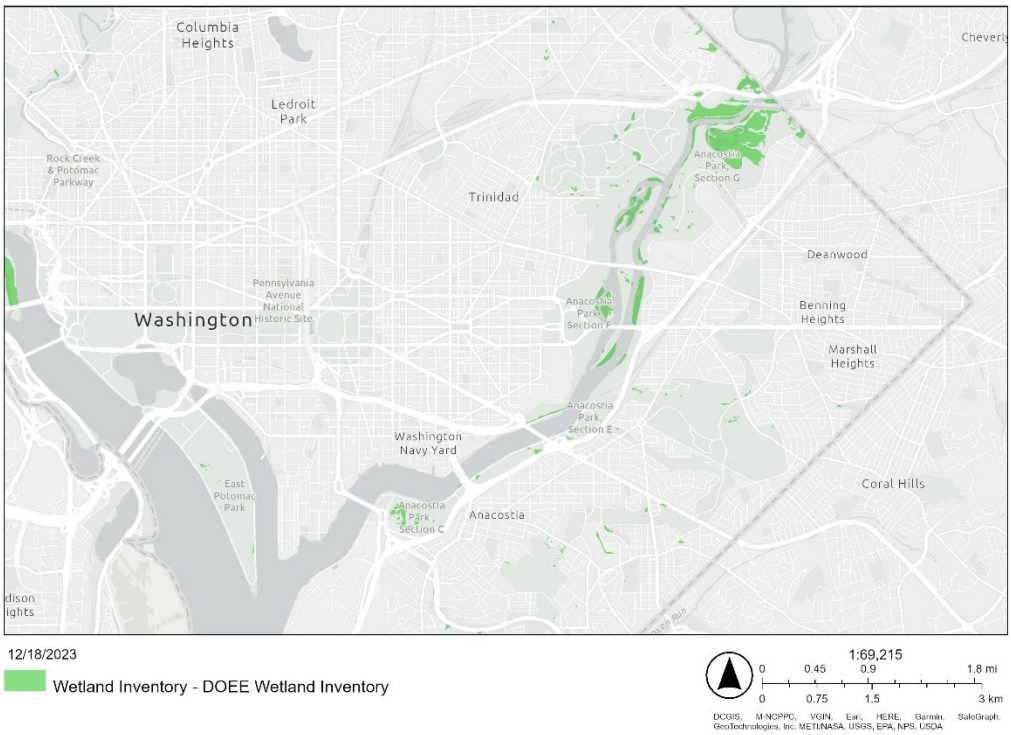

Figure 3.3 Northeast DC Wetland Locations (Source: DC Department of Energy and Environment)

There are several reasons why some species settle in urban areas. While urban areas do make extreme land use changes and impervious surfaces, cities create distinct types of habitats that species can adapt to. Urban areas can provide unique habitats for both native and non-native species. This can happen through designed spaces like gardens and public parks, or even through human-centered built spaces, like rooftops and abandoned buildings.[54] With the amount of activity in these areas, cities can provide food sources through food scraps, landscaping, and other urban pests. In some cases, urban areas can become places for species conservation at

[54] Lepczyk, Christopher A., Myla F. J. Aronson, Karl L. Evans, Mark A. Goddard, Susannah B. Lerman, and J. Scott MacIvor. "Biodiversity in the City: Fundamental Questions for Understanding the Ecology of Urban Green Spaces for Biodiversity Conservation." *BioScience* 67, no. 9 (September 1, 2017): 799–807. Accessed October 13, 2023. https://doi.org/10.1093/biosci/bix079.

regional and global scales, allowing for some native species to actually thrive in cities.[55] The quality and amount of urban biodiversity depends on the size and quality of the urban green spaces and habitats offered.[56] The range of habitat types in urban areas can come in the form of green spaces, brownfields, and native, vegetation. This creates a unique environmental gradient within the city that some animals and plants can survive and adapt to, even after being displaced from their original native habitat. (Figure 3.1) Because of this unique ecosystem, urban areas have the potential to become urban biodiversity hubs and species conservation sites at a much greater scale.

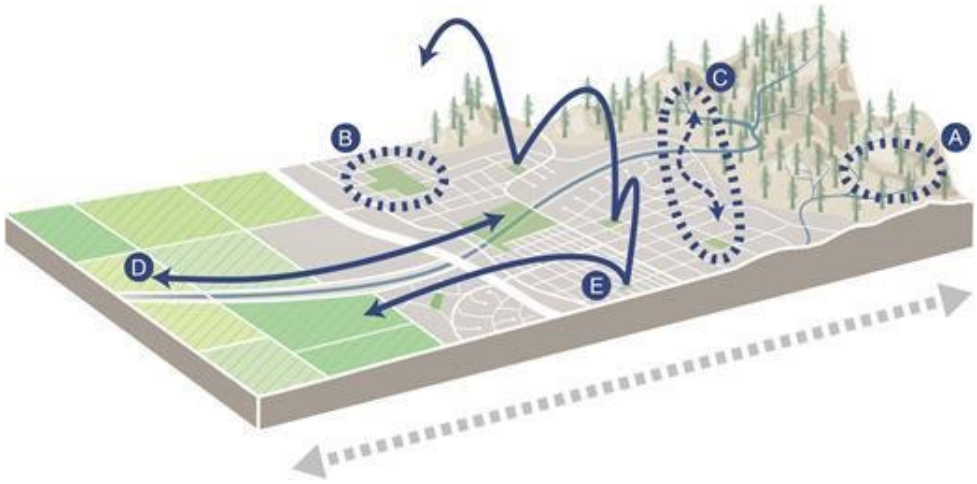

Figure 3.4: Environmental Gradient between Urban and Rural Areas. (Source: Erica N Spotswood, et al, "The Biological Deserts Fallacy: Cities in Their Landscapes Contribute More than We Think to Regional Biodiversity," *BioScience*, 71, no. 2 (2021), 148.)

[55]Lepczyk, et al. "Biodiversity in the City: Fundamental Questions for Understanding the Ecology of Urban Green Spaces for Biodiversity Conservation." 799-807.
[56] Ibid.

Chapter 4: More-than-Human Design

Definition

"More-than-human" is a concept that influences various fields, including more tangible fields such as design and environmentalism. More-than-human refers to the perspective that all living and non-living entities are interconnected and shifts away from an anthropocentric point of view.[57] More-than-human thinking, or interspecies thinking, highlights humans' interdependence with the environment and non-human entities like animals, plants, and ecosystems. It challenges western, anthropocentric views of places in favor of coexistence, a shared environment and experience.

This concept is not new, as many Indigenous cultures and epistemologies already recognize and integrate into daily life.[58] Indigenous cultures recognized the reciprocal relationships between humans, land, and other species.[59] Within these epistemologies, the nature and the land itself is recognized as living beings and acknowledges working within the limits and needs of nature.[60] Pushing the limits of nature, can lead to severe consequences, like the impact of climate change that we are

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[57] Niki Kiepek. "Occupation in the Anthropocene and Ethical Relationality." *Canadian Journal of Occupational Therapy* (April 18, 2023): 00084174231169390. https://doi.org/10.1177/00084174231169390.
[58] Libby Porter, Julia Hurst, and Tina Grandinetti. "The Politics of Greening Unceded Lands in the Settler City." *Australian Geographer* 51, no. 2 (June 2020): 221–38. doi:10.1080/00049182.2020.1740388.
[59] Cecily Maller, "Re-orienting nature-based solutions with more-than-human thinking," *Cities* Volume 113, 2021. https://doi-org.proxy-um.researchport.umd.edu/10.1016/j.cities.2021.103155.
[60] Ibid.

starting to see. More-than-human, in all its interpretations, calls for a holistic and inclusive approach to understanding and interacting with the world around us.

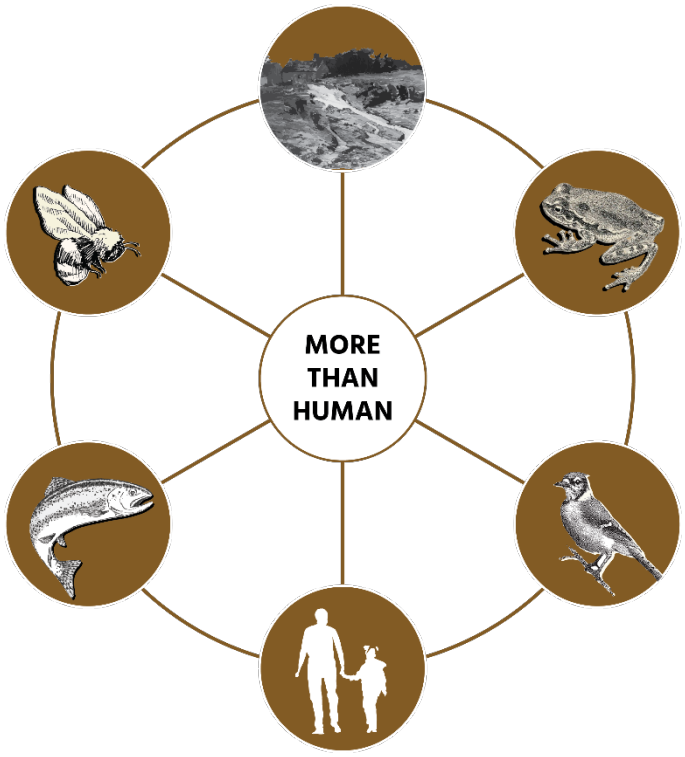

Figure 4.1 More-than-Human Concept (Source: Author)

More-than-human as an urban concept has become more popularized as western interpretations of urban areas have shifted. Modern urban design is more willing to challenge the idea that cities are the opposite to nature. This still raises concerns that existing cities and urban areas are too human-centric. Throughout the 20th century, nature has been a more recognized tool in research and how we live. Cities have shifted to be interpreted as living, breathing organisms, rather than just concrete jungles. This opens a perspective that cities can grow, adapt, and connect to

other systems.[61] While this is a positive shift for how urbanization grows, this approach focused on the cities as a single body and left little room to consider other nonhumans. In the late 20th century, the opposite of the approach started to become popular; that nature in its own way was a busy metropolis.[62] This was similar to indigenous interpretations and highlighted how human-centered ways of living caused climate change and impacted hundreds of natural species and systems. This sudden impact on biodiversity and the natural environment has pushed for more sustainable approaches to the built environment and our cities. In 1996, David Abram coined the term "more-than-human" to refer to the natural world and start to explore humans' relationships with it.[63] Sustainable systems thinking is the approach to understanding and managing complex systems in a way that ensures their long-term viability and well-being.[64] Similar to more-than-human, it emphasizes the interconnectedness of all parts of a system, recognizing that actions in one area can have ripple effects throughout the entire system. As a result of these shifts in perspective, the concept of "more-than-human" is gaining traction in urban design, emphasizing the need to consider the interconnectedness of humans and non-humans in the creation of sustainable and harmonious urban environments.

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[61] K. Wahl-Jorgensen. "The Chicago School and Ecology: A Reappraisal for the Digital Era."
[62] Bruce Braun. "Environmental Issues: Writing a More-Than-Human Urban Geography." *Progress in Human Geography* 29, no. 5 (2005): 635–50. doi:10.1191/0309132505ph574pr.
[63] Abram, David. 1996. *The Spell of the Sensuous: Perception and Language in a More-Than-Human World First* ed. New York: Pantheon Books.
[64] Kathryn M. Davidson, and Jackie Venning. "Sustainability Decision-Making Frameworks and the Application of Systems Thinking: An Urban Context." Local Environment 16, no. 3 (March 2011): 213–28. doi:10.1080/13549839.2011.565464.

Benefits

More-than-human strategies can be utilized to help and support natural systems, plant and animal species. Reevaluating human development to incorporate more-than-human design can enhance and conserve habitats for native plant and animal species. These concepts can be implemented by habitat and ecological restoration can protect biodiversity within cities.[65] The United States already sets aside "wilderness areas" to protect natural areas and biodiversity from human development.[66] More-than-human design can integrate the wilderness to how humans live by implementing habitat patches and vegetation corridors.[67] It can also help create biodiversity sensitive urban areas, in order to help species thrive in these new habitats.[68] Plant and animal species can establish new habitats and homes within the urban developments, helping in preserving species abundance and density within native areas.[69] Planting native plant species within habitat patches and green spaces

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[65] Joscha Beninde. Michael Veith, and Axel Hochkirch. "Biodiversity in Cities Needs Space: A Meta-Analysis of Factors Determining Intra-Urban Biodiversity Variation." *Ecology Letters* 18, no. 6 (2015): 581–92. https://doi.org/10.1111/ele.12427.

[66] Joyce Hwang. "Constructing Wilderness." *New Constellations, New Ecologies: proceedings of the 101st Annual Meeting of the Association of Collegiate Schools of Architecture (ACSA)*, pp. 344-351. 2013.

[67] Joscha Beninde. Michael Veith, and Axel Hochkirch. "Biodiversity in Cities Needs Space: A Meta-Analysis of Factors Determining Intra-Urban Biodiversity Variation." *Ecology Letters* 18, no. 6 (2015): 581–92. https://doi.org/10.1111/ele.12427.

[68] Garrard, Georgia E., Nicholas S. G. Williams, Luis Mata, Jordan Thomas, and Sarah A. Bekessy. "Biodiversity Sensitive Urban Design." *Conservation Letters* 11, no. 2 (March 2018): 1. doi:10.1111/conl.12411.

[69] Greg Planchuelo, Moritz von Der Lippe, and Ingo Kowarik. "Untangling the Role of Urban Ecosystems As Habitats for Endangered Plant Species." *Landscape and Urban Planning* 189 (2019): 320–34. https://doi.org/10.1016/j.landurbplan.2019.05.007.

can also minimize anthropogenic threats to biodiversity and specific species.[70] Limiting manicured yards and landscaping and prioritizing native plant spaces can reduce the impact of invasive species on natural systems.[71] Maintaining biodiversity and minimizing loss to important to the functionality of natural systems that humans rely on. More-than-human design can create safe urban environments that meet the needs of plants and animals to be comfortable in these unique habitats and conserve species populations.

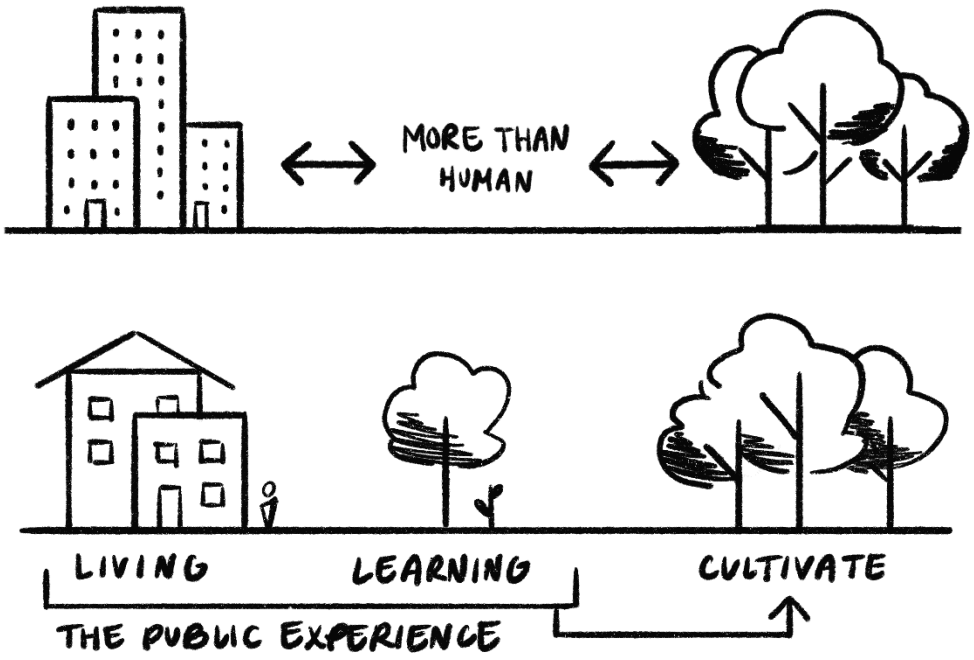

Figure 4.2 More-than-Human as a bridge to Nature (top) and Process within Urban Context (bottom) (Source: Author)

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[70] Joscha Beninde. Michael Veith, and Axel Hochkirch. "Biodiversity in Cities Needs Space: A Meta-Analysis of Factors Determining Intra-Urban Biodiversity Variation." *Ecology Letters* 18, no. 6 (2015): 581–92. https://doi.org/10.1111/ele.12427.

[71] Garrard, Georgia E., Nicholas S. G. Williams, Luis Mata, Jordan Thomas, and Sarah A. Bekessy. "Biodiversity Sensitive Urban Design." *Conservation Letters* 11, no. 2 (March 2018): 1. doi:10.1111/conl.12411.

More-than-human thinking puts human and nonhuman species and systems at equal level of importance, meaning there are benefits to humans as much as the natural environment. More-than-human design brings human living closer to the natural world and fosters a stronger connection to it. There are benefits for psychological health, like reducing stress and mental health, and physical health, like providing exercise. Spending time in green and blue natural environments can help improve health and well-being for humans.[72] Post Covid-19, natural spaces are seen as more valuable as the natural environment provided safe spaces for social interaction.[73] This stronger connection created by sustainable and more-than-human intervention also promotes environmental education and stewardship for people. Being exposed to natural elements and systems provides people with a better understanding of their place in the natural world. A stronger interest in the environment can encourage public participation in ecological research, especially in urban areas.[74] Organizations like NASA and the National Parks Services already offer Citizen Science programs to encourage public participation and research in natural environments.[75] These programs can consist of long term observations of the natural environment and collect the data for further research, like eBird, developed by the

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[72] Jonathan Reeves, Conor H. D. John, K. A. Wood and Phoebe R. Maund. "A Qualitative Analysis of UK Wetland Visitor Centres as a Health Resource." *International Journal of Environmental Research and Public Health*, 18 (2021). https://doi.org/10.3390/ijerph18168629.

[73] Jonanth Reeves, Conor H. D. John, K. A. Wood and Phoebe R. Maund. "A Qualitative Analysis of UK Wetland Visitor Centres as a Health Resource."

[74] Seth B. Magle, Mason Fidino, Elizabeth W Lehrer, Travis Gallo, Matthew P Mulligan, María Jazmín Ríos, Adam A Ahlers, et al. "Advancing Urban Wildlife Research through a Multi-City Collaboration." *Frontiers in Ecology and the Environment* 17, no. 4 (2019): 232–239. https://onlinelibrary.wiley.com/doi/abs/10.1002/fee.2030.

[75] "CitizenScience.Gov." Accessed October 20, 2023. https://www.citizenscience.gov/.

Cornell Lab of Ornithology.[76] Sustainability efforts can be better implemented if there is a public interest in the environment and understanding how humans impact it. This can minimize anthropogenic damages and address climate change and its consequences as well.[77] More-than-human thinking and its strategies can ensure a better planet for people and future generations.

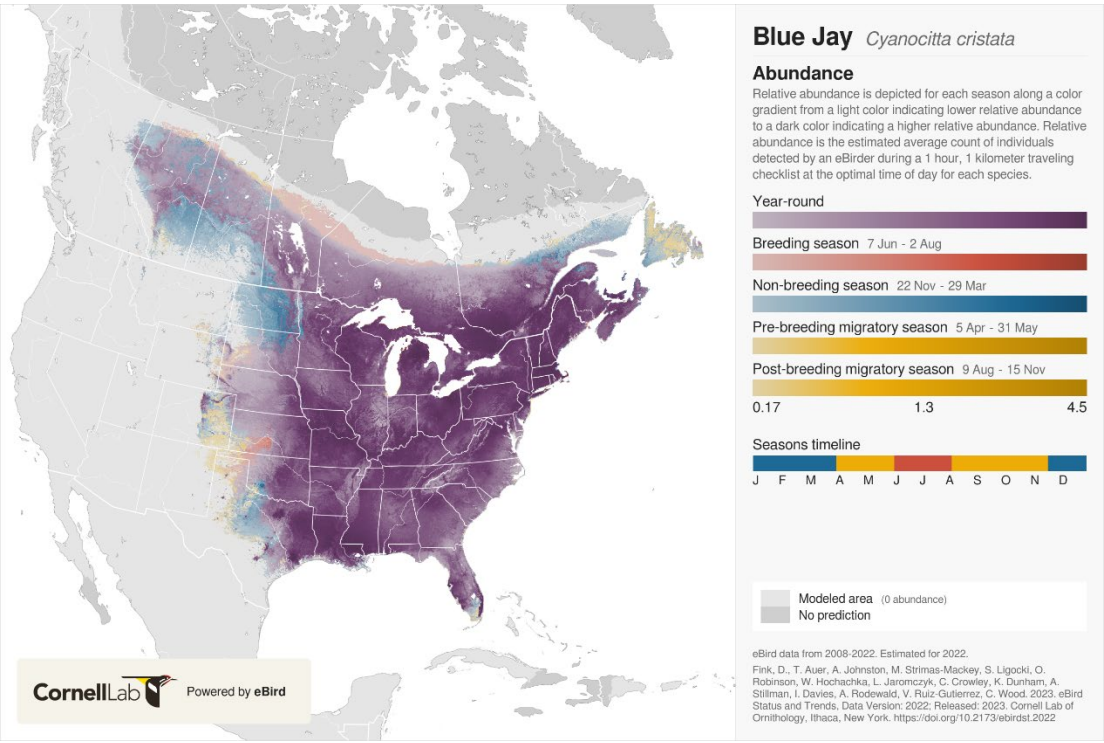

Figure 4.3 Blue Jay Abundance Map. Example of eBird's citizen observation data. (Source: Cornell Lab of Ornithology)

[76] eBird. "About eBird." eBird, accessed December 18, 2023. https://ebird.org/about.
[77] Seth B. Magle, Mason Fidino, Elizabeth W Lehrer, Travis Gallo, Matthew P Mulligan, María Jazmín Ríos, Adam A Ahlers, et al. "Advancing Urban Wildlife Research through a Multi-City Collaboration."

Applying Strategies in an Urban Context

More-than-human strategies come in many forms and scales, but the core theme is consideration of other nonhuman entities. This can be approached in different ways, but most start from familiar sustainable practices, and begin to consider how these strategies benefit more than just people. More-than-human strategies that focus on plants and animal species come in the form of protecting habitats and biodiversity.[78] Reestablishing habitat patches and corridors can make up for the consequences of human development and reintroduce native species to the area.[79] A strategy that has been popularized in more-than-human and sustainable thinking is shifting away from traditional manicured lawns and landscapes in favor or native plant species or urban meadows. This alternative to traditional lawns it is referred to as "antilawn," encourages native biodiversity and creates stronger ecological systems, which benefit people as well.[80] Urban meadows are capable of supporting three times as many plant and insect species compared to traditional lawns.[81] An increase of native plants invites more insect diversity and pollinators to

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[78]Joscha Beninde, Michael Veith, and Axel Hochkirch. "Biodiversity in Cities Needs Space: A Meta-Analysis of Factors Determining Intra-Urban Biodiversity Variation." *Ecology Letters* 18, no. 6 (2015): 581–92. https://doi.org/10.1111/ele.12427.

[79] Threlfall, Caragh G., Luis Mata, Jessica A. Mackie, Amy K. Hahs, Nigel E. Stork, Nicholas S. G. Williams, Stephen J. Livesley, and Jacqueline Beggs. "Increasing Biodiversity in Urban Green Spaces through Simple Vegetation Interventions." *Journal of Applied Ecology* 54, no. 6 (December 2017): 1874–83. doi:10.1111/1365-2664.12876.

[80] "To Be Greener, Get Rid Of Your Grass: Consider This from NPR." *NPR*. Last modified October 6, 2023. https://www.npr.org/2023/10/06/1198908440/to-be-greener-get-rid-of-your-grass.

[81] Cicely A. M. Marshall, et al, "Urban wildflower meadow planting for biodiversity, climate and society: An evaluation at King's College, Cambridge," *Ecological Solutions and Evidence* Vol 4, 2 2023, https://doi-org.proxy-um.researchport.umd.edu/10.1002/2688-8319.12243.

help with agriculture and food production.[82] Switching lawns to native plant gardens also reduces the strain of maintaining the lawns, meaning less water is wasted and less fertilizers seep into soil and watersheds.[83] This is an example of how a more-than-human strategy can positively impact plants, animals, natural systems, and humans, within an urban scale.

Figure 4.4: Tom Lee Park (Source: SCAPE Landscape Architecture)

[82] Neal M. Williams, Kimiora L. Ward, Nathaniel Pope, Rufus Isaacs, Julianna Wilson, Emily A. May, Jamie Ellis, et al. "Native Wildflower Plantings Support Wild Bee Abundance and Diversity in Agricultural Landscapes across the United States." *Ecological Applications* 25, no. 8 (2015): 2119–31. http://www.jstor.org/stable/24700682.

[83] Myla FJ Aronson, Christopher A Lepczyk, Karl L Evans, Mark A Goddard, Susannah Lerman, J Scott MacIvor, Charles H Nilon, and Timothy Vargo. "Biodiversity in the City: Key Challenges for Urban Green Space Management." *Frontiers in Ecology and the Environment* 15, no. 4 (2017): 189–96.

Urban areas add a layer of complexity to more-than-human strategies as human centric systems are introduced and dependent on each other. More-than-human design becomes more prominent as a concept in the planning process. This involves more elements to the practice, introducing political, social, and cultural aspects to consider.[84] Due to this complexity in decision making, more-than-human design needs to be more prominent in people's urban lives in order to expose them to the process and the benefits.[85] Educating and demonstrating to people natural systems and more-than-human thinking are essential to be accepted within the political, social, and cultural aspects. Strategies should be implemented at various scales to better integrate itself with urban life. Wildflower meadows and gardens can be introduced at a smaller scale to become more socially accepted. From there, the intervention can grow and be more prominent to support more natural systems, such as hosting small animals. Exposure to small animals and their natural processes can encourage education and acceptance of more animals, especially those considered "pests" or unwanted in cities. Joyce Hwang questions the ideas of "pests," and how many people do not recognize the value of animals that are typically seen as pests, like bats and or even weeds.[86] Reevaluating how people view "pests" can help long term biodiversity and natural systems, but the first step needs to be to recognize that these pests are still valuable to our urban environments.

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[84] Jonathan Metzger. "Cultivating Torment: The Cosmopolitics of More-Than-Human Urban Planning." *City* 20, no. 4 (2016): 581–601. doi:10.1080/13604813.2016.1193997.
[85] Jonathan Metzger. "Cultivating Torment: The Cosmopolitics of More-Than-Human Urban Planning."
[86] Joyce Hwang. "Living Among Pests." Ants of the Prairie. https://www.antsoftheprairie.com/?page_id=1589

Figure 4.5 Brood X Cicada – “Pests” (Source: Author)

Chapter 5: Critique of Current Urban Sustainability

Current Urban Planning

Urban planners are increasingly seeking to design cities and communities that are environmentally friendly, economically viable, and socially equitable. Planners recognize the importance of incorporating design and policy that addresses the effects of climate change. Historically, planning has prioritized physical land use and how it impacts public health by controlling where development occurs and what for.[87] This can be seen through the establishment of Central Business Districts surrounded by less dense urban sprawl.[88] In recent years, the discipline is transitioning to more community-centered methods that encompasses multiple shared themes and values, like preserving history, providing resources, and building sustainable communities.[89] Sustainability as a whole is recognized as a necessity in urban planning and building resilient cities and sustainable planning practices are implemented in tandem with other urban needs. Urban planners recognize that sustainability also impacts the social and economic experience of cities, but the extent

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[87] Michail Fragkias, "Urbanization, Economic Growth and Sustainability," In *The Routledge Handbook of Urbanization and Global Environmental Change* Edited by Karen C. Seto, William D. Solecki and Corrie A. Griffin. 9-26. Routledge: Taylor & Francis Group, 2016.
[88] Dagmar Haase and Nina Schwarz, "Urban Land Use in the Global Context," In *The Routledge Handbook of Urbanization and Global Environmental Change* Edited by Karen C. Seto, William D. Solecki and Corrie A. Griffin. 9-26. Routledge: Taylor & Francis Group, 2016. 53.
[89] David C. Rouse, and Rocky Piro. 2022. *The Comprehensive Plan: Sustainable, Resilient, and Equitable Communities for the 21st Century*. Apa Planning Essentials. New York, NY: Routledge.

this is seen in local and urban planning varies in scale, scope, and amount of intervention.[90] Urban planning is evolving to embrace sustainability and resilience, recognizing the interconnectedness of environmental, social, and economic well-being in building resilient cities.

Sustainable planning strategies come in various forms, dependent on various factors like region, climate, and local policy. Sustainable strategies might be limited to what can be built, such as green infrastructure and urban resiliency. Green infrastructure does not have a clear definition within urban planning, but generally relates to implementing public systems that can minimize damage to the environment.[91] The types of green infrastructure can vary throughout the US, but many tend to focus on stormwater management and landscapes.[92] This includes strategies like rainwater gardens and collecting, bioswales, and stormwater management plans. Sustainable urban plans can be implemented as another means of incorporating sustainability into urban development through both the built environment and public policy. Washington D.C has its own Sustainable DC plan which establishes main goals and actions that hopes to balance the environmental, economic, and social needs of the city.[93] The plan addresses a wide scope of topics,

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[90] Sara Meerow, and Joshua P. Newell. "Urban Resilience for Whom, What, When, Where, and Why?" *Urban Geography* 40, no. 3 (March 16, 2019): 309–29. https://doi.org/10.1080/02723638.2016.1206395.

[91] Zbigniew J. Grabowski, Timon McPhearson, A Marissa Matsler, Peter Groffman, Steward TA Pickett. "What is green infrastructure? A study of definitions in US city planning*." Frontiers in Ecology and the Environment* 20, No 3 (January 5, 2022): p. 152-160. https://doi.org/10.1002/fee.2445.

[92] Ibid.

[93] "Sustainable DC 2.0 Plan." Washington DC Department of Energy and Environment. https://sustainable.dc.gov/node/1447351

like equity, built environment, and nature. For nature in particular, DC goals include protecting and expanding aquatic wildlife and habitat, protecting and expanding land wildlife and habitat, improving residents' access to nature.[94] Establishing these goals alongside DC other social needs and priorities shows that the city recognizes the importance of protecting its natural wildlife.

Figure 5.1 Kingman Island, Washington DC. Island on the Anacostia River that supports a variety of DC's wildlife. (Source: National Parks Service, Claire Hassler)

Alternatively, urban resilience, "the ability of city dwellers to withstand economic, social, health, environmental, disaster and climate related risks," is a planning response to climate change adaptation and disaster response in urban

[94] "Sustainable DC 2.0 Plan." Washington DC Department of Energy and Environment. https://sustainable.dc.gov/node/1447351. 104-116.

areas.[95] This type of planning focuses on how urban areas respond and prepare for disasters, typically ones caused by climate change. This comes in the form of creating policies that strengthen cities economically and through the built environment, like flooding adaptability and stormwater management.[96] Within urban buildings themselves, sustainability focuses on how the building is constructed and performs. This can be seen through sustainable methods that incorporate energy efficiency and materiality, as a means of addressing the building's impact on the environment and climate change.[97] Sustainable urban planning encompasses a range of strategies, from green infrastructure to urban resilience, to address environmental, social, and economic challenges in cities.

The Gap Between Current Practices

The current urban practices highlight how urban design and architecture focus primarily on humans and not other species. Considering how urbanization happens at such a rapid rate, there is a more pressing need to provide for urban residents, but now that there is a greater understanding of how cities can play a role in supporting nature. This opens up the responsibility to create urban areas that take natural systems into account. Urban areas already play a unique role in sustainability and combating

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[95] Asako Okai. "Urban resilience: Addressing an old challenge with renewed urgency." United Nations Development Programme. https://www.undp.org/blog/urban-resilience-addressing-old-challenge-renewed-urgency.

[96] Patricia Romero-Lankao and Daniel Gnatz, "Urbanization, vulnerability, and risk," In *The Routledge Handbook of Urbanization and Global Environmental Change* Edited by Karen C. Seto, William D. Solecki and Corrie A. Griffin. 9-26. Routledge: Taylor & Francis Group, 2016. 217.

[97] Julie Futcher, Gerald Mills, Rohinton Emmanuel, and Ivan Korolija. "Creating Sustainable Cities One Building at a Time: Towards an Integrated Urban Design Framework." *Cities* 66 (June 2017): 63–71. doi:10.1016/j.cities.2017.03.009.

the consequences of climate change, but there are still gaps in how urban areas address these issues. Most urban spaces are human centered, and do not consider how development impacts natural species and systems.

Strategies like green infrastructure, materiality, energy efficiency are implemented as a means of reducing our impact on climate change and the natural systems humans depend on. Green infrastructure as implemented in the US does not have a uniform definition of the practice, but tends to prioritize stormwater management with bioretention and other stormwater facilities.[98] This focus on stormwater protects natural watersheds and reduces water pollution caused by humans and flooding risks caused by impermeable surfaces. Additional types of green infrastructure, like blue-green corridors and spaces are implemented for the social benefits, like improving health and recreation.[99] Looking at a building scale, sustainable practices, like green roofs and shading devices, focus on building performance also as a means of addressing climate change and reducing the impact. Sustainability in the built environment is a necessary part of reducing people's impact on the planet, but it can be implemented in a way that supports other species.[100]

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[98] Zbigniew J. Grabowski, et all. "What is green infrastructure? A study of definitions in US city planning." *Frontiers in Ecology and the Environment* 20, No 3 (January 5, 2022): p. 152-160. https://doi.org/10.1002/fee.2445.

[99] Ibid.

[100] Walter Fieuw, Marcus Foth, and Glenda Amayo Caldwell. 2022. "Towards a More-than-Human Approach to Smart and Sustainable Urban Development: Designing for Multispecies Justice" *Sustainability* 14, no. 2: 948. https://doi-org.proxy-um.researchport.umd.edu/10.3390/su14020948

Figure 5.2 Town Branch Commons – Green Infrastructure. (Source: SCAPE Landscape Architecture)

Current sustainable practices can adapt to not only address climate change but also support other plant and animal species in urban environments. Most sustainable practices are human centered, focusing on the methods that can benefit humans' way of living in urban areas. Urban development and planning have a negative impact on natural systems, habitats, and species due to its destruction of habitats and stealing resources. By incorporating a more rounded understanding of ecological systems, urban areas can become more-than-human spaces and be more efficient in supporting the environment. By improving design strategies, construction methods, and existing infrastructure, urban sustainability as a practice can shift to consider all forms of

nature, including plants, animals, and systems.[101] This is important for future urban development and spaces as small scale environmental impacts can have long term consequences that affect human livelihood.

[101] Garrard, Georgia E., Nicholas S. G. Williams, Luis Mata, Jordan Thomas, and Sarah A. Bekessy. "Biodiversity Sensitive Urban Design." *Conservation Letters* 11, no. 2 (March 2018): 1. doi:10.1111/conl.12411.

Chapter 6: Creating a Framework

Urban Scale

Sustainability strategies can be implemented at an urban scale in a way that can support and foster urban biodiversity and establish more-than-human living in urban areas. Cities recognize the value of green spaces and natural elements in urban areas and the benefits that they have for residents and the planet. Existing sustainability methods can be pushed further to incorporate more-than-human design in order to further benefit the environment through supporting urban biodiversity.

Urban green spaces are a common implementation strategy that brings natural landscapes into cities, but not all urban green spaces cultivate biodiversity in similar ways. Urban green spaces include parks, gardens, and also lawns or yards.[102] These spaces vary in quality and management of the natural elements, from remnant habitat patches to manicured green lawns.[103] Urban green space can be pushed further to assist with supporting biodiversity. Cities already have existing urban biodiversity populations, specifically bird and plant species.[104] The density of these populations

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[102] Caragh G. Threlfall, Luis Mata, Jessica A. Mackie, Amy K. Hahs, Nigel E. Stork, Nicholas S. G. Williams, Stephen J. Livesley, and Jacqueline Beggs. "Increasing Biodiversity in Urban Green Spaces through Simple Vegetation Interventions." *Journal of Applied Ecology* 54, no. 6 (December 2017): 1874–83. doi:10.1111/1365-2664.12876.

[103] Myla FJ Aronson, Christopher A Lepczyk, Karl L Evans, Mark A Goddard, Susannah Lerman, J Scott MacIvor, Charles H Nilon, and Timothy Vargo. "Biodiversity in the City: Key Challenges for Urban Green Space Management." *Frontiers in Ecology and the Environment* 15, no. 4 (2017): 189–96.

[104] Joscha Beninde, Michael Veith, and Axel Hochkirch. "Biodiversity in Cities Needs Space: A Meta-Analysis of Factors Determining Intra-Urban Biodiversity Variation." *Ecology Letters* 18, no. 6 (2015): 581–92. https://doi.org/10.1111/ele.12427.

vary depending on the city and depending on the urban landscape within the city.[105] Urban green spaces can be adapted to act as larger habitat patches with higher green space area and vegetation density for animals to reside in.[106] These patches can then be connected through corridors which can provide additional support towards urban biodiversity levels because of elements such as vegetation resources and proportion of impervious surfaces.[107] Stepping stone habitats are also a common method of creating more-than-human spaces, but are not as effective as corridors due to fragmentation.[108] Corridors act as direct connections between habitat patches that help with species richness. Cities that can preserve existing large natural habitats and establish a large-scale green network or green corridor can create effective urban habitats for species to live alongside humans.

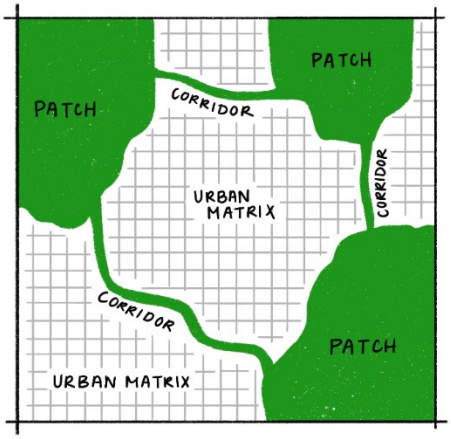

Figure 6.1 Patches and Corridors Diagram (Source: Author)

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[105] Jessica R. Sushinsky, Jonathan R. Rhodes, Hugh P. Possingham, Tony K. Gill, Richard A. Fuller. "How should we grow cities to minimize their biodiversity impacts?" *Global Change Biology* 19, no. 2 (2013) p. 401-410. https://doi-org.proxy-um.researchport.umd.edu/10.1111/gcb.12055.
[106] Joscha Beninde, et al. "Biodiversity in Cities Needs Space: A Meta-Analysis of Factors Determining Intra-Urban Biodiversity Variation."
[107] Ibid.
[108] Ibid.

Implementing abundant and well connected urban green spaces can support biodiversity in cities, as long as there are significant amounts of vegetation types and density.[109] Traditional landscape management practices pose threats to biodiversity.[110] Landscape management practices like grass lawns, vegetation pruning, and pesticides and herbicides at the small scale impacts large scale biodiversity as it threatens vulnerable species.[111] Pollinators and other insects are negatively impacted by chemical usage and excessive lawn mowing, which has consequences to large scale biodiversity and food supply.[112] Social and cultural pressures encourage the use of chemicals to maintain a neat lawn and garden, making it difficult for pollinators to survive and adapt.[113] Implementing more sustainable yard management and preserving natural green spaces and vegetation can rebuild ecological connections in urban areas and create stable habitats for pollinators and

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[109] Caragh G. Threlfall, Luis Mata, Jessica A. Mackie, Amy K. Hahs, Nigel E. Stork, Nicholas S. G. Williams, Stephen J. Livesley, and Jacqueline Beggs. "Increasing Biodiversity in Urban Green Spaces through Simple Vegetation Interventions." *Journal of Applied Ecology* 54, no. 6 (December 2017): 1874–83. doi:10.1111/1365-2664.12876.

[110] Myla FJ Aronson, Christopher A Lepczyk, Karl L Evans, Mark A Goddard, Susannah Lerman, J Scott MacIvor, Charles H Nilon, and Timothy Vargo. "Biodiversity in the City: Key Challenges for Urban Green Space Management." *Frontiers in Ecology and the Environment* 15, no. 4 (2017): 189–96.

[111] Yang Fengping, M. Ignatieva, J. Wissman, K. Ahrné, Shuoxin Zhang and Si-Xi Zhu. "Relationships between multi-scale factors, plant and pollinator diversity, and composition of park lawns and other herbaceous vegetation in a fast growing megacity of China." *Landscape and Urban Planning* (2019). https://doi.org/10.1016/J.LANDURBPLAN.2019.02.003.

[112] Neal M. Williams, Kimiora L. Ward, Nathaniel Pope, Rufus Isaacs, Julianna Wilson, Emily A. May, Jamie Ellis, et al. "Native Wildflower Plantings Support Wild Bee Abundance and Diversity in Agricultural Landscapes across the United States." *Ecological Applications* 25, no. 8 (2015): 2119–31. http://www.jstor.org/stable/24700682.

[113] Myla FJ Aronson, Christopher A Lepczyk, Karl L Evans, Mark A Goddard, Susannah Lerman, J Scott MacIvor, Charles H Nilon, and Timothy Vargo. "Biodiversity in the City: Key Challenges for Urban Green Space Management." *Frontiers in Ecology and the Environment* 15, no. 4 (2017): 189–96.

other species.[114] Planting native flowering plants in garden beds, or wildflower gardens, can reintroduce pollinator richness to cities. Limiting the amount of habitat alteration, like tree and shrub pruning or removing leaf litter can provide resources for insects and birds.[115] Simple adjustments to how we design and maintain urban green spaces can provide essential resources to urban wildlife, while also benefiting the cities themselves as less time and money are spent on landscape maintenance.[116]

Neighborhood Scale

Maintaining the matrix quality of green habitats and corridors is important in fostering biodiversity within urban neighborhoods. Matrix quality refers to range of habitat types within an area, depending on elements within the area.[117] A green network maintains the matrix quality of the surrounding urban areas in order to support biodiversity. Matrix quality of surrounding urban greenspaces can better support biodiversity through green infrastructure like street trees, bioretention areas, and gardens.[118] These spaces are not intended to house dense biodiversity but act as

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[114] Ibid.
[115] Ibid.
[116] Myla FJ Aronson, Christopher A Lepczyk, Karl L Evans, Mark A Goddard, Susannah Lerman, J Scott MacIvor, Charles H Nilon, and Timothy Vargo. "Biodiversity in the City: Key Challenges for Urban Green Space Management." *Frontiers in Ecology and the Environment* 15, no. 4 (2017): 189–96.
[117] "Making Nature's City," San Francisco Estuary Institute. https://www.sfei.org/sites/default/files/biblio_files/Making%20Natures%20City%20Executive%20Summary_0.pdf
[118] Ibid.

supportive spaces for wildlife movement and resources.[119] These spaces can mitigate the impact of habitat loss and fragmentation caused by urbanization. Including habitat diversity to these matrices can increase the total amount of resources available to species and provide more species richness.[120] Diversifying matrix quality to increase biodiversity can work within the existing urban matrix and adapt to existing neighborhood conditions.[121] These spaces can be applied throughout neighborhoods depending on existing urban conditions and add habitats elements and physical features.[122] Neighborhoods with unique existing conditions, like access to water or existing tree density, can adapt to create specific habitats that cater towards certain species.[123] Implementing a urban matrix quality can integrate biodiversity needs and elements without disrupting the urban fabric.

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[119]Melina de Souza Leite, Andrea Larissa Boesing, Jean Paul Metzger, and Paulo Inácio Prado. "Matrix quality determines the strength of habitat loss filtering on bird communities at the landscape scale." *Journal of Applied Ecology* 59, no. 11 (2022): 2790-2802.

[120] "Making Nature's City," San Francisco Estuary Institute. https://www.sfei.org/sites/default/files/biblio_files/Making%20Natures%20City%20Executive%20Summary_0.pdf

[121] Charles H. Nilon, "Urban Biodiversity and the Importance of Management and Conservation." *Landscape and Ecological Engineering* 7, no. 1 (2011): 45–52. https://doi.org/10.1007/s11355-010-0146-8.

[122] Ibid.

[123]"Making Nature's City," San Francisco Estuary Institute. https://www.sfei.org/sites/default/files/biblio_files/Making%20Natures%20City%20Executive%20Summary_0.pdf

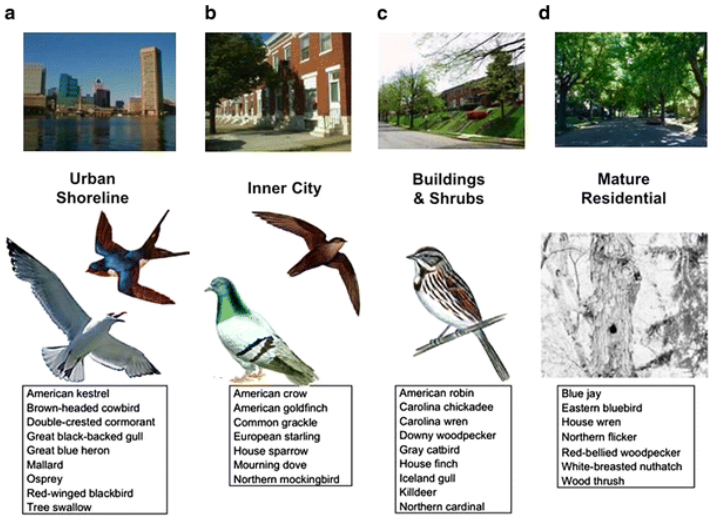

Figure 6.2: Example of an Urban Matrix and Bird Diversity (Source: Nilon, 2011)

Urban gardens act as another means of introducing and supporting biodiversity in cities while also creating green spaces for people to utilize. Gardens can be another piece to the green network for urban areas, especially if it implements wildlife friendly methods and management.[124] Gardens have higher density and complexity of flora and vegetation, allowing for more insect abundance and richness.[125] Planting native plant species can make up for the potential negative impacts of gardens, and provide displaced species immediate habitats to adapt to.[126] Urban gardens also have a positive impact on humans and their understanding of the

[124] Myla FJ Aronson, Christopher A Lepczyk, Karl L Evans, Mark A Goddard, Susannah Lerman, J Scott MacIvor, Charles H Nilon, and Timothy Vargo. "Biodiversity in the City: Key Challenges for Urban Green Space Management." *Frontiers in Ecology and the Environment* 15, no. 4 (2017): 189–96.
[125] Mark A. Goddard, Andrew J. Dougill, and Tim G. Benton. "Scaling up from gardens: biodiversity conservation in urban environments." *Trends in ecology & evolution* 25, no. 2 (2010): 90-98.
[126] Ibid.

environment and biodiversity.[127] They act as educational opportunities to show plant biodiversity and how plants impact the environment.[128] Community gardens provide residents with food resources by growing fruits and vegetables, while educating about food systems.[129] Adding additional mini habitats within the garden, like nesting sites and ponds, can further increase small-scale biodiversity, including different plants and fungus, insects, and amphibians.[130] At this scale, gardens offer a live demonstration of cultivating biodiversity and how it begins to benefit humans as well.

Figure 6.3 Example of a Community Garden Space. 103rd Street Community Garden Site Plan (Source: SCAPE Landscape Architecture)

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[127] Teresa Gómez-Villarino, María, and Teresa Briz. "With Sustainable Use of Local Inputs, Urban Agriculture Delivers Community Benefits beyond Food: Urban Gardens Based on Sustainable Principles Help Create Healthier Communities along with Healthful Food." *California Agriculture* 76, no. 4 (October 2022): 121–30. doi:10.3733/ca.2022a0013.

[128] Dorothee Benkowitz and Karlheinz K¨ohler. "Preception of Biodiversity - The Impact of School Gardening." In *Urban Biodiversity and Design.* Edited by Norbert Müller, Peter Werner, John G. Kelcey. Blackwell Publishing Ltd. 2010.

[129] Teresa Gómez-Villarino, María, and Teresa Briz. "With Sustainable Use of Local Inputs, Urban Agriculture Delivers Community Benefits beyond Food: Urban Gardens Based on Sustainable Principles Help Create Healthier Communities along with Healthful Food." California Agriculture 76, no. 4 (October 2022): 121–30. doi:10.3733/ca.2022a0013.

[130]Kevin J. Gaston, Richard M. Smith, Ken Thompson, and Philip H. Warren. "Urban domestic gardens (II): experimental tests of methods for increasing biodiversity." *Biodiversity & Conservation* 14 (2005): 395-413.

Building Scale

Buildings are known for their impact on the environment as construction and materiality pull from natural resources and energy performance affects carbon output. These consequences emphasize the built environment's role and potential in more-than-human design and supporting urban biodiversity. Existing sustainable building strategies can be adjusted to cater towards nonhuman species, while still decreasing the building's impact on the environment. Building design can incorporate features that make the building more friendly towards other species and create spaces to house those species.

Sustainable building strategies and infrastructure can create spaces for nonhuman species to thrive as part of the building scale. Green roofs can reduce the temperature of buildings by providing insulation, shading, and cooling, reducing the amount of energy needed to maintain building temperatures.[131] By creating extensive green roof systems that can house a diverse set of native plant species, green roofs can support plant biodiversity and provide resources for other small species like birds and insects.[132] An extensive roof system provides enough soil depth for native plants to root themselves well enough to survive weather conditions and disruptions, and combining this with other types of gardening beds, like hay, can ensure a sturdy root

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[131] Kristin L. Getter, D. Rowe, J. Andresen and I. Wichman. "Seasonal heat flux properties of an extensive green roof in a Midwestern U.S. climate." *The Lancet* (2011). https://doi.org/10.1016/J.ENBUILD.2011.09.018.

[132] Nathalie Baumann and Friederike Kasten. "Green Roofs – Urban Habitats for Ground-Nesting Birds and Plants." In U*rban Biodiversity and Design.* Edited by Norbert Müller, Peter Werner, John G. Kelcey. Blackwell Publishing Ltd. 2010.

system.[133] Additional greening methods like green walls, whether natural or artificial can also provide the vegetation base to house other species. Plants can spontaneously climb walls as they grow, if given the chance.[134] Incorporating more textured exterior wall facades and letting some plant species grow along building walls naturally can improve urban biodiversity.[135] Artificial or human-made green walls can also support urban biodiversity by housing plants and providing resources for insects and small animals.[136] Green building infrastructure can create spaces for nonhuman species to thrive, leading to a more biodiverse urban environment.

Figure 6.4: Swift Box Bird Nesting Brick (Source: Vivara Pro)

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[133] Ibid.

[134] Chundi Chen, Longfei Mao, Yonggui Qiu, Jian Cui, and Yuncai Wang. "Walls Offer Potential to Improve Urban Biodiversity." *Scientific Reports* 10, no. 1 (June 18, 2020): 1–10. doi:10.1038/s41598-020-66527-3.

[135] Ibid.

[136] Z. Azkorra, et al. "Evaluation of Green Walls as a Passive Acoustic Insulation System for Buildings." Applied Acoustics, vol. 89, Mar. 2015, pp. 46–56. EBSCOhost, https://doi-org.proxy-um.researchport.umd.edu/10.1016/j.apacoust.2014.09.010.

Urban buildings can integrate urban biodiversity elements into their design to play a greater role in cultivating biodiversity in cities. Urban trends focus on how to deter animals from the building. Like how building facades avoid surfaces that birds can perch on, like ledges and windowsills, and can take more aggressive approaches like nets and wire to deter birds.[137] Instead of trying to force birds and other animals away from urban areas, designing with nonhuman species in mind can establish habitats as part of the building for these animals to live in. Some issues that buildings create for animals are already known, like issues of birds not recognizing building glass and crashing into it. To address this issue, buildings incorporate bird glass and patterns visible to birds, like the bird strike pattern at the National Aquarium in Baltimore, Maryland.

To push this idea further, buildings can adapt and take a more active approach in creating space for animals. Nest hollows provide shelter for small animals, keeping them safe from predators and creating safe spaces for nesting and breeding.[138] These can be naturally and artificially created, but essentially is a cavity with access to the surrounding environment. Natural hollows typically form from timber, but can be integrated in building facades as well. “Bird bricks” allow brick walls to house

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[137]Joyce Hwang. “Constructing Wilderness.” *New Constellations, New Ecologies: proceedings of the 101st Annual Meeting of the Association of Collegiate Schools of Architecture (ACSA)*, pp. 344-351. 2013.

[138] https://cdn.environment.sa.gov.au/greenadelaide/images/Hollows-Teacher-Resource-Pack-GA2021.pdf

sparrows without disrupting the building.[139] Other types of animal walls can be integrated into the built environment and act as a teaching tool for urban residents, such as "insect hotels.[140]" Pollinators are recognized as an essential part of the environment, but most insects also need spaces to nest. Installing insect hotels made up of natural materials can create shelters for pollinators.[141] Creating a variety of textures and density can increase species diversity and richness as well. Structures like these also demonstrate the role insects have in natural environments, making their presence more known in urban environments. With detailed changes like these, urban buildings can house more than just humans but also plants and animals.

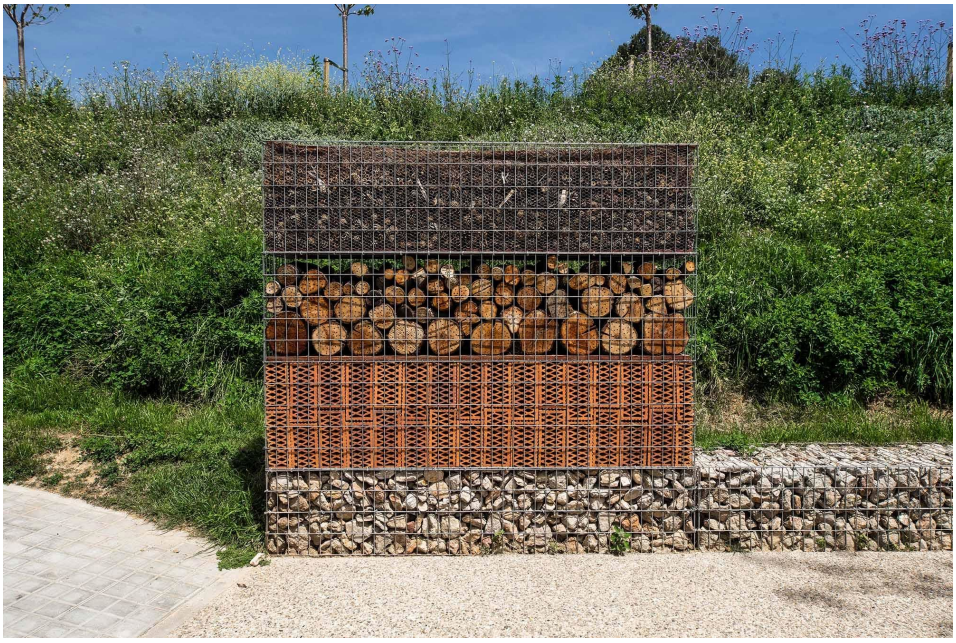

Figure 6.5: Insect Hotel, Vallmora Park, Barcelona, Spain. (Source: Batlleiroig & Jordi Surroca)

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[139] Liz Stinson. "A Brick That Lets Threatened Birds Build Nests Directly Into Walls." *Wired*, July 26, 2013. https://www.wired.com/2013/07/these-bricks-are-made-for-birds-to-nest-in/

[140] Elizabeth N. Hane, and Karl F. Korfmacher. "Insect 'Bee&Bees' and pollinator penthouses: teaching students about pollinators and their services in an urban environment." *Urban Ecosystems* 25, no. 4 (2022): 1057-1064.

[141] Ibid.

Chapter 7: Program

Program Abstract

The programming would be to demonstrate more-than-human design and urban biodiversity strategies at various scales in order to integrate these concepts in urban areas. Implementing these strategies are intended to strengthen people's relationship with native nonhuman species. To do that, the program must be able to support both people's and nonhuman's way of living in urban areas, and also show the value of a symbiotic relationship. The Living Zone meets basic needs of people and nonhumans, providing spaces for rest and refuge. The Coexistence Zone offers spaces of parallel living between humans and nonhumans, allowing for gathering for different species. It also begins to create an ecotone habitat between human urban living and native animal habitats. The Symbiosis Zone is intended for full integration between urban living and urban biodiversity. This is where the program encourages human and nonhuman relationships through shared benefits and education. This zone would offer outdoor and educational spaces to demonstrate the more-than-human themes more publicly, to offer a better understanding of human's role in nature.

Zones

The proposed program is broken down into three zones: urban living, coexistence, and symbiosis. These zones relate to how humans, plants, and animals survive and interact within the urban context. Urban living reflects the basic needs

that people, plants, and animals need to continue to live their daily lives in an urban area. For people, this includes housing, food services, and access to other resources. For plants and animals, this includes access to food resources, water, and spaces and resources to build safe habitats. For non-human species, these spaces need to mimic natural ecosystems and have limited human intervention.[142] The Coexistence zone begins to take these basic needs to start to expose urban daily life to natural daily life. This includes more recreational space for both humans and animals and creates program spaces for parallel play settings. These spaces allow for humans and animals to continue about their day with more visual exposure and connection to the other species, like with observation decks. This visual connection brings awareness to visitors of their proximity to ecosystem and its natural system.[143] The Symbiosis zone starts to take these connections and build relationships that work together. This comes in the form of wildflower gardens nature trails that allow for people to go into nature and see the natural processes up close. This is also where there is dedicated civilian research programming so that integrated relationships can educate the public and discover ways to further support plants and animals in urban areas.[144]

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[142] Myla FJ Aronson, Christopher A Lepczyk, Karl L Evans, Mark A Goddard, Susannah Lerman, J Scott MacIvor, Charles H Nilon, and Timothy Vargo. "Biodiversity in the City: Key Challenges for Urban Green Space Management." *Frontiers in Ecology and the Environment* 15, no. 4 (2017): 189–96.

[143] Stephanie Panlasigui, Erica Spotswood, Erin Beller, and Robin Grossinger. 2021. "Biophilia beyond the Building: Applying the Tools of Urban Biodiversity Planning to Create Biophilic Cities" *Sustainability* 13, no. 5: 2450. https://doi.org/10.3390/su13052450

[144] Seth B. Magle, Mason Fidino, Elizabeth W Lehrer, Travis Gallo, Matthew P Mulligan, María Jazmín Ríos, Adam A Ahlers, et al. "Advancing Urban Wildlife Research through a Multi-City Collaboration." *Frontiers in Ecology and the Environment* 17, no. 4 (2019): 232–239. https://onlinelibrary.wiley.com/doi/abs/10.1002/fee.2030.

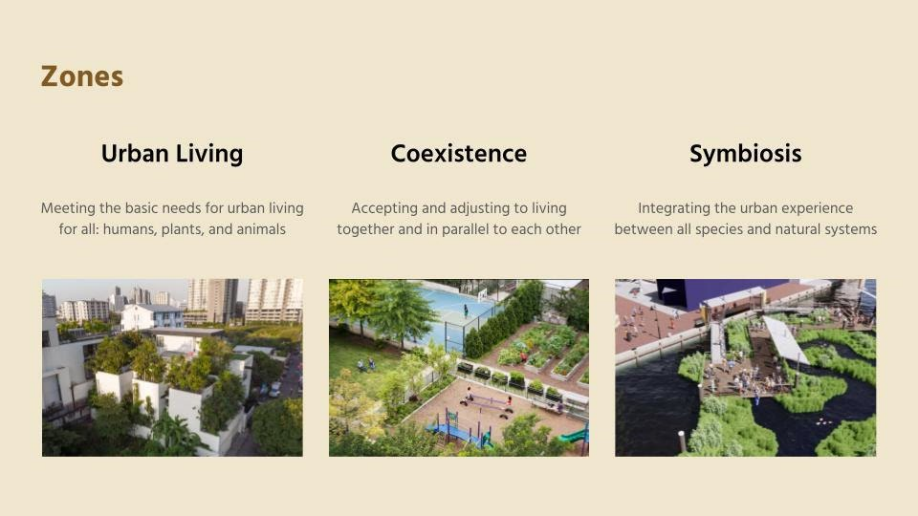


Figure 7.1 Zone Summary (Source: Author)

Thesis Program

Living Zone			*Square Feet*
Description	Quantity	Size	Total
Residential	-	60000	60000
Lobby	1	1500	1500
Retail	3	2500	7500
Service	-	1500	1500
Total			**70500**

Coexistence Zone			*Square Feet*
Description	Quantity	Size	Total
Observation Decks	5	150	750
Lounges	2	1000	2000
Recreation Spaces	1	2000	2000
Total			**4750**

Outdoor Spaces			*Square Feet*
Description	Quantity	Size	Total
Dense Natural Spaces	-	14000	14000
Courtyard/Plaza	-	12000	12000
Community Gardens	2	4000	8000
Wildflower Gardens	4	1500	6000
Total			**40000**

Symbiosis Zone			*Square Feet*
Description	Quantity	Size	Total
Nature Walk	-	500	500
Civilian Research	-	500	500
Total			**1000**

Figure 7.2: Program Tabulation (Source: Author)

As a means of presenting this more-than-human, urban framework, multifamily housing is the method in which more-than-human and urban biodiversity strategies will be applied to. This framework can be applied within any urban setting, but a multifamily residential building can showcase how urban living can be more-

than-human. Due to this choice to create a multifamily residential building, most of the urban living program is dedicated to residential space. Other functions within this zone include a lobby, community spaces for residents and building services. There are also retail spaces intended for the ground floor of the project, to create an active mixed-used urban setting. All of these mentioned spaces are a part of people's urban living. The dense natural space, as part of the outdoor spaces, intends to serve non-human species' urban living. These spaces are intended to be safe natural areas exclusively for plants and animals, with limited landscaping and maintenance so that human intervention does not disrupt animal habitats.[145]

Figure 7.3 Example of a Dense Natural Space. Camley Street Natural Park, London, UK. (Source: London Wildlife Trust

[145] Myla FJ Aronson, Christopher A Lepczyk, Karl L Evans, Mark A Goddard, Susannah Lerman, J Scott MacIvor, Charles H Nilon, and Timothy Vargo. "Biodiversity in the City: Key Challenges for Urban Green Space Management." *Frontiers in Ecology and the Environment* 15, no. 4 (2017): 189–96.

In the coexistence zone, most of the program is dedicated to recreational and community gathering spaces. For people, this includes interior spaces like lounge areas, and exterior spaces like courtyards. This part of the program also includes observation desks to allow residents and visitors to view nature and learn from it, from a comfortable distance. The community gardens are intended to serve both people and animals. As it provides people access to locally grown food, it also provides food resources to animals as well. The community garden attracts insects and pollinators that help the garden grow and act as food sources for larger animals like birds.[146] These spaces within the coexistence zone allow for humans and animals to continue their daily activities in parallel with each other.

Figure 7.4 Example of a Community Garden Space. 103rd Street Community Garden Site Plan (Source: SCAPE Landscape Architecture)

[146] Neal M. Williams, Kimiora L. Ward, Nathaniel Pope, Rufus Isaacs, Julianna Wilson, Emily A. May, Jamie Ellis, et al. “Native Wildflower Plantings Support Wild Bee Abundance and Diversity in

In the symbiosis zone, the program is focused on interconnectedness between humans, plants and animals. These spaces are bridges to nature so that the urban experience can blend with the natural experience. This includes more organic spaces like a nature walk and wildflower gardens as these spaces can foster a more informal and organic experience for people to view and interact with nature. In addition to this, this zone includes a civilian research area, to not only bring residents and visitors closer to nature, but also help to learn and understand it better. These spaces are dependent on final site selection and existing habitat conditions and can vary in size and square footage.

Figure 7.5 Example of Symbiosis Spaces. Vallmora Park and Insect Hotel, Barcelona, Spain (Source: Batlleiroig)

Agricultural Landscapes across the United States." *Ecological Applications* 25, no. 8 (2015): 2119–31. http://www.jstor.org/stable/24700682.

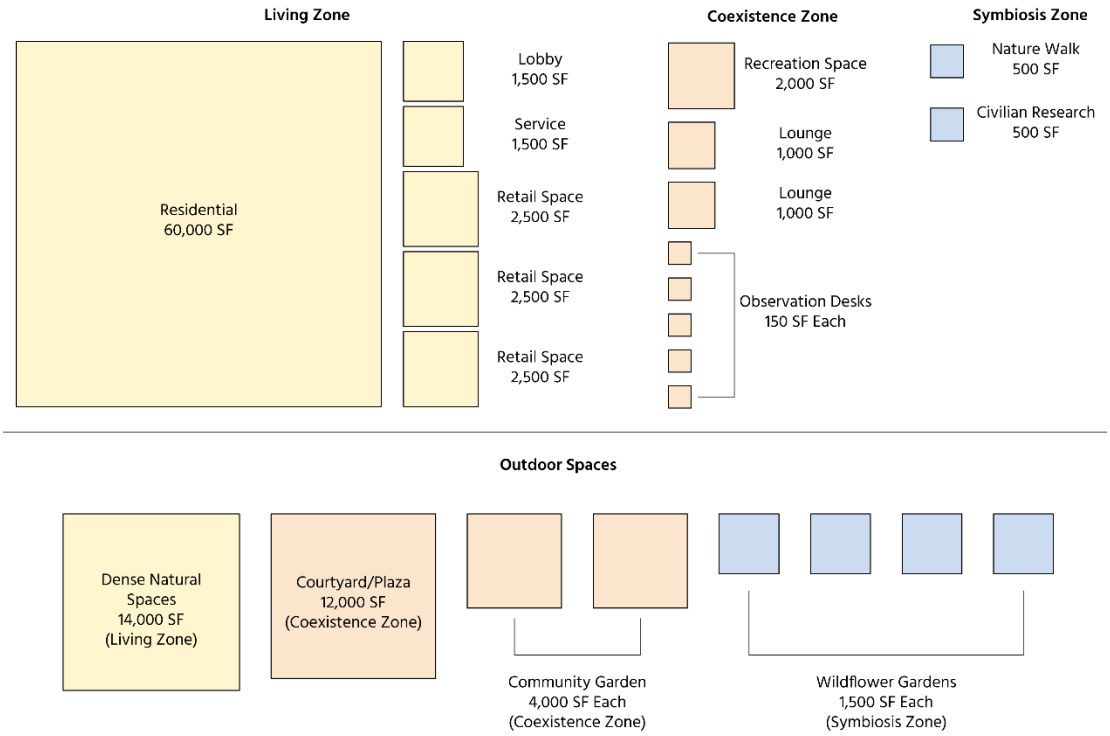


Figure 7.6 Graphic Program (Source: Author)

Precedent Analysis

The following typological precedents are focused primarily on how people and urban experience and be intertwined with nature. These precedents come in the form of experiential and spatial relationships between the built environment and natural elements. It focuses on how people can directly interact with natural elements to form a sense of interconnectedness with nature. This ties back to sustainable systems thinking to make people more aware of their role within nature and develop a more-than-human way of thinking.[147]

[147] Kathryn M. Davidson, and Jackie Venning. "Sustainability Decision-Making Frameworks and the Application of Systems Thinking: An Urban Context." Local Environment 16, no. 3 (March 2011): 213–28. doi:10.1080/13549839.2011.565464.

Figure 7.7 Town Branch Commons (Source: SCAPE Landscape Architecture)

Town Branch Commons is in Lexington, Kentucky and was designed by SCAPE Landscape Architecture, it was completed in 2022.[148] It is a linear park system that follows the existing Town Branch Creek through the city, connecting the downtown area to its rural surrounding communities. Throughout the park system, water and green corridors are brought to the public realm, by playing with form, materiality, and access. This system is a form of living infrastructure as it reflects the existing creek and watershed. As a precedent, this project highlights the ways that natural systems can be implemented at an urban scale, especially one that may change in density and scale. It brings sustainable education to the public realm due to its easy access and following common urban spaces. The linear park system throughout the urban district also shows how this infrastructure does not simply exist, but also creates connectivity throughout the city.

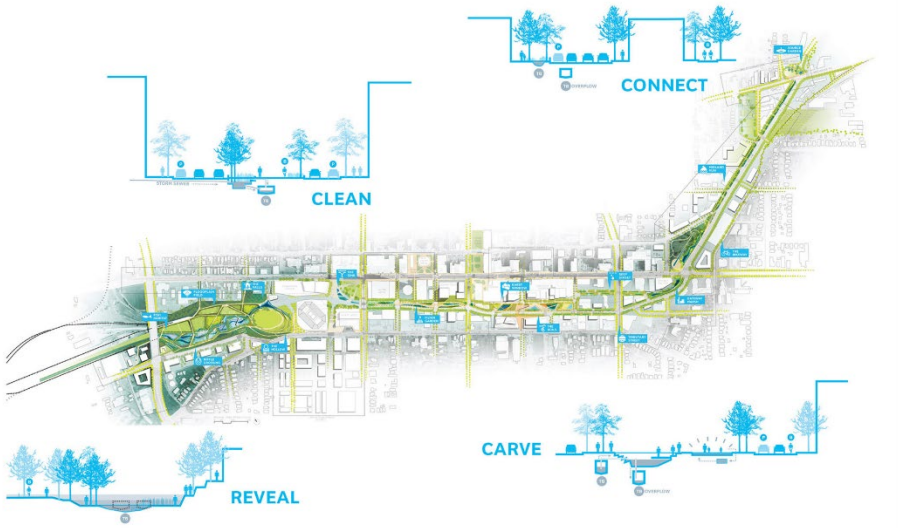


Figure 7.8: Town Branch Commons Corridor System (Source: SCAPE Landscape Architecture)

[148] SCAPE Landscape Architecture. "Town Branch Commons." SCAPE Landscape Architecture. Accessed December 17, 2023. https://www.scapestudio.com/projects/town-branch-commons/.

Figure 7.9: 103rd Street Community Garden (Source: SCAPE Landscape Architecture)

Figure 7.10: 103rd Street Community Garden Site Plan (Source: SCAPE Landscape Architecture)

103rd Street Community Garden in East Harlem, New York City, NY. It was completed in 2011, designed by SCAPE Landscape Architecture in collaboration with East Harlem community members.[149] This project revitalized an existing, empty lot and turned it into a multidisciplinary community, consisting of community gardens, recreational spaces, and a playground. Major design decisions were community driven. The lot was divided into four programming spaces and existing vegetation was preserved as much as possible. The existing and additional vegetation also works to help set up boundaries between spaces. This project showcases strategies at the neighborhood scale, with an emphasis on community-oriented design. Retrofitting the existing lot shows that existing urban spaces can be reevaluated to better serve communities and create more diverse greenspaces. This has taken otherwise underutilized urban space and transformed it into a community asset that brings nature into the city.

Figure 7.11 103rd Street Community Garden (Source: SCAPE Landscape Architecture)

[149] SCAPE Landscape Architecture. "103rd Street Community Garden." SCAPE Landscape Architecture. Accessed December 17, 2023. https://www.scapestudio.com/projects/103rd-street-community-garden/.

Figure 7.12 Robinson Nature Center (Source: GWWO Architects)

The Robinson Nature Center, located in Columbia, Maryland, was designed by GWWO Architects and completed in 2011. The building focuses on environmental education through experiential learning and visual connections to nature.[150] The building is LEED Platinum certified and has a variety of sustainable building strategies like a green roof, rainwater harvesting, and a pervious concrete lot. Exterior balconies, along with ample windows and daylighting, help blend the indoor with the outdoor experiences and build visual ties to nature. The spaces within the building create unique educational exhibits that mimic natural elements. At the building scale, this project is aware of its place in nature and attempts to integrate itself into the existing landscape, rather than disrupting it. The sustainable strategies in place lessen the building's impact of the environment while also utilizing to educate its visitors.

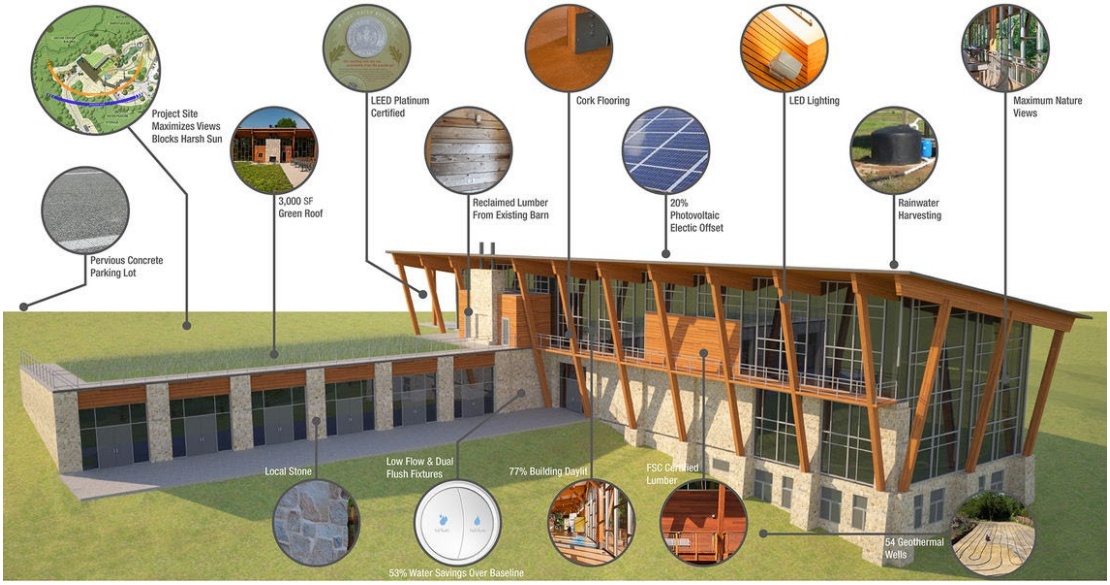


Figure 7.13 Robinson Nature Center Sustainability Diagram (Source: GWWO Architects)

[150] GWWO Architects. "Robinson Nature Center." GWWO Architects. Accessed December 17, 2023. https://www.gwwoinc.com/projects/robinson-nature-center.

Reverse Engineering

Sustainability Park, or S*Park, in Denver, Colorado was designed by Tres Bird and completed in 2018. This mixed-use multifamily residential project takes up one neighborhood block in the transitional zone between commercial and residential neighborhoods.[151] The housing project designed to create a sustainable and "agro-living," or urban farming, type culture within the community. There are a variety of housing types within the block to encourage mixed income, and a series of retail spaces at the street level. There is a community garden and greenhouse for residents and for a farm-to-table restaurant that sits at the edge of the site. There is a communal park within the block and a planted stormwater retention system throughout.

[151] Tres Birds. "S*Park." Tres Birds Workshop. Accessed December 17, 2023. https://tresbirds.com/S-PARK.

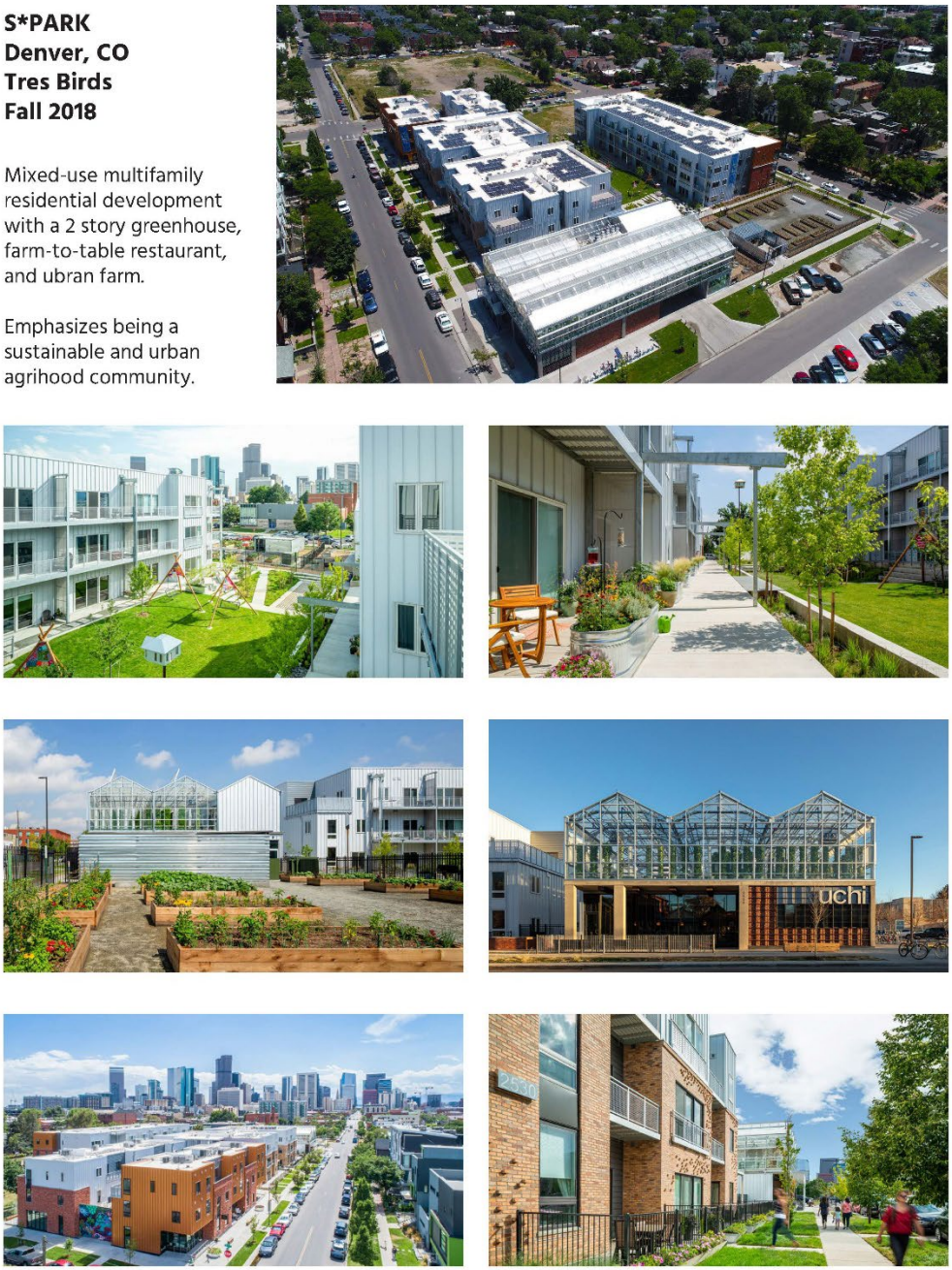
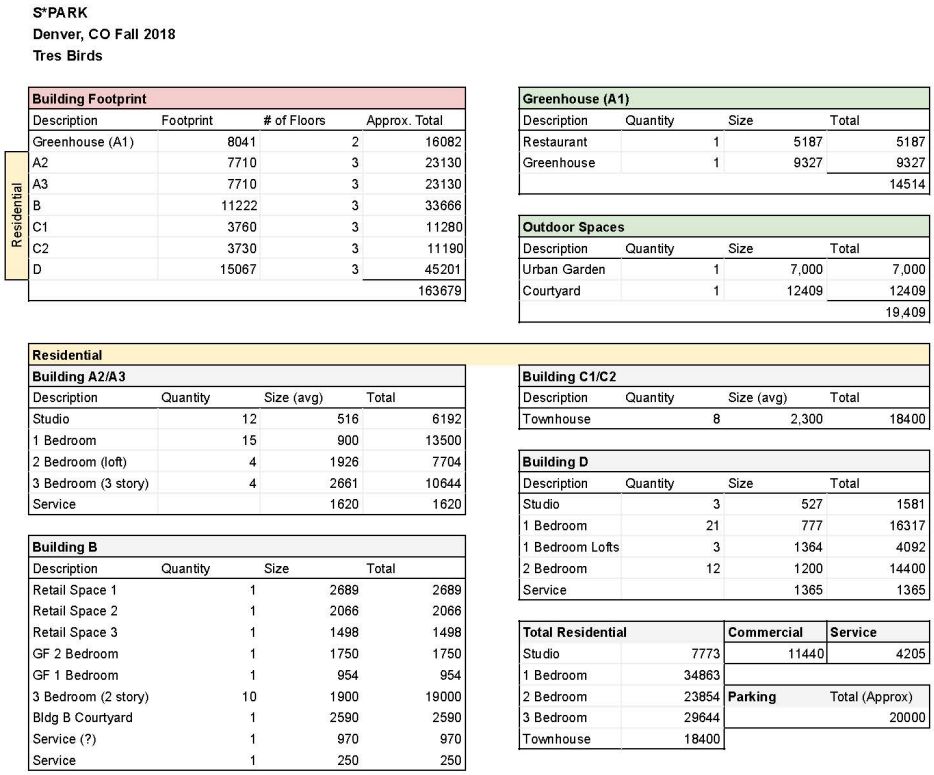


Figure 7.14: S*Park (Source: Tres Bird)

This project sets a neighborhood scale precedent, specifically for understanding program. S*Park was used to reverse engineer program division and

scale and understand proportions between residential and urban farming spaces. A large portion of the site is dedicated to greenspaces and urban farming, like the two-story greenhouse, community garden, and park. This is an example of implementing greenspaces at a neighborhood scale in a way that can serve more of the community. The residential program breakdown is spilt into housing typology, including townhouses and apartment suites ranging from studios to 3-bedroom apartments. This shows a glimpse of how to establish a mixed income community as a variety of living styles can house a variety of residents.



S*PARK
Denver, CO Fall 2018
Tres Birds

Residential

Building Footprint

Description	Footprint	# of Floors	Approx. Total
Greenhouse (A1)	8041	2	16082
A2	7710	3	23130
A3	7710	3	23130
B	11222	3	33666
C1	3760	3	11280
C2	3730	3	11190
D	15067	3	45201
			163679

Greenhouse (A1)

Description	Quantity	Size	Total
Restaurant	1	5187	5187
Greenhouse	1	9327	9327
			14514

Outdoor Spaces

Description	Quantity	Size	Total
Urban Garden	1	7,000	7,000
Courtyard	1	12409	12409
			19,409

Residential

Building A2/A3

Description	Quantity	Size (avg)	Total
Studio	12	516	6192
1 Bedroom	15	900	13500
2 Bedroom (loft)	4	1926	7704
3 Bedroom (3 story)	4	2661	10644
Service		1620	1620

Building B

Description	Quantity	Size	Total
Retail Space 1	1	2689	2689
Retail Space 2	1	2066	2066
Retail Space 3	1	1498	1498
GF 2 Bedroom	1	1750	1750
GF 1 Bedroom	1	954	954
3 Bedroom (2 story)	10	1900	19000
Bldg B Courtyard	1	2590	2590
Service (?)	1	970	970
Service	1	250	250

Building C1/C2

Description	Quantity	Size (avg)	Total
Townhouse	8	2,300	18400

Building D

Description	Quantity	Size	Total
Studio	3	527	1581
1 Bedroom	21	777	16317
1 Bedroom Lofts	3	1364	4092
2 Bedroom	12	1200	14400
Service		1365	1365

Total Residential		Commercial	Service
Studio	7773	11440	4205
1 Bedroom	34863		
2 Bedroom	23854	Parking	Total (Approx)
3 Bedroom	29644		20000
Townhouse	18400		

Figure 7.15 S*Park Tabular Reverse Engineering (Source: Author)

Figure 7.16 S*Park Graphic Reverse Engineering (Source: Author)

Chapter 8: Site Selection

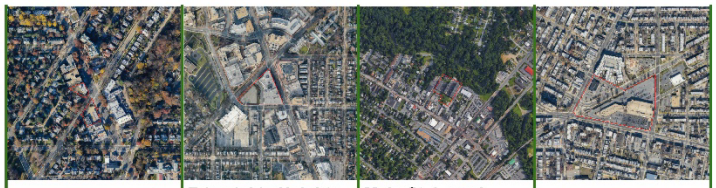
Site Abstract

This thesis aims to find a balance between human living and urban biodiversity to integrate into our cities. In order to create a bridge between urban life and wildlife, the site needs to be located within urban areas and near dense natural spaces. The type of urban area is a core part of the thesis site, as the main goal is to rethink urban living. The site should fit in between an urban transect, likely a general urban area or near an urban center. This medium urban area provides more flexibility to integrate green spaces and infrastructure. The site should also be near a dense natural area, ideally within walking distance, but not required. An established natural area that has its own source of biodiversity will connect the project to a greater natural system. It also will provide plant and animal species with a more stable environment to start from and the site will act as a corridor or bridge between the natural landscape and urban areas.

Additional site criteria looks at the urban quality of the site, to ensure that there is human activity to experience and be exposed to more-than-human experience. Access to and through the site creates an opportunity for an active public experience that can be catered towards more-than-human experiences and systems. This considers multi-modal transit, including walkability, automotive traffic, and public transportation. As people move through the site, they can experience the small-scale

features, like building features and street infrastructure, that bring them closer to urban biodiversity. As another means of ensuring human activity, the site criteria considers housing demand. People living in and around the site can establish public activity and serve the thesis objective to create urban living for both humans and nonhumans.

Site Matrix



	Location	**Chevy Chase, DC**	**Friendship Heights, DC**	**Main St, Laurel, Maryland**	**H St, DC**
	Intervention Type	*Retrofit / Mixed Density / Connect to Nature*	*Underutilized / Urban / Connect to Nature*	*Underutilized / Increase / Bridge to Nature*	*Underutilized / Mixed Density / Connect to Nature*
	Criteria *(1-5 scale, 5 being the highest)*				
Priority	Proximity to Dense Natural Spaces	3	2	5	3
Priority	Urban Density/Type	5	4	5	5
Priority	Access to Site	4	5	4	4
Priority	Housing Demand	3	3	5	5
	Size & Density of Greenspaces	4	3	4	2
	Existing Green Infrastructure/Systems	3	3	4	4
	Zoning	4	5	5	4
	Absence of Existing Limitations	5	4	4	5
	Existing Habitat Variation	1	1	5	2
	Existing Biodiversity	3	5	5	3
	Nearby Development	5	5	5	5
	Sunlight	5	5	5	4
	Visibility	5	5	4	5
	Total *(65 possible points)*	50	50	60	51
	Percentage out of 65	77%	77%	92%	78%

Figure 8.1 Site Selection Matrix (Source: Author)

Site criteria considered for the site matrix is split into priority criteria and secondary criteria. The priority criteria pulls from the major themes discussed in previous chapters to establish a general location within the DMV area. These four criteria include (1) proximity to dense natural spaces, (2) urban density/type, (3)

access to site, and (4) housing demand. The goal of locating the site near an established, dense natural space is so that the project and site can provide additional support to the existing biodiversity. A site located close to natural areas with their own biodiversity would allow for the project to act as a habitat patch of its own and create a corridor system to places like the Anacostia River or Rock Creek Park in Washington DC. Urban density/type focuses on central themes of more-than-human cities. A general urban area or center, pictured in Figure 8.2 as T4 through T6, is dense enough to challenge how development can be more-than-human, while also having the additional space to accommodate for additional outdoor programming. Access to site establishes how many people are passing through the site and experiencing the project. This is measured by assessing transportation networks and walkability. Housing demand is additional priority criteria so that the project serves a greater purpose for the surrounding community and is determined based on existing population and housing data.

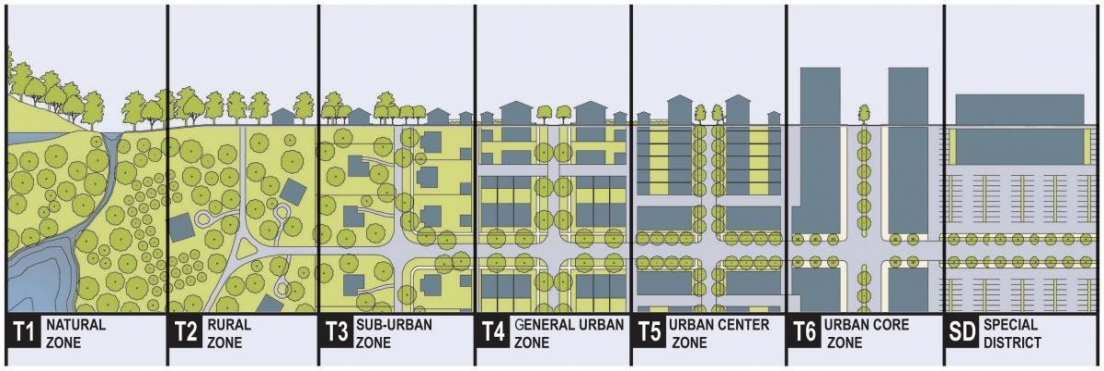


Figure 8.2 Transect Diagram (Source: DPZ)

The secondary site selection criteria focuses on the additional site features that may impact the project approach. These features are not a requirement for each site to have but provide insight on how the project might need to adjust to the site. For example, existing green infrastructure, habitat variation, and biodiversity looks at how each site may be able to adapt to additional greenspaces and plant and animal species. The urban-based criteria like zoning, nearby development, and visibility considers how surrounding context might impact the project and the habitats it may introduce. It might be difficult to introduce and preserve urban biodiversity in an area zoned for industrial use or surrounded by large scale construction as it may disrupt or pollute animal habitats.[152]

Selected Sites

Based on the priority site selection criteria, four sites were considered, most of which were based in Washington, DC. DC was chosen as a primary location due to its growing urban density within two major natural spaces, Rock Creek Park and the Anacostia River. Three of the selected sites are in DC, two located in relation to Rock Creek Park and the third in relation to the Anacostia River. The fourth site is an outlier located in Laurel, Maryland as more exploratory approach. As a supplementary approach, each site is categorized with intervention types a way to envision how the thesis and its proposed framework might fit within the site context.

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[152] Fangzheng Li, Wei Zheng, Yu Wang, Junhui Liang, Shuang Xie, Shiyi Guo, Xiong Li, and Changming Yu. 2019. "Urban Green Space Fragmentation and Urbanization: A Spatiotemporal Perspective" *Forests* 10, no. 4: 333. https://doi-org.proxy-um.researchport.umd.edu/10.3390/f10040333

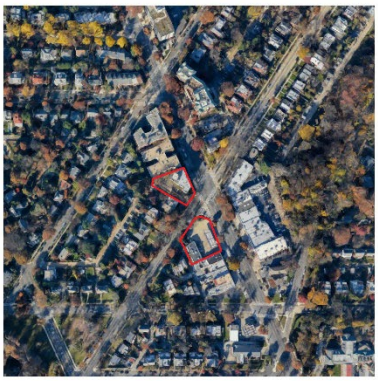
The Chevy Chase site, located at the corner of Connecticut Avenue and Nebraska, is mixed density, general urban zone. The site is about a thirty-minute walk and five-minute drive from the edge of Rock Creek Park, and the surrounding neighborhood is made up of single-family homes with Connecticut Avenue acting as a commercial strip. This site is very car centric, limiting overall access to the site for public transportation and walking. The site itself would include an existing gas station and an existing six story apartment complex located at the corner. With the existing apartment building, this intervention would potentially be retrofitting the existing building and apply the more-than-human framework and urban biodiversity strategies. This intervention could also be an exploration of mixed density in this general urban transect context.

Connecticut Ave & Nebraska Ave
5100 Connecticut Ave NW, Washington, DC 20008

Proposed Intervention Type: Retrofit / Mixed Density

Priority Criteria

Proximity to Dense Natural Spaces: Broad Branch/Rock Creek Drive: 3min Walk: 30min	3
Urban Density/Type: T5	5
Access to Site *(walkscore)*: Walkability - 80 Transit - 62 Bikeable - 68	4
Housing Demand: Limited to single family homes. Could use more mixed income.	3



Other Criteria Scores

Size & density of greenspaces	4
Existing green infrastructure/systems	3
Zoning	4
Absence of existing limitations	5
Existing habitat variation	1
Existing biodiversity	3
Nearby development	5
Sunlight	5
Visibility	5
Total (65 possible points)	**50**
Percentage out of 65	**77%**

Figure 8.3 Chevy Chase Site Summary (Source: Author)

The Friendship Heights Site is near the Friendship Heights Metro Station and located at the former Mazza Gallery on Wisconsin Avenue and Western Avenue. This site has the most urban density in its vicinity compared to the other selected sites. The immediate surrounding buildings are mixed used high rises creating a commercial center, with single-family homes in the surrounding neighborhoods. This site is significantly farther away from Rock Creek Park, with about forty-five-minute walk and a thirty-minute drive to the edge of the park. Site access shows that it is a busy area with the metro station being directly next to it, a walkability score of 90, and

significant vehicle traffic passing through Wisconsin and Western Avenue. The existing Mazza Gallery is closed and scheduled for demolition, so this site intervention would be centered on an underutilized space. The existing context would also mean that the intervention would match or increase urban density in this area.

Friendship Heights, DC
5300 Wisconsin Ave NW, Washington, DC 20015

Proposed Intervention Type: Underutilized / Urban

Priority Criteria	
Proximity to Dense Natural Spaces: Broad Branch/Rock Creek Drive: 7min Walk: 45min	2
Urban Density/Type: T5/T6	4
Access to Site *(walkscore)*: Walkability - 90 Transit - 71 Bikeable - 72	5
Housing Demand: Growing demand, single family homes. Could use more mixed income`	3

Other Criteria Scores	
Size & density of greenspaces	3
Existing green infrastructure/systems	3
Zoning	5
Absence of existing limitations	4
Existing habitat variation	1
Existing biodiversity	5
Nearby development	5
Sunlight	5
Visibility	5
Total (65 possible points)	**50**
Percentage out of 65	**77%**

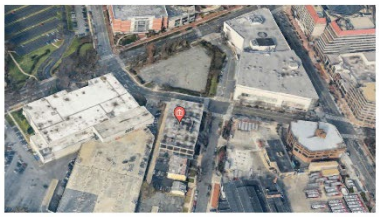


Figure 8.4 Friendship Heights Site Summary (Source: Author)

As an exploration to apply the thesis framework to other types of urban areas, Laurel, Maryland was considered as another site, specifically Main Street. By stepping away from DC, the thesis framework could be envisioned in an area that is seeing more stable urban growth. Main Street also has a significant number of historic

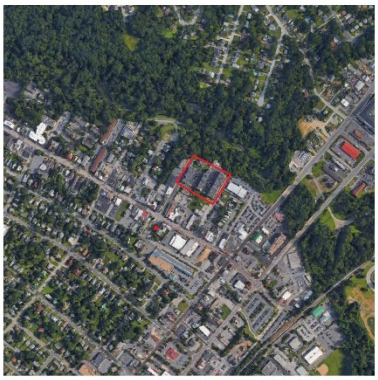
buildings and sites that would need to be considered differently when applying project strategies. The site is immediately adjacent to the Patuxent River, providing established biodiversity. Site access from surrounding areas is limited to vehicle traffic, but the street itself is pedestrian friendly. The Main Street site would also be a retrofit intervention type by adapting an existing apartment complex that is a block behind historic Main Street. With this proximity to the Patuxent River, this intervention could also act as a bridge from urban life to nature and be an experiential threshold. Main Street is a commercial strip, but most of the buildings are low density and the surrounding blocks are mostly single-family homes. It does not provide the urban demand or density needed to explore this thesis.

Main St, Laurel
24 C St, Laurel, MD 20707

Proposed Intervention Type: Underutilized / Increase / Bridge to Nature

Priority Criteria

Proximity to Dense Natural Spaces: Patuxent River & Trail Directly behind site	5
Urban Density/Type: T4/T5	5
Access to Site *(walkscore)*: Walkability - 79 Transit - 30 Bikeable - 43	4
Housing Demand: Growing housing demand	5



Other Criteria Scores

Size & density of greenspaces	4
Existing green infrastructure/systems	4
Zoning	5
Absence of existing limitations	4
Existing habitat variation	5
Existing biodiversity	5
Nearby development	5
Sunlight	5
Visibility	4
Total (65 possible points)	**60**
Percentage out of 65	**92%**

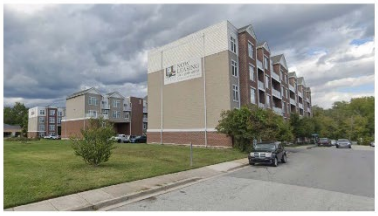


Figure 8.5 Main Street, Laurel Site Summary (Source: Author)

H Street Site Analysis

H St Neighborhood, DC

845 Bladensburg Rd NE, Washington, DC 20002

Underutilized Site / Mixed Density / Connectivity to Nature

	Criteria *(1-5 scale, 5 being the highest)*	Score	Notes
Priority	Proximity to Dense Natural Spaces	3	Kingman Island/Anacostia River Drive: 6min / Walk: 32min
Priority	Urban Density/Type	5	T5
Priority	Access to Site	4	Walkability: 90 / Transit: 72 / Bikeable: 64
Priority	Housing Demand	5	Yes, probaby needs more affordable housing
	Size & Density of Greenspaces	2	Very few street trees
	Existing Green Infrastructure/Systems	4	Rain Gardens, permeable surfaces, green roofs - not on site
	Zoning	4	Mixed Use (MU-7)
	Absence of Existing Limitations	5	Topographic change at shopping center, otherwise fine
	Existing Habitat Variation	2	Urban, Forested & Riparian around Kingman Island
	Existing Biodiversity	3	74 bird species observed (Lincoln Park)
	Nearby Development	5	Mostly completed housing projects
	Sunlight	4	Low rise buildings to the south, mid rise to the north
	Visibility	5	Major commercial intersection and bus station/stop
	Total *(65 possible points)*	51	
	Percentage out of 65	78%	

Figure 8.6 H Street Neighborhood Site Matrix Breakdown

Ultimately, the H Street Site was chosen for this thesis. The site is located in DC Ward 5 and in the Carver/Langston neighborhood, at the eastern end of the H Street corridor. The site is an existing shopping center, called Hechinger Mall, and surface lot at the corner of Bladensburg Road and Benning Road. It is adjacent to a larger intersection where Bladensburg Road, Maryland Avenue, H St, Benning Road, and Florida Avenue come together. At this intersection is Starburst Plaza, an informal bus station and DC Streetcar stop. Site observations also show that the plaza is a community gathering spot where people gather and socialize. The nearest natural spaces are the United States National Arboretum and Kingman Island on the Anacostia River. The site is about a five-minute drive and twenty-five minute walk from the National Arboretum public entrance. The edge of the Anacostia River and Kingman Island is also a five-minute drive away from the site.

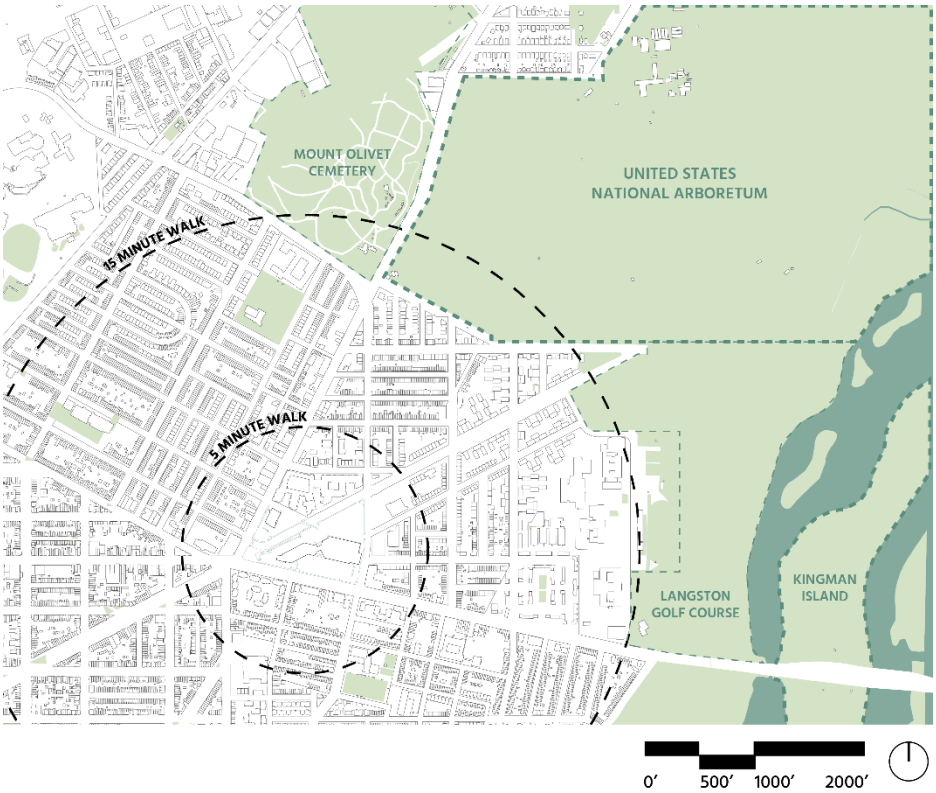


Figure 8.7 Overview Site Map (Source: Author)

Figure 8.8 Figure Ground Diagram of Site (Source: Author)

The site offers a unique urban context and density as it is located at the edge of multiple DC neighborhoods, like Trinidad, Carver/Langston, and Kingman Park. Most of these neighborhoods are zoned for residential use (RF-1 and RA-2)[153] and typically made up of rowhouse style, single-family homes. The H Street Corridor, Bladensburg Road, and Benning Road act as commercial centers as they are zoned for mixed used and commercial activity. The site itself and buildings along Bladensburg Road and Benning are zoned MU for medium-density, mixed use.[154] The H Street Corridor specifically is Mixed-Use Commercial Arts with an emphasis on arts and

[153] DC Office of Zoning. "Zoning Handbook." DC Office of Zoning, accessed December 4, 2023. https://handbook.dcoz.dc.gov/.
[154] Ibid.

entertainment (NMU-4/H-A).[155] This combination of residential, mixed-use, and commercial allows for the site to act as a transect or threshold between urban commercial and less dense residential. The major intersection at the corner of the site and Starburst Plaza allows for access to and through the site and the commercial and mixed-used activity provides an urban experience.

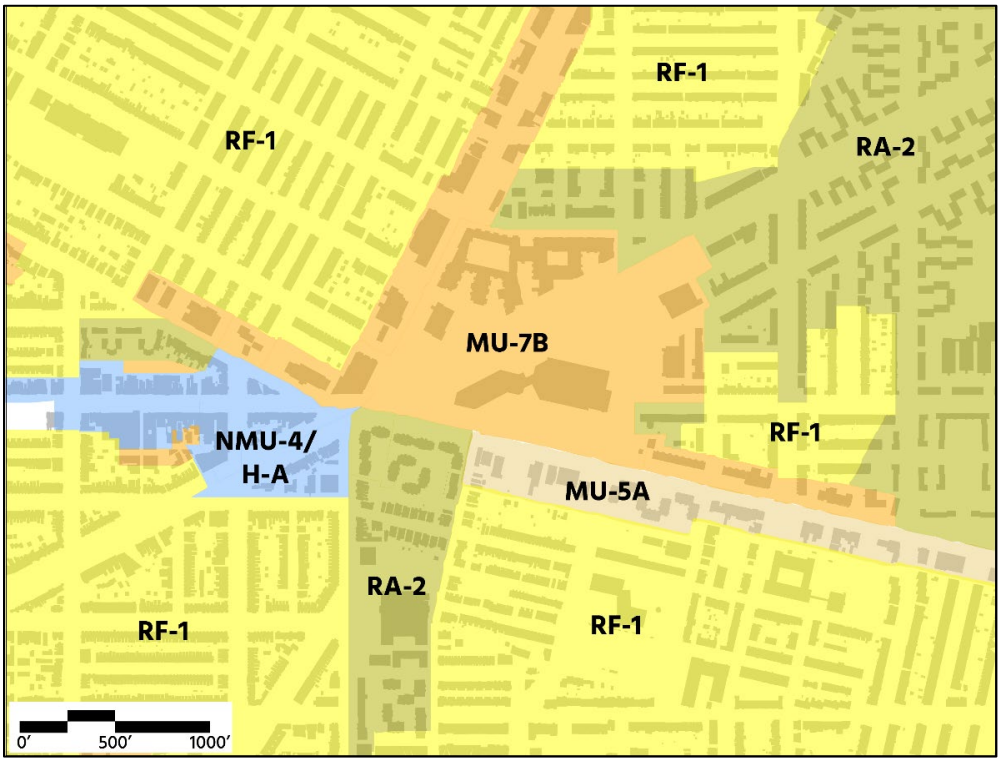


Figure 8.9 Zoning Map (Source: Author)

[155] Ibid.

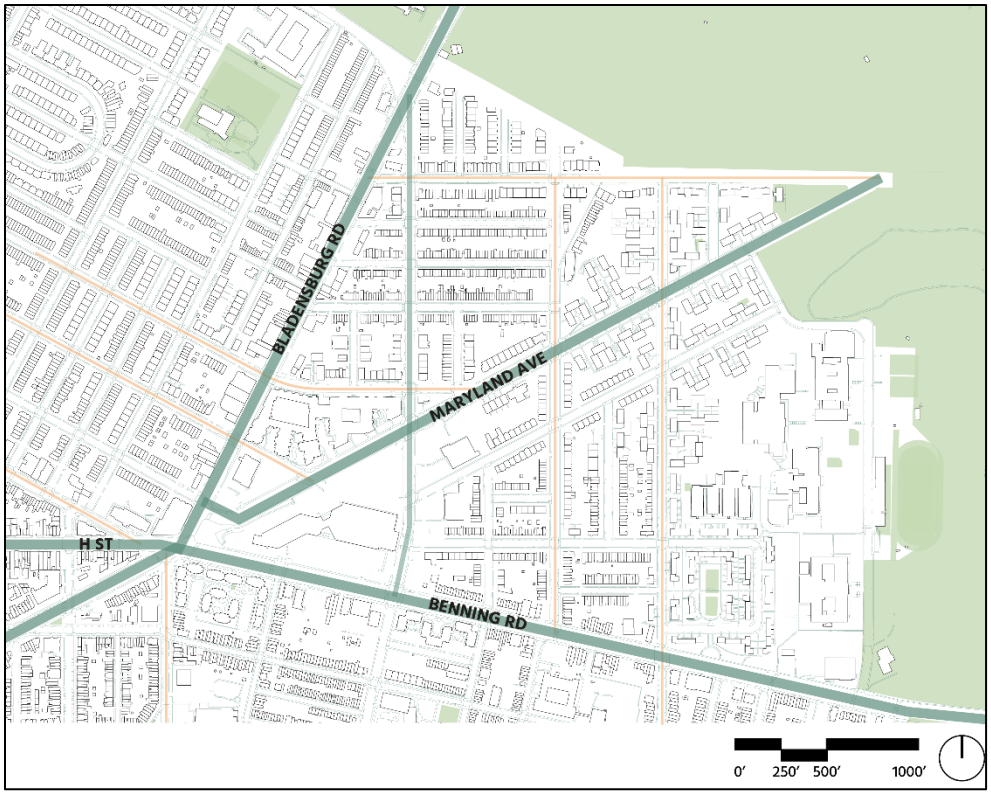


Figure 8.10 Street Hierarchy (Source: Author)

Chapter 9: Convergence

Blocking

These design iterations show the initial process of transitioning from research to design intervention, by blocking out program and establishing initial guidelines and design choices. These iterations of blocking focus only on the block at Bladensburg Road and Maryland Avenue, as an initial attempt of what one mixed use, multifamily building might look like under this framework. They focus on relationships between the block layout and how it extends into the rest of the urban context.

Iteration 1

This stacking iteration tries to maintain street wall and block edges along Bladensburg Road by placing the building and the retail spaces along it. Building lobby and community spaces face inward. The south corner of the block is open to keep a relationship with the existing Starburst Plaza, and the community gardens are placed there so they can serve the whole community. The Maryland Avenue edge is built up with dense natural spaces as this road leads to the edge of the Arboretum.

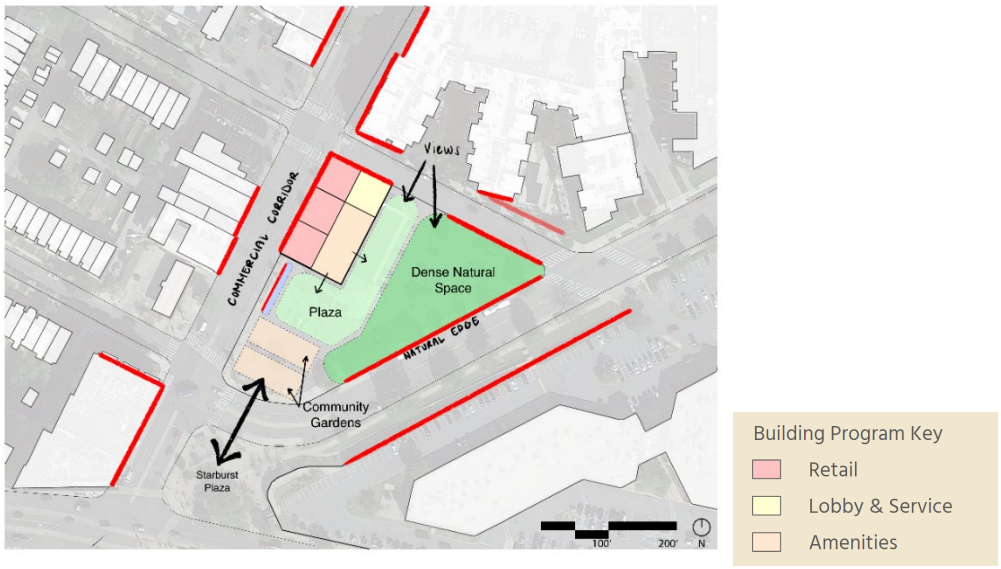


Figure 9.1 Iteration 1 (Source: Author)

Iteration 2

This iteration attempts to build the urban edge with only the dense natural spaces to potentially create a natural street wall on Bladensburg Road and Maryland Avenue while maintaining a more porous edge in front of Starburst Plaza. This can then create an axis from the plaza to the internal courtyard and residential building. The retail faces the northern street, Neal Street, so that road could potentially become a pedestrian strip as it faces an existing apartment building.

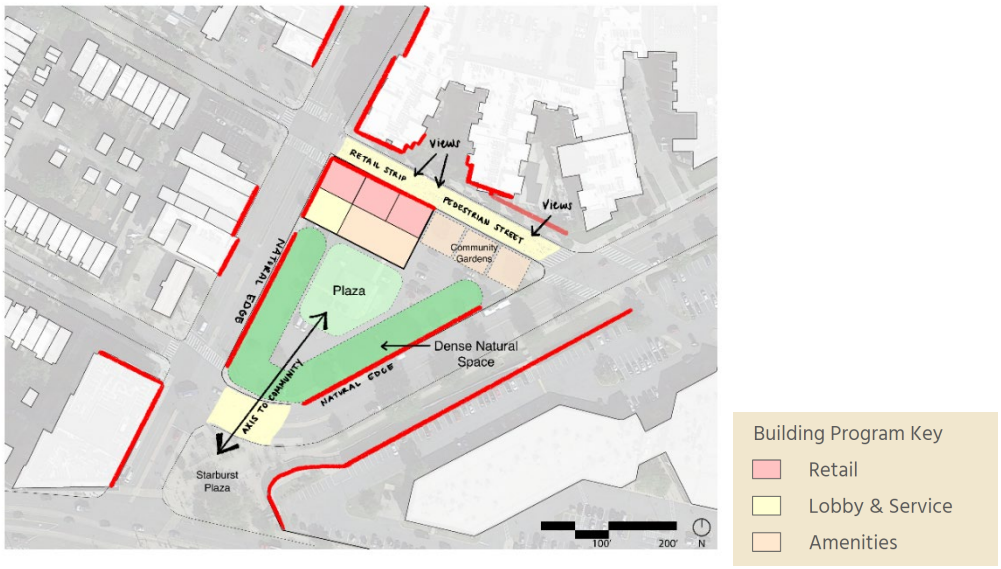


Figure 9.2 Iteration 2 (Source: Author)

Iteration 3

This iteration places the retail spaces south of the site and closer to the commercial strip on H Street/Benning Road. The dense natural spaces build up the block edge towards the south, to create almost a nested (haha) community within the site block. This would create more private plaza and community garden, which might not serve the community or thesis themes well.

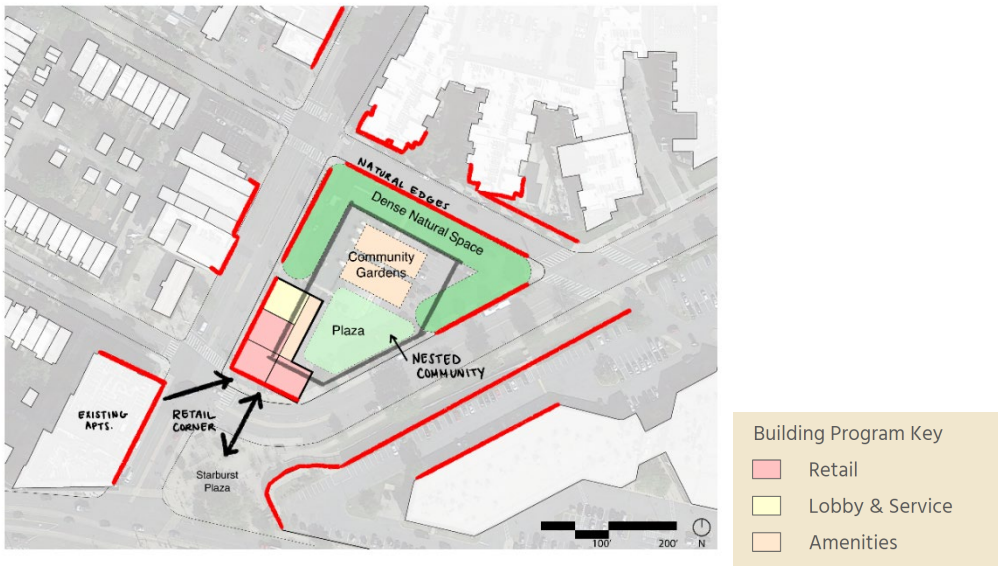


Figure 9.3 Iteration 3 (Source: Author)

City Scale Exploration

To begin developing a corridor system, some exploratory figure ground diagrams were created. These are not to scale and are rough drafts that focus more on the urban relationships. Many of these explorations looked at meshing the existing streets grids into a cohesive connection point.

Figure 9.4 – City Scale Iteration 1

Iteration 1: tries to keep existing roads and Starburst Plaza. More similar to existing building scale.

Figure 9.5 – City Scale Iteration 2

Iteration 2: More extreme grid changes and scale changes. Attempts to create a green corridor along Maryland Ave.

Figure 9.6 – City Scale Iteration 3

Iteration 3: Completely removes Maryland Ave. More emphasis on greenspaces.

Chapter 10: Design Intervention

Introduction

This thesis aims to find a balance between urban life and biodiversity, by staying within the realm of current architectural practices and existing urban conditions. A collection of strategies can start to reimagine urban areas as a shared ecosystem that serves all species. An ideal shared ecosystem can support urban living, embrace coexistence, and foster a symbiotic relationship between humans and nature.

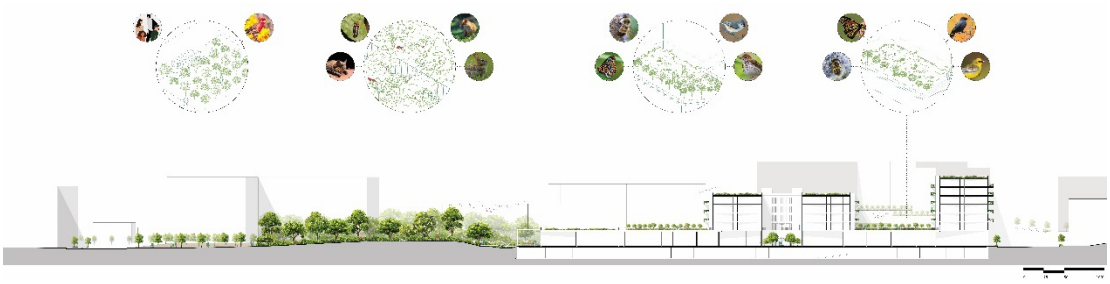


Figure 10.1 Longitudinal Section through Site (Source: Author)

Site Conditions and Response

Figure 10.2 Existing Site Conditions (Source: Author)

The existing site at the corner of Bladensburg Road and Benning Road has its own collection of strengths and weaknesses. These strengths and weaknesses can be corrected and combined to reimagine a shared ecosystem that serves human, plants, and animals.

Much of the site is made up of surface parking lots to serve the existing shopping center and commercial building. This provides challenges for urban residents as the excess surface lot increases the heat island effect, increasing temperatures and decreasing air quality for the neighborhood. The site also has a

significant topographic change running north to south, in some places with a 40 foot change in grade. With the existing topographic change and the excess amount of surface lot, there is significant potential for stormwater runoff to pollute into the Anacostia Watershed, disrupting species that rely on it.

The site has the potential to be a major node for both animal and human residents as the site is located at a major intersection. The site is surrounded on all sides by major thoroughfares with heavy vehicular traffic. The west corner of the site, where Starburst Plaza is located, also has several Metro bus stops and a DC Streetcar stop. Maryland Avenue cuts through the site diagonally and connects it to the edge of the Arboretum, creating a potential corridor for animals to move between the site and the Arboretum and Anacostia.

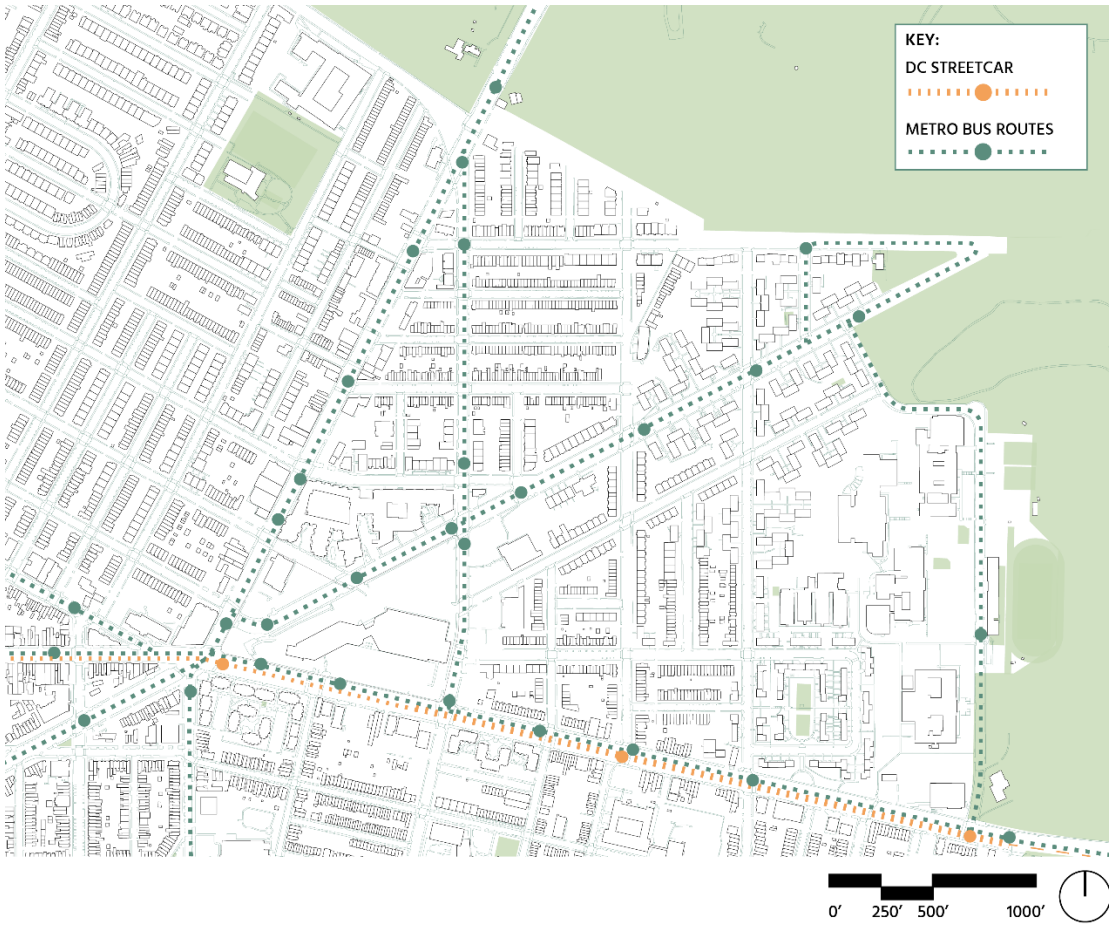


Figure 10.3 Transportation Network (Source: Author)

City Scale Implementation

Urban Matrix

DC offers a range of urban habitats that can serve its urban biodiversity. The Arboretum and Anacostia hosts natural habitats that can better serve animals, like forests, creeks, and riverbeds. Creating a connection between the site and these natural resources helps to diversify habitats that can greatly support plant and animal species. This can improve species richness and help in creating more resilient ecosystems. Within the design intervention, the site offers a range of habitats to

mirror DC's urban matrix and serve all urban species, which can be seen in more detail in the proposed site plan.

Patches and Corridors

Figure 10.4 Aerial View of Site (Source: Author)

The site is close in proximity to existing natural resources, the Anacostia River, and human made resources, the US National Arboretum. This allows for the site to act as another habitat patch for existing urban biodiversity to take refuge in. This means providing spaces for urban wildlife to safely reside in. This can also serve human residents as a public amenity and connection to nature. Green corridors are implemented to connect the existing habitat patches to the proposed one. This provides safe paths for wildlife to move between. In this case, Bladensburg Rd and Maryland Ave are the primary green corridors that connect back to the Arboretum. This thesis aims to work within existing urban conditions, so existing road width and boundaries are maintained, and the interventions are more strategically placed. The green corridor along Bladensburg Rd serves primarily human users due to its heavier

vehicle traffic, while Maryland Ave can serve both human and animal users as it is more residential. The green corridors are made up of bioretention gardens with native plantings to assist with stormwater management, especially with the existing topography leaving the site at the bottom of a hill.

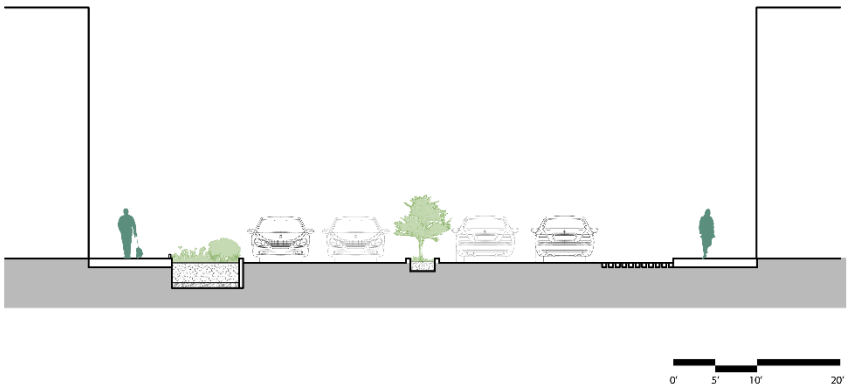


Figure 10.4 Bladensburg Road Green Corridor Section (Source: Author)

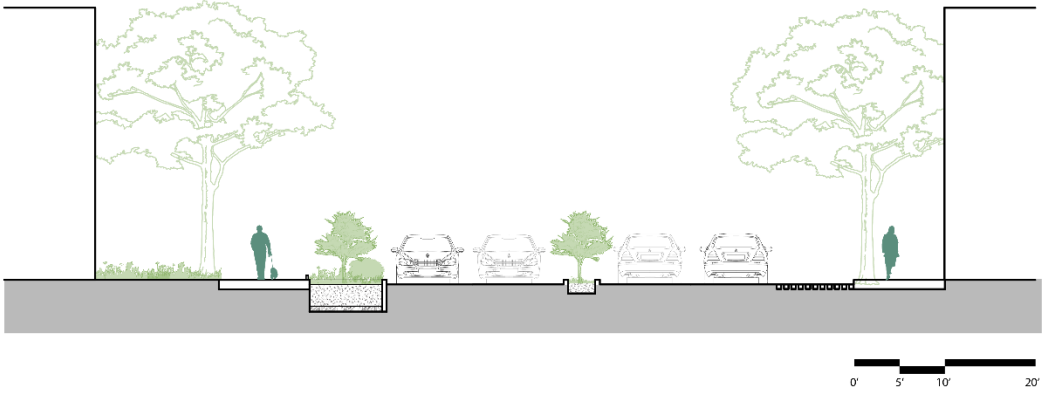


Figure 10.5 Maryland Avenue Green Corridor Section (Source: Author)

Neighborhood Scale Implementation

Figure 10.6 Proposed Site Plan (Source: Author)

The proposed site plan is a product of the existing urban conditions and attempts to use those conditions to support urban biodiversity. The site responds to the urban context by building up the urban edges along Bladensburg Rd, Benning Rd, Maryland Ave, and 17th St with four proposed mixed use, multifamily housing. The street grid surrounding the site is complex as the street grid of four neighborhoods meet at this site. These building masses are placed at certain corners to continue the existing street grid, both formally and informally. Formally, the buildings' front edges help to create defined corners and continue the street wall. Informally, breaks

between the buildings create pedestrian paths and visual connections from minor streets into the site.

The existing southwest corner of the site creates a complex five-way traffic pattern, for both vehicles and pedestrians. The proposed site plan remedies that by redirecting the southern half of the Maryland Ave to Neal St. Maryland Ave and its diagonal is cut off and redirected for vehicles, but the axis continues into the site for pedestrian and animal access.

Figure 10.7 Urban Response Diagram (Source: Author)

As a result of the urban response, the site creates opportunities for zones nested within the site. These zones can be broken down into different habitats, to diversify the urban matrix and serve more species. These nested zones consist of both

public and private spaces. The shape of the proposed buildings creates private outdoor amenity spaces for building residents. To separate public and private spaces, these amenity spaces are elevated on a podium. The buildings and their elevated podiums build the edges of the site where the public spaces are nested within.

Figure 10.8 Nests & Zones Diagram (Source: Author)

With this form, the site can use those zones to create public hubs that have their own unique characteristics that serve different types of urban users, both human and non-human. (Figure 10.10) The first hub is Starburst Plaza. Starburst Plaza continues to act as a bus station and pedestrian plaza, but with a more established grid of trees to provide shade and cooling for all. The expanded size is intended to make the plaza more welcoming as both a bus station and a community gathering space.

With this expansion and introduction of more trees and shading, this hub can serve and support human activity along with birds, insects, and small urban animals like foxes, rabbits, and squirrels.

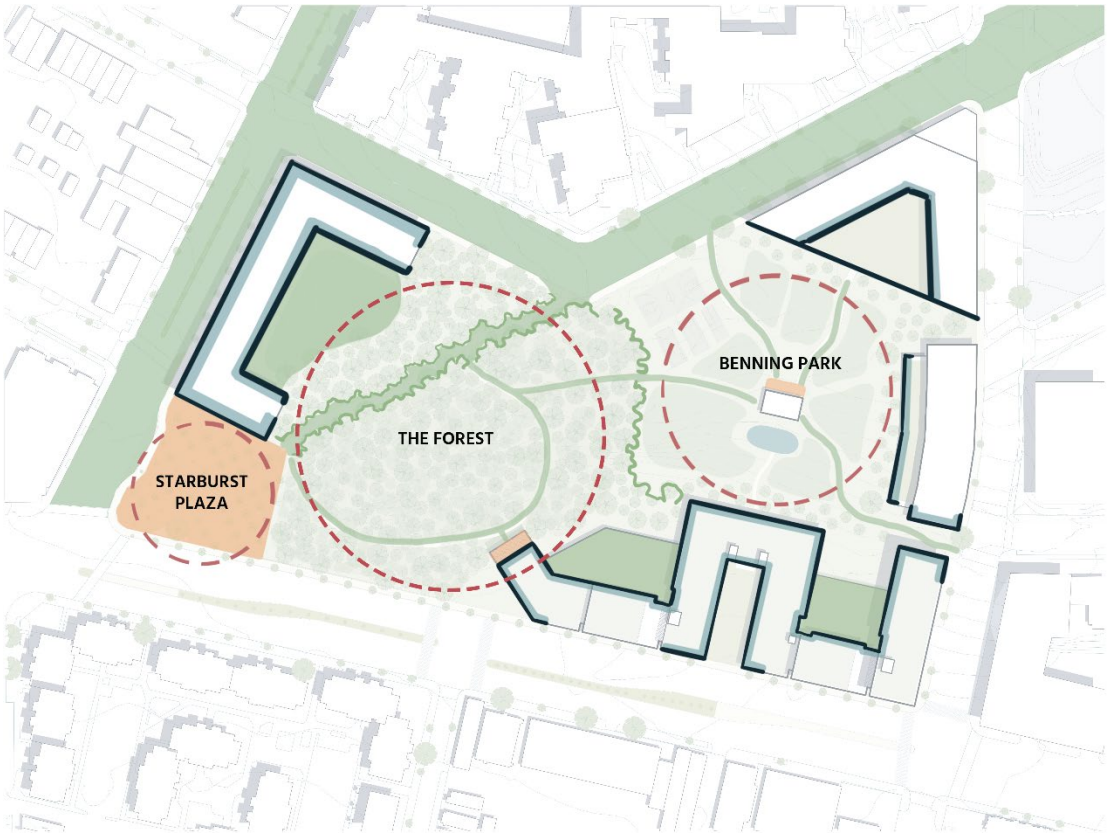


Figure 10.9 Hubs Diagram (Source: Author)

The next hub is the Forest, which is intended to be reforested area with dense tree coverage and undergrowth. The Forest branches off the axis created by Maryland Ave and has its own series of nature trails that branch into other parts of the site. As the multifamily buildings are urban homes for people, the Forest is a urban home for animals. The dense tree coverage and undergrowth creates a habitat that can serve birds, a variety of insects like Eastern Fireflies, and small, urban mammals like Red Foxes and Little Brown Bats. The nature trail through the Forest connects to hubs like

Starburst Plaza, the park, and to a public nature center. It is intended to be low impact so not to disrupt animal habitats with human intervention.

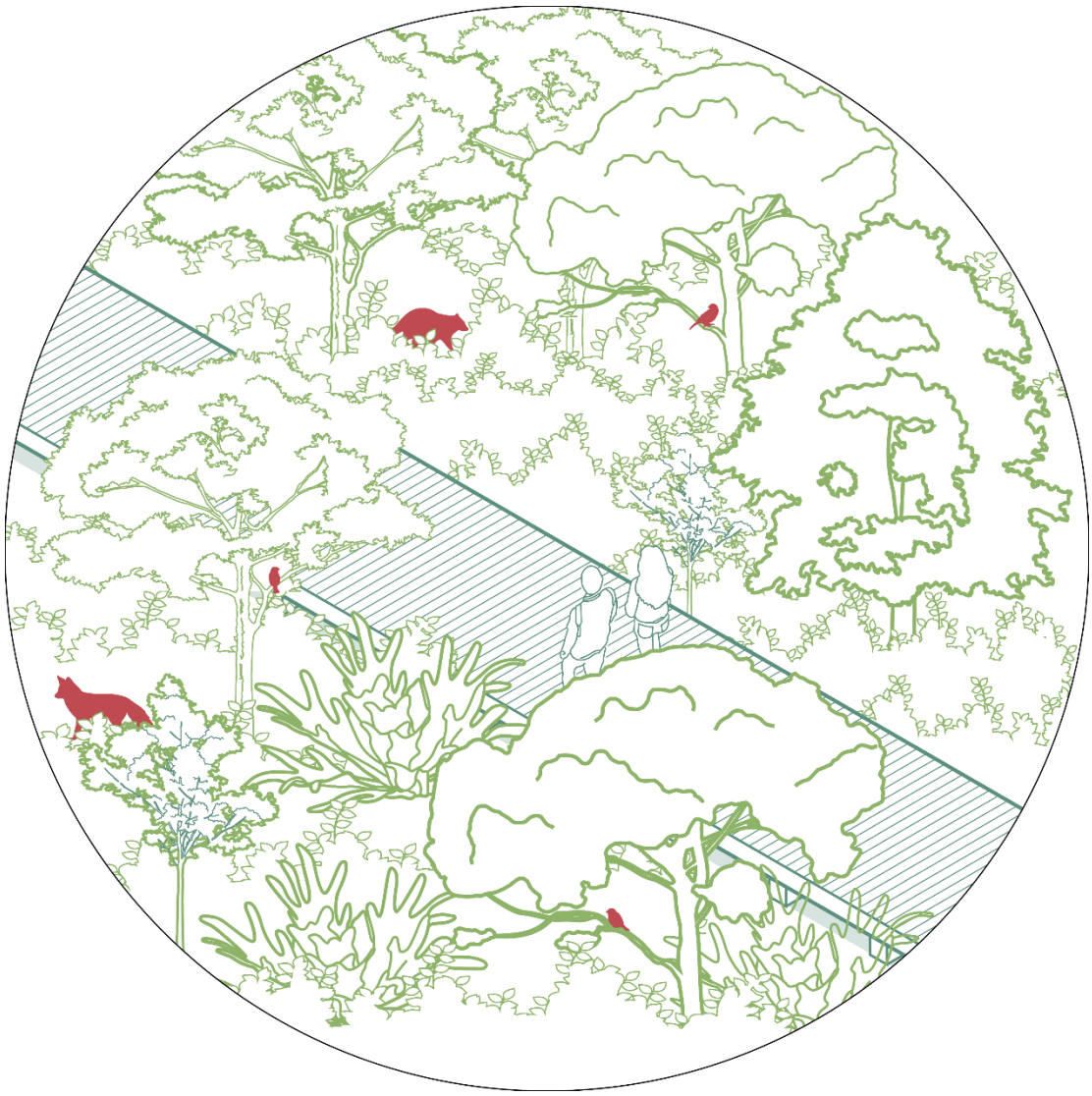


Figure 10.10 Vignette of the Forest (Source: Author)

The next hub is Benning Park, which primarily serves as a public park and gardens. The neighborhood surrounding the site has limited access to public greenspaces and parks. Benning Park intends to remedy that with recreation spaces like sport courts, and encourage coexistence with native animal species through the

gardens. The main entrance of the park is along Maryland Ave, facing the existing multi-family residential building. Street trees at the entrance signal a green threshold as user enter the park. Other paths within the park connect to the proposed residential buildings, pedestrian paths, and the Forest. At the center of all of this is the Pavilion facing a human-made pond. This pavilion acts as a central node for the park, primarily human users, and the pond acts as a node for non-human users.

Building Scale Implementation

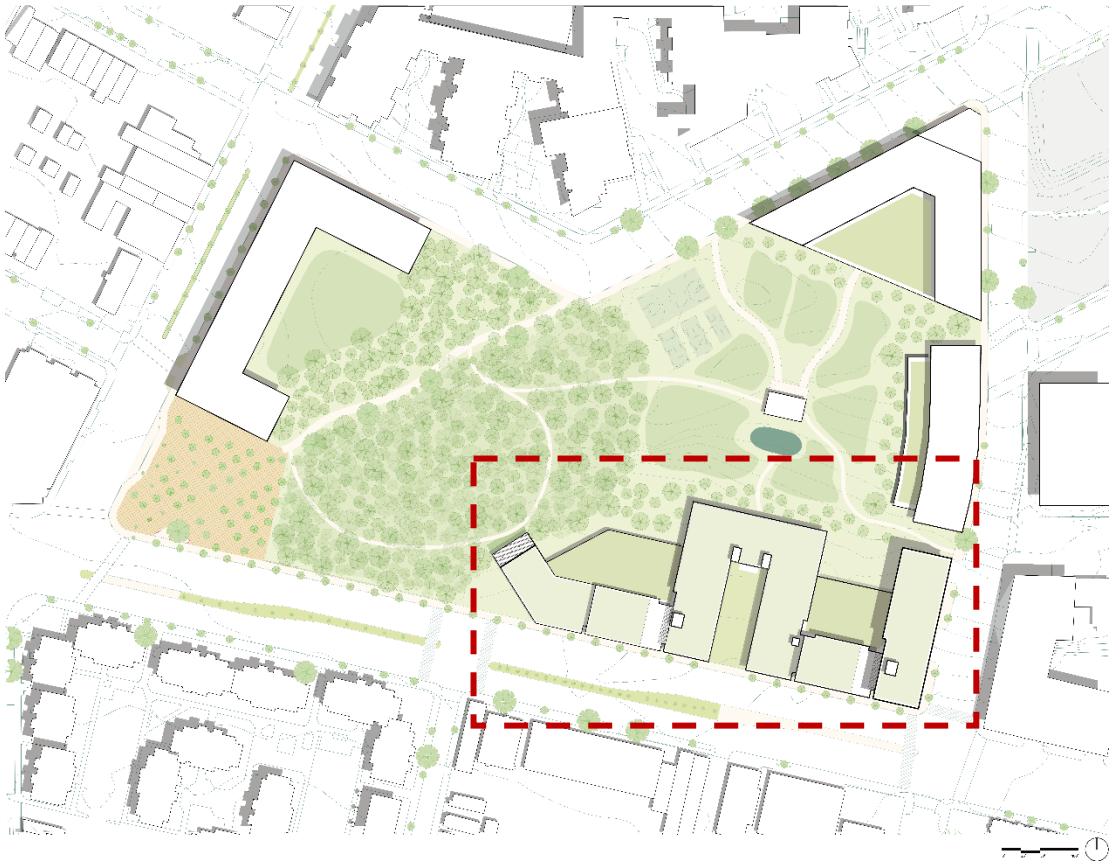


Figure 10.11 Proposed Site Plan with Building Focus (Source: Author)

For the building scale exploration, this thesis focuses on the mixed-use, multifamily building at the southeast corner of the site, as highlighted in Figure 10.12. This building is located at the corner of Benning Rd and 17th St, with its primary façade facing Benning Rd. The building is a long, snake-like form that ends in the direction of the Forest. The massing is stepped at nearly each corner of the building to transition between urban context and the Forest, creating more of a transect between urban and nature. The stepped mass also helps to break the building down visually and match the surrounding building scales.

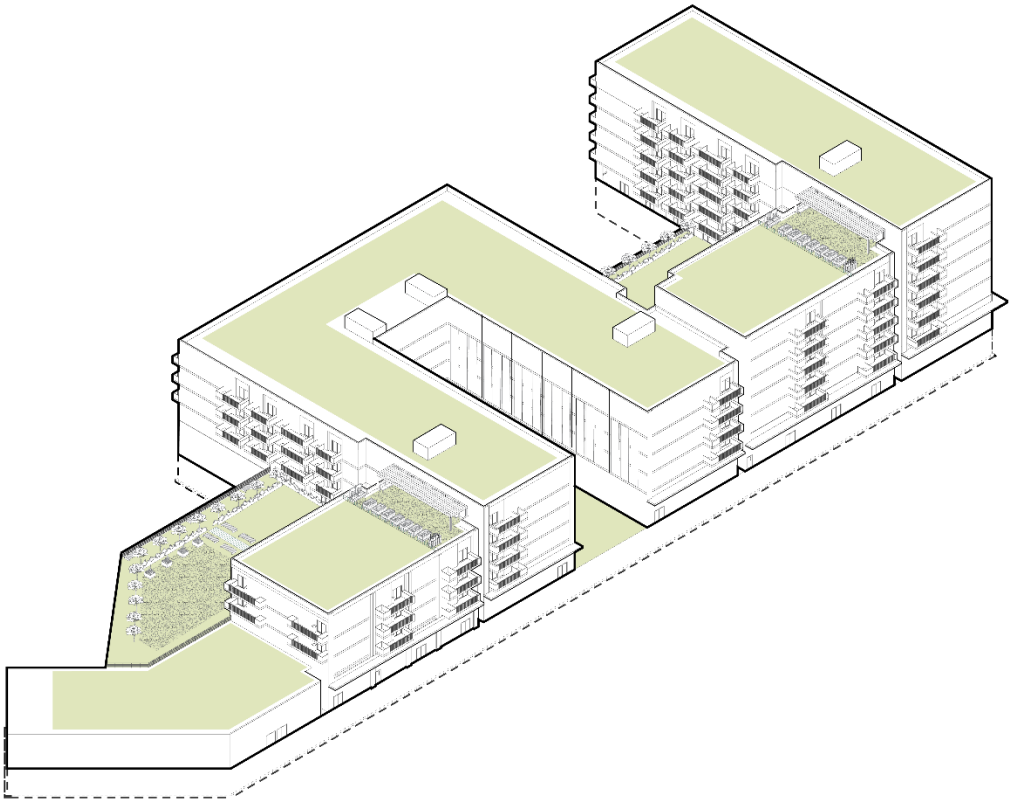


Figure 10.13 Building Axonometric (Source: Author)

The first floor of the building serves its urban context with retail spaces facing Benning Rd, replacing the retail spaces of the original site. At the center of the

building is a courtyard that acts as a green threshold for residents, allowing them to transition between urban life and nature. At the west end of the building is a public nature center that hosts educational exhibits about DC's wildlife and teaches users about civilian research, to build stronger relationships with nature. Due to the topographic change, the north edge of the building is buried underground, the back of house program is pushed to this side. This includes program like mechanical systems, storage for both retail and residents, a bike repair shop and storage. Parking for both residential and retail is underground.

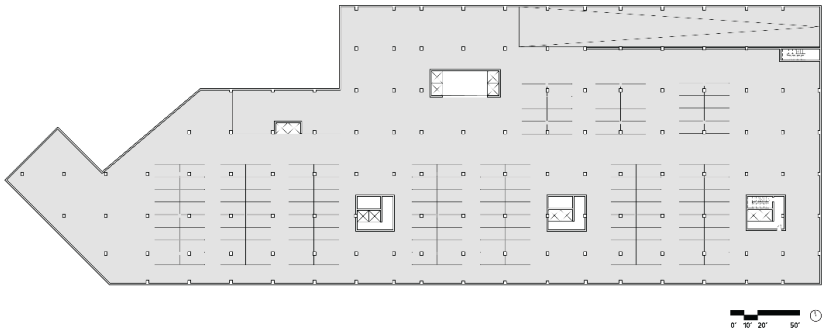


Figure 10.12 Basement Floor Plan (Source: Author)

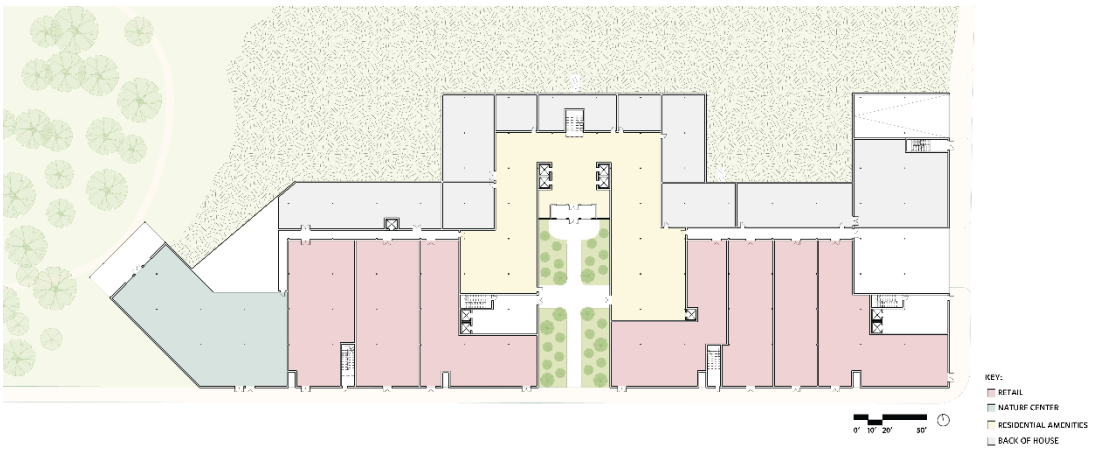


Figure 10.13 First Floor Plan (Source: Author)

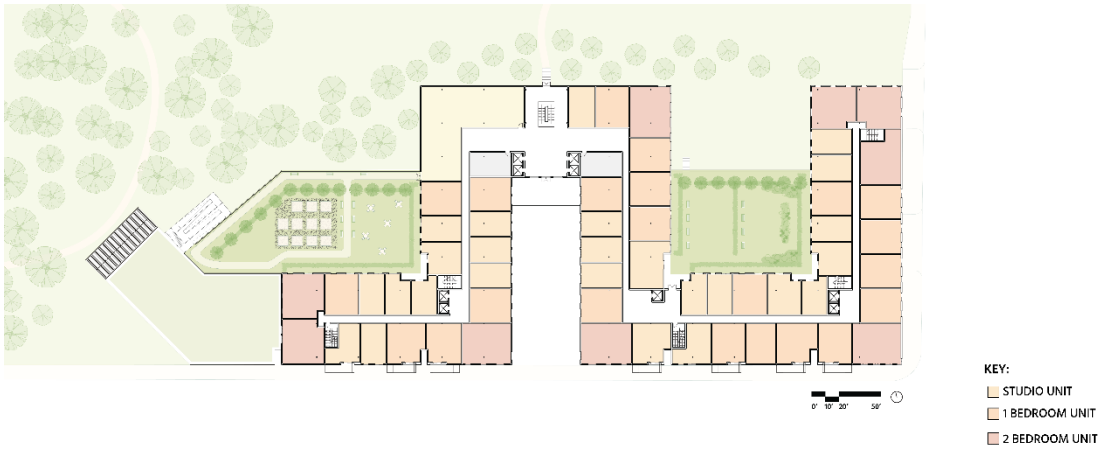


Figure 10.14 Second Floor Plan (Source: Author)

The second floor of the building has residential amenities facing the north side with views out to the Forest and Benning Park, with outdoor access. The second floor has access to green podiums, private outdoor greenspaces for residents on the east and west ends. These spaces ensure privacy while keeping a visual connection to the natural environment. These podiums have their own programs to embrace coexistence

between species. Features like native plant gardens, community gardens, and access to the forest and park encourage residents to live with and interact with other species.

Upper floors are similar to each other but begin to reduce in floor plate size to make up for the building's stepped massing. With every other step, there is rooftop access for residents with pollinator gardens and views out into both the natural and urban landscape.

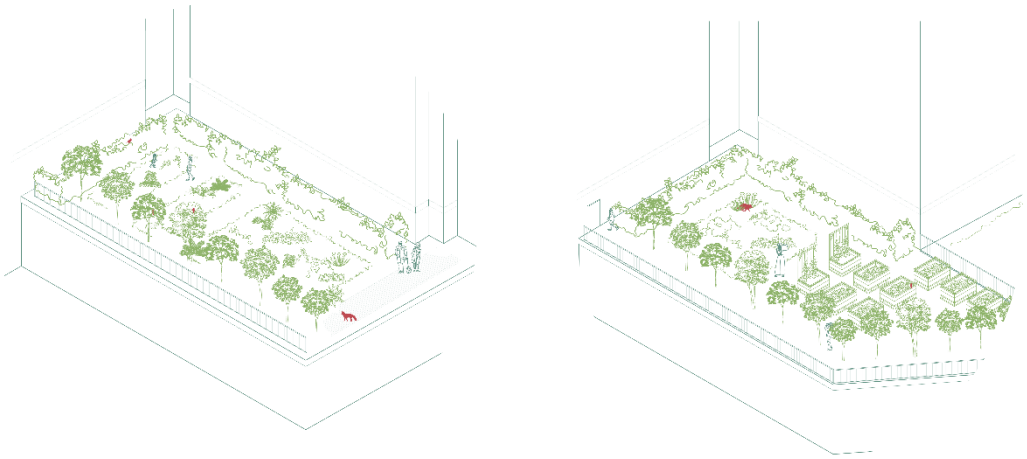


Figure 10.15 Vignettes of the East Podium (left) and West Podium (right) (Source: Author)

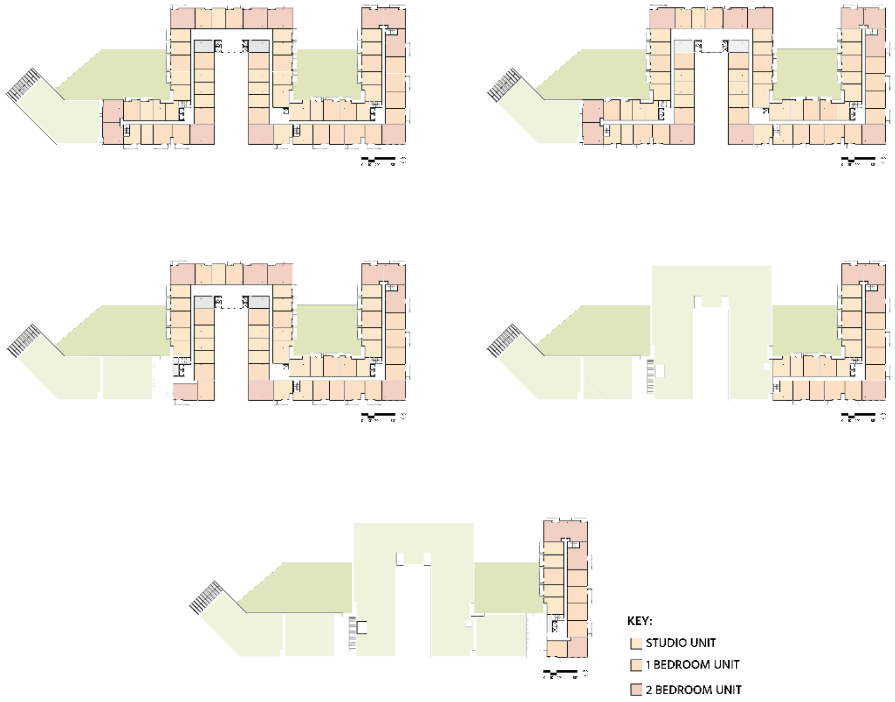


Figure 10.16 Floors 3-7 (Source: Author)

Living Façade

Figure 10.17 Benning Road Elevation (Source: Author)

As part of the building scale, the façade was given a kit of parts to support and house multiple species. The first intervention was the green balcony. 50% of the residential units have a green balcony where the ends of the balcony have planters to give residents their own private gardens. The exterior wall is also pushed inward to

create green thresholds when walking out onto the balcony, as seen in Figure 10.20. Vegetation on the balconies can also provide resources for insects and birds.

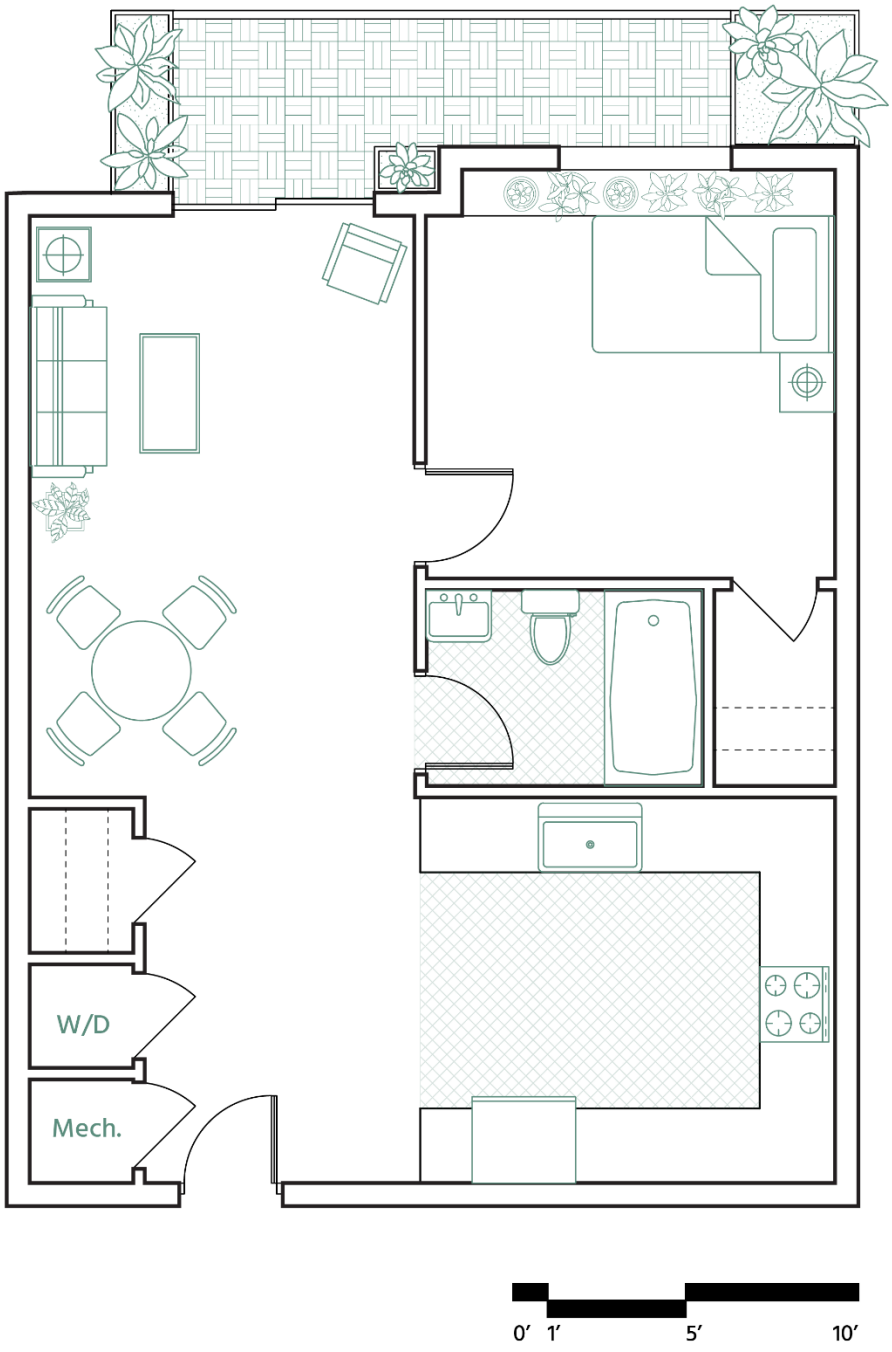


Figure 10.18 Typical 1-Bedroom Unit Plan (Source: Author)

As a living façade, the façade is designed to create spaces specifically for urban birds and insects. The brick façade of the building has bird bricks and insect hotel bricks scattered throughout. These are built directly into the façade and can house smaller birds and solitary insects like sparrows and solitary bees. Since the nesting patterns of these critters require some privacy and safety from other species, a façade partition is incorporated in the design. This is a planar change in the elevation to give birds and insects from distance and comfort away from humans. The bird bricks are placed above window and balcony height to give birds a sense of comfort. The insect hotels are placed closer to the balcony planters to give insects and pollinators direct access to vegetation.

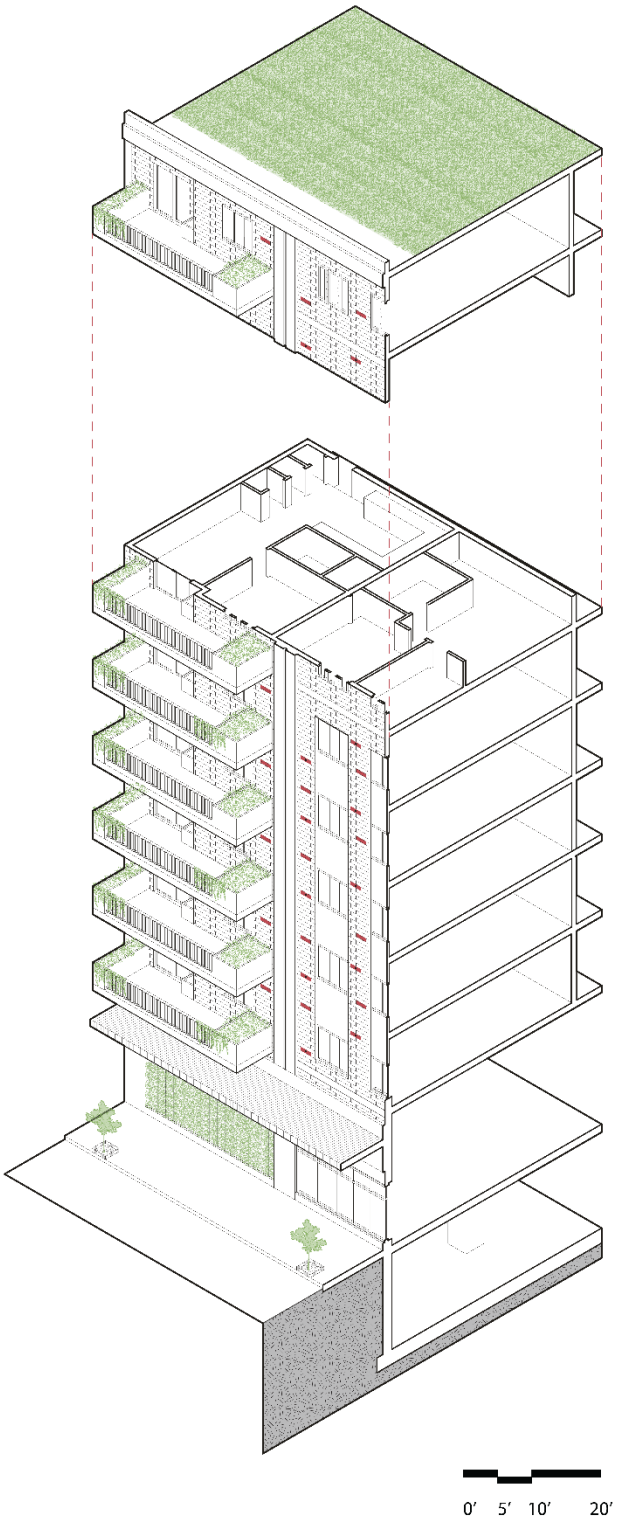


Figure 10.19 Exploded Facade Axon (Source: Author)

Chapter 11: Conclusion

Urban Matrix

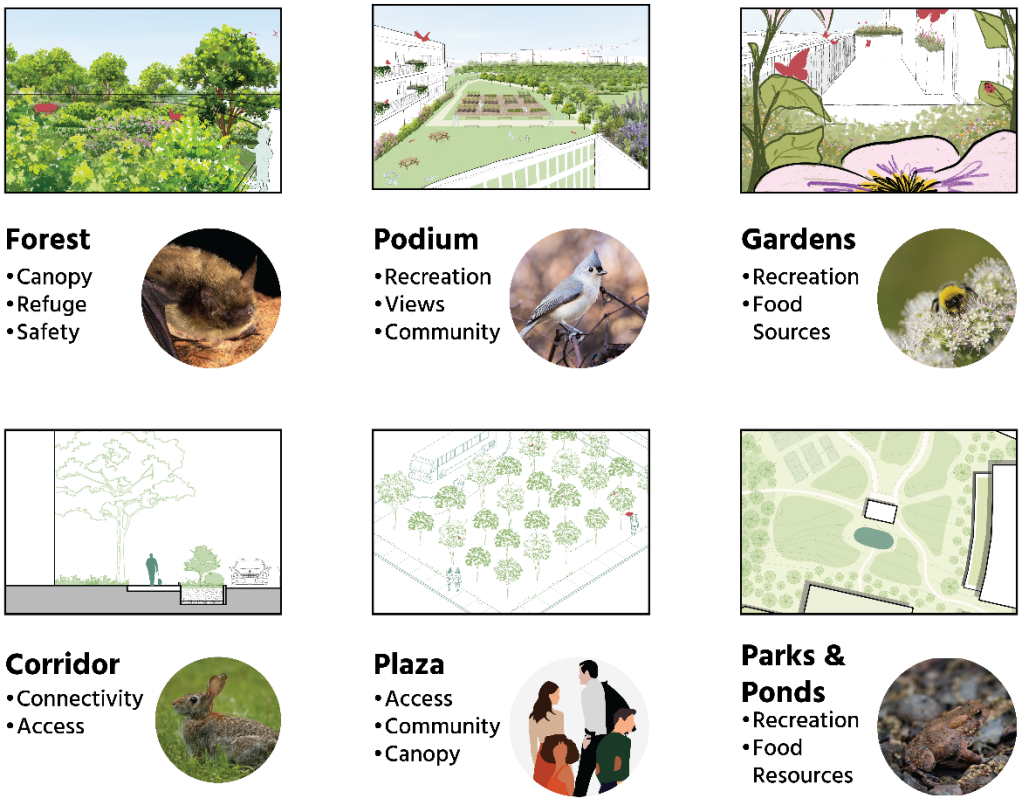


Figure 11.1 Proposed Urban Matrix (Source: Author)

As part of the collection of strategies, the proposed design intervention introduces a variety of habitats and programs that serve all urban residents. The proposed urban matrix offers services and resources that can support urban biodiversity. In the Fores,

spaces of refuge and canopy can cater towards small mammals, like bats and rabbits, and give them a safe haven from vehicle driven urban spaces. This idea can also extend towards humans as Starburst Plaza makes similar to cover and protect the community. Spaces created at the neighborhood and building scale offers recreation and resources for people, birds, and insects. These spaces are also shared between all species, encourage coexistence and rebuilding a symbiotic relationship between all species.

Conclusion

Building relationships between humans and animals is important as all species work together to maintain our natural systems. The goal of this thesis aims to use what we know about urban life and biodiversity to create a shared ecosystem for all. By creating a variety of spaces and programs at multiple scales, there is an opportunity to think outside of our typical human-centric perspective and rethink how our cities work within nature. This can support urban living for all, embrace coexistence between species, and foster a symbiotic relationship between humans and nature.

Figure 11.2 Symbiotic Experience (Source: Author)

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