RUTGERS–NEW BRUNSWICK
Center for Urban Environmental Sustainability
School of Environmental and Biological Sciences

Middlesex County Cultural Landscape and Ecosystems Service Plan

Part II

Ecosystem Services and Cultural Landscape Analysis

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PREFACE

The Middlesex County Department of Planning supported the development of a comprehensive Cultural Landscape and Ecosystems Service Plan as part of the Destination 2040 planning process, County's strategic vision.
Although the political and administrative process is still ongoing, we publish the underlying research to disseminate relevant information to the general public and interested members of the environmental community. Further we believe that the developed methodology is a contribution to the ongoing discussion on the role of environmental planning in a home rule state.

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TABLE OF CONTENTS

TABLE OF CONTENTS **3**

INTRODUCTION **5**

ECOSYSTEM SERVICES ANALYSIS **9**

Introduction 9

Ecological Habitats of Concern 10

Wetlands and Buffers with Watershed Delineation 15

Priority Flood Mitigation Ranks 22

Priority Flood Mitigation and Impervious Surfaces 25

Tree Canopy Cover and Impervious Surfaces 31

Urban Heat Island (8/26/2021) & Impervious Surfaces 34

Ecosystem Services Summary 37

CULTURAL LANDSCAPE ANALYSIS **39**

Introduction 39

Cultural Landscape Features and Assets 43

- Historical and Cultural Assets Analysis 45
- Viewshed Analysis 50
- Character of Place 56
- Downtown Analysis 63
- Cultural Landscape Features and Assets Summary 82

Cultural Landscape Perception: Engagement Analysis 85

- Nature & Place. Photo Survey Analysis 87
- D 2040 Public Outreach 91
- Municipal Engagement 95
- Cultural Landscape Perception Summary 96

Nature and Place 97

Cultural Landscape Summary 99

OPEN SPACE AND RECREATION **101**

LANDSCAPE THREATS **107**

Land at Development Risk 108
Land at Development Risk Summary 116
LANDSCAPE TYPES 117
Land Use Types 117
Cultural Landscape Types 120
LANDSCAPE INFLUENCERS 152
CONCLUSION 154
DATA DICTIONARY 160
APPENDIX 162
Appendix 1: Downtown Existing Quality Analysis Matrix Definitions 162

INTRODUCTION

Middlesex County's cultural and ecological landscape analysis stems from the extensive inventory chapter that studies the County's existing landscape conditions. The Inventory chapter revealed Middlesex County's existing cultural and ecological landscape character and assets through available online data and selected on-site data collection. The focus centered on ecological, environmental, and natural resources, infrastructure, and cultural landscape elements. Eight selected Destination 2040 Strategic Initiatives informed the inventory study categories and guided which topics to consider for further analytical assessment.

The eight Destination 2040 Strategic Initiatives in alignment with the ecological and cultural landscape include:

1. *Expand the use of green infrastructure approaches for water management.*
2. *Expand the use of green infrastructure to reduce the heat and stormwater impacts of transportation facilities.*
3. *Enhance the capacity of municipalities to advance sustainable and resilient land use and development.*
4. *Preserve wildlife habitats and natural resources.*
5. *Improve the stewardship of environmental resources.*
6. *Revitalize walkable town centers, downtowns, and commercial corridors.*
7. *Develop the Arts Institute of Middlesex County into a hub for all arts, cultural, and historical programming.*
8. *Provide safe, innovative, inclusive, and sustainable parks and recreation services.*

These Strategic Initiatives are the framework for developing assessment criteria for existing landscape conditions, land use, ecological, topographic, flood risk areas, urban heat islands, transportation networks, open spaces and farmland, historic properties and districts, downtown areas, arts and cultural centers, demographic character, and more. The inventory already showed that the County is 60 percent urban with 20 percent wetland cover; open space and farmland preservation accounts for roughly 16 percent of the County's landscape; water throughout the County feeds four watershed management areas; four transit village designations exist in the County. Out of the 20 identified downtown areas, only two receive support from Main Street NJ programs. The ***Nature & Place.*** Photo Survey public outreach responses from 229 participants located favorite outdoor places throughout the County with a linked narrative giving place importance.

The Strategic Initiatives paired with existing inventory elements exemplified the need for place-based, ecologically driven urban and landscape design to serve Middlesex County's resilient future.

The analysis must prepare a process-oriented, flexible environmental decision-making framework because the landscape is not a static object but a dynamic system. Landscape urbanism principles in "which landscape replaces architecture as the basic building block of contemporary urbanism" and "landscape thinking" that values a dynamic process producing flexible outcomes inspire this approach. [(1)] We consider this approach suitable in the home rule context—where municipalities govern their landscapes—because landscape urbanism respects property ownership, values the role of private investment, and applies to local decision-making.

The inventory further showed that the urbanized environment of Middlesex County requires a revised interpretation of natural systems. Nature in central New Jersey no longer contains the pristine but is a new urban nature closely intertwined with human activity. "We need to conceive a new urban nature, where our actions restore and celebrate the world around us. We need to plan and design buildings and landscapes that give back to regenerative ecosystems. A starting place is understanding what is suitable and what is not." [(2)]

This quest for suitability is the core component of the applied analysis methodology, identifying the most pressing challenges and potential solutions, following the tradition of interdisciplinary environmental data overlay developed by Ian McHarg (1971) while adding a cultural landscape component.

The *Ecosystem Services Analysis* section considers the threat of development throughout the County's natural landscapes, comparing impervious surfaces (a marker of development) with wetlands and buffers, flood risk zones, urban heat islands, tree canopy cover, and ecological habitats of concern compared with protection status. The D 2040 Strategic Initiatives and inventory findings informed those chosen analytical components within this chapter to identify opportunities for landscape enhancements through impervious surface reduction and habitat connectivity and conservation. Each section outlines areas of concern and potential interventions informing action-based solutions further developed in the *Actions* chapter.

The *Cultural Landscape Analysis* first utilizes traditional GIS mapping to assess cultural landscape features and assets such as historic properties and districts, arts and cultural centers, and historic trails. Then moves beyond the limitation of available online data, comparing field study findings with online information to assess the County's landscape character through a *Viewshed Analysis.* A *Character of Place* analysis assesses the County's architectural makeup identifying an organizational tool for landscape enhancements at the regional scale. A *Downtown Character* assessment studies the quality of the 20 downtown streets identified in the *Inventory* chapter, listing criteria such as historic downtowns, population density, amenities, programming, and more.

The *Cultural Landscape Perception: Engagement Analysis* identifies the human connection to space through perception narrated by community members at various outreach opportunities such as the ***Nature & Place.*** Photo Survey, D 2040 public outreach, and Municipal Engagement Meetings.

The Middlesex County Open Space and Recreation Plan (OSRP) Update, 2021, identified areas at development risk. The *Landscape Threats* section further examines the OSRP analysis providing an in-depth analysis of existing municipal base zoning, state and federal environmental regulations, and wastewater service areas to identify natural *Land at Development Risk.*

Informed by the *Ecosystem Services* and *Cultural Landscape Analysis,* the final section concludes with landscape types. The defined landscape types and associated maps outline organization for implementations specific to land use categories. The analysis further asks whose interactions with the land directly influence the landscape. The landscape influencers include private and public landowners, administrative decision-makers, and other stakeholders; they directly impact the landscape's preservation, management, or development.

This chapter states a call to action for Middlesex County to design in a landscape urbanist mindset, designing cities with people and the surrounding ecology at the core of the decision-making framework as simultaneous entities. This chapter answers the question: where and how can we expect more from our landscapes to safeguard a more resilient and enjoyable outdoor experience benefiting both people and ecological communities?

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ECOSYSTEM SERVICES ANALYSIS

Introduction

Climate change projections and increased urbanization pose increasing threats to the quality of life for Middlesex County residents and visitors. Several ways to combat climate threats and urbanization are to mitigate environmental issues, improve ecosystem service function (environmental benefits for people from the landscape), and protect natural resources near developed areas where humans reside and work. The previous inventory chapter demonstrated ecological attributes such as macrohabitats and physiographic regions, natural resources such as wetlands and waterbodies, and environmental issues such as urban heat islands and flood risk. The following research examines these critical environmental conditions, threats, and conservation status. The goal is to identify deficits and prioritize potential improvements. The Strategic Initiatives informing this analysis include:

1. *Expand the use of green infrastructure approaches for water management.*
2. *Expand the use of green infrastructure to reduce the heat and stormwater impacts of transportation facilities.*
3. *Enhance the capacity of municipalities to advance sustainable and resilient land use and development.*
4. *Preserve wildlife habitats and natural resources.*
5. *Improve the stewardship of environmental resources.*

The natural resources analyzed include ecological habitats, wetlands, wetland buffers, and tree canopy cover. Natural resource improvement through protection and restoration can mitigate environmental issues such as flooding, stormwater impacts, and urban heat island effects. The thorough assessment of these environmental conditions compared to impervious surfaces targets the most beneficial locations for improvement and restorative actions such as green infrastructure. This analysis will inform actions that the County can perform or guide municipalities and other landscape influencers to improve the resilience and sustainability of Middlesex County's landscapes in alignment with the ecologically-based Strategic Initiatives listed above.

Ecological Habitats of Concern

Ecologically viable habitats provide critical resources for indigenous flora and fauna and invaluable ecosystem services (natural capital) such as clean water, clean air, fertile soils, and recreational opportunities for residents of Middlesex County. [3] As urbanization and development progressed over time, it caused losses of habitat and subsequent losses of ecosystem goods and services that harm human well-being and quality of life. The remaining ecological habitats of concern are sensitive to further environmental degradation and subject to increased habitat loss. Environmental planning must consider ecological habitat preservation as development pressures continue to increase. [4]

The GIS overlay assessment approaches determined the most at-risk and essential habitat areas in Middlesex County. These factors include the habitat cores and corridors (NJDEP CHANJ), critical wildlife habitats categorized by imperiled species (NJDEP CHANJ), vernal pool habitats (NJDEP), Natural Heritage Priority Conservation areas (NJDEP Natural Heritage Program), and habitat fragments (National Habitat Fragment Database). [5]

The most critical ecological habitats to preserve are within the highest *Rank 3,* encompassing habitat cores, critical wildlife habitats (for the most imperiled species), and priority conservation sites ***Table 1, Figure 1***. Habitat size matters because larger ecosystems are more resilient against disturbance. Large parcels (at least 193 acres) are habitat cores that provide vital conditions for terrestrial wildlife species. [6] Critical wildlife habitats possess many ecosystem traits that provide for indigenous and at-risk wildlife, such as food web complexity. Rare and protected species population statistics provide the information for ranking these areas in the NJDEP CHANJ Landscape Project datasets, focusing on crucial terrestrial wildlife habitats.[7] Priority conservation sites, determined by the NJDEP Natural Heritage Program, hold top priorities for preserving biological diversity as they support rare plant species. [8] Combining the above factors creates the most inclusive terrestrial spatial dataset outlining the highest quality habitat vital to the survival of imperiled species and native biodiversity.

Figure 1: Ecological Habitats of Concern

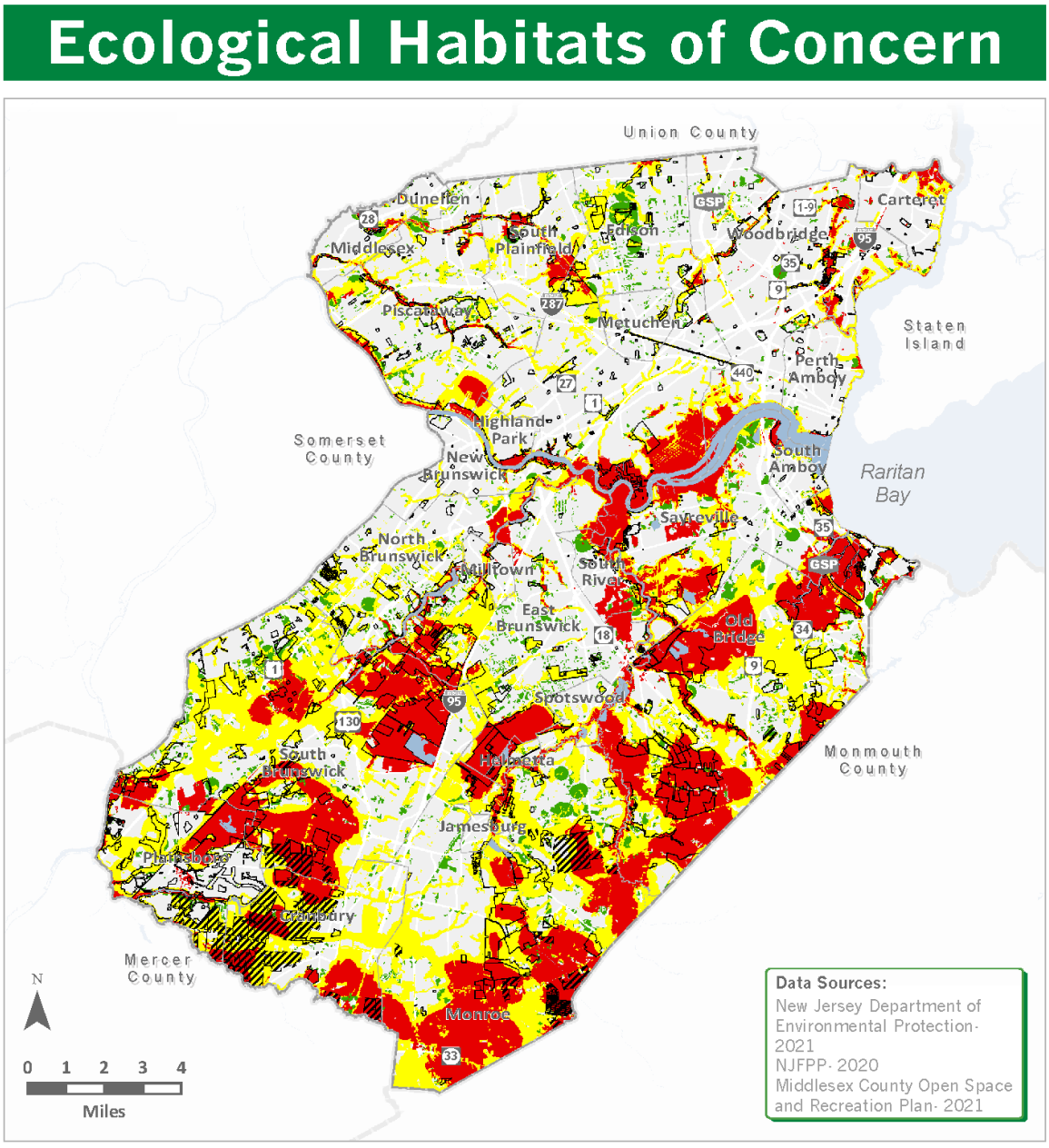


Table 1: Ecological Habitats of Concern Rank Descriptions

Rank	Description
3	• Habitat cores (CHANJ)* • Priority conservation sites (only four areas in the County) ** • Critical wildlife habitat that contains state threatened, state endangered, and federally listed wildlife species***
2	• Habitat corridors (CHANJ)* • Critical wildlife habitat that contains state-listed wildlife species of particular concern or meets habitat-specific suitability requirements for imperiled species even though they do not have confirmed species sightings*** • Vernal pool habitat that occurs outside *Rank 3****
1	• Habitat fragments that occur outside of the above* • Potential vernal pool habitat outside of the above****
0	• Does not contain documented habitat area

Sources: *NJDEP Division of Fish and Wildlife, & CHANJ Working Group. (2019, April). Guidance for CHANJ cores and corridors. NJDEP Division of Fish and Wildlife. Retrieved January 14, 2022, from https://www.njfishandwildlife.com/ensp/chanj_guidance.pdf

**NJDEP Bureau of GIS. (2021). Natural Heritage Priority Sites in New Jersey [Data set].

*** New Jersey Division of Fish and Wildlife. (2017). New Jersey Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program. pp. 33.

**** New Jersey Endangered and Nongame Species Program. (2017, May). NJDEP Species Based Habitat, Vernal Pools. Version 3.3. New Jersey Department of Environmental Protection.

The *Rank 2* areas, ***Table 1, Figure 1,*** encompass smaller habitats with important connecting functions. These include habitat corridors, critical wildlife habitat (for rare species), and vernal pool habitat outside *Rank 3* regions. Habitat corridors are natural lands that provide pathways for wildlife between habitat cores and buffering cores from urban development stressors and dangers. [(9)] The critical wildlife habitats represented in *Rank* 2 are areas that support or potentially support rare species even without confirmed sightings. [(10)] Vernal pool habitats include areas identified as vernal pools and their surrounding wetlands. Vernal pools are forested wetland areas that contain small pooling water for at least two consecutive weeks between March and September and are free of fish populations throughout the year or dry intermittently. [(11)] Vernal pools are important breeding sites and habitats; [(12)] obligate wildlife species are uniquely adapted to vernal pool sites and cannot thrive in permanent waters. [(13)] *Rank 2* areas are essential for preserving and protecting the natural biodiversity, following *Rank 3* areas vital to the most imperiled species within Middlesex County.

Rank 1 parcels include habitat fragments and potential vernal pool habitat locations that do not occur within *Rank 2* or *3* zones, ***Table 1, Figure 1***. Minimally disturbed natural parcels are habitat fragments and not habitat cores due to their smaller size, usually less than 100 acres. [14] Habitat fragments provide essential ecosystem services and habitats for wildlife species even though they are smaller because they function as stepping stones between cores. Potential vernal pool habitats have landscape characteristics suitable for vernal pools, even with no vernal pool verification on-site. These locations can still provide valuable habitat and ecosystem services and serve as vernal pools and habitat restoration sites.

The County's southern portion has the most expansive ecological habitats of concern. In the South, there are more conserved and remnant forests and wetlands, ***Figure 1***. The South is where *Rank 2* areas connect multiple large *Rank 3* areas relatively well. *Rank 1* parcels, even though marginal, ***Table 2***, also assist in connectivity while serving as development stressor buffers protecting higher-ranking adjacent regions. In the County's northern half, the *Rank 3* areas are fewer, smaller, and not as well connected or buffered as *Rank 2* and *Rank 1* areas, ***Figure 1***. Methods for property managers (public and private) to improve connectivity include planting locally native species or performing ecological restorations to increase habitats. The *Actions* chapter will outline best practice options.

There are more unprotected ecological habitats of concern throughout the County's landscape than preserved farmland or open space shown in ***Table 2, Figure 1***. Unprotected lands are vulnerable to development or other land use changes that would destroy or harm the integrity of the habitats. More than half of the *Rank 3* habitat parcels lack protection, leaving the associated at-risk species in danger, ***Table 1***. Destruction of these habitats leads to permanent loss. Strict *Rank 3* habitat protection is essential for the survival of rare plant species, the imperiled wildlife depending on them, and Middlesex County's indigenous biodiversity. In addition, most of the *Rank 3* parcels occur in designated wetland areas which are highly biodiverse and productive ecological communities that provide several invaluable ecosystem services to the residents of the County. The *Actions* chapter will outline measures to decrease development and negative impacts affecting wetlands, critical to conserving imperiled wildlife, rare plant species, and habitats.

Table 2: Ranked Ecological Habitats of Concern in Protected and Unprotected Land Areas

Rank	Total acres	Percent land area	Protected acres*	Percent protected land area	Acres not protected	Percent land not protected
3	46,988	23%	16,868	35%	30,120	65%
2	49,610	24%	10,768	21%	38,842	78%
1	8,031	4%	707	8%	7,324	91%
1,2,3 combined	104,629	51%	28,343	27%	76,286	73%
0	98,231	49%	3,394	3%	94,837	97%
Total	202,860**	100%	31,737	16%	171,123	84%

*Protected lands are designated open spaces or preserved farmland (Figure 1).

** New Jersey Department of Environmental Protection (NJDEP), Bureau of Geographic Information Systems (BGIS), (2021), County Boundaries of New Jersey, [Data set], ESRI GIS Area (ac) Field Calculator.
PCS: NAD_1983_StatePlane_New_Jersey_FIPS_2900_Feet.

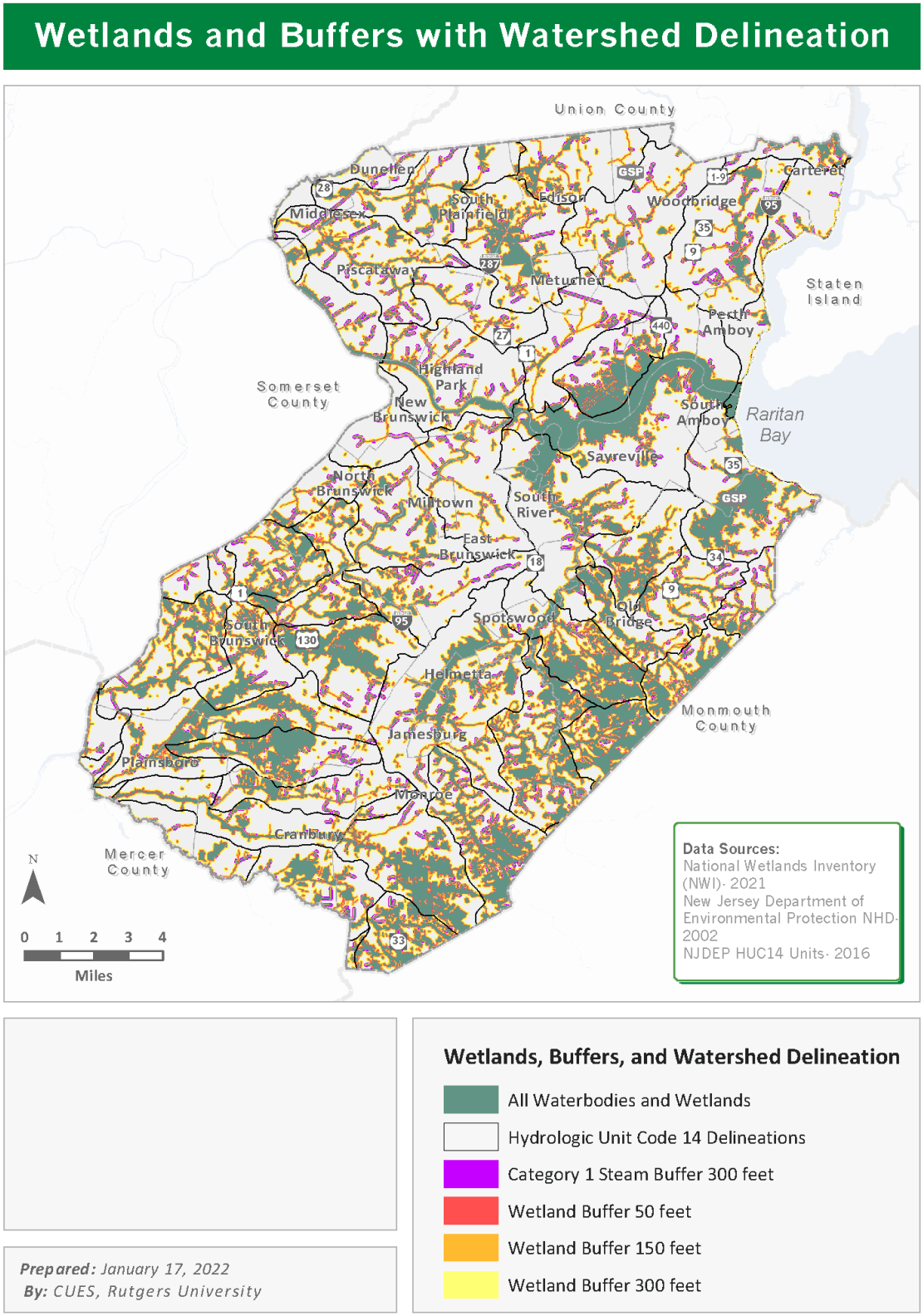
Most *Rank 2* and *Rank 1* habitats occur in unprotected lands, ***Table 2, Figure 1***. These areas serve as vital connections for wildlife species and life-saving buffers to urban development stressors and impacts. *Rank 2* or *Rank 1* habitat losses harm the flora and fauna of these areas and degrade the adjacent *Rank 3* habitats, leaving them more vulnerable to adverse environmental impacts. The current expanse of ecological habitats of concern cohesively functions as a whole ecosystem or habitat network. Losses or effects harm the entire ecosystem to any portion. The *Actions* chapter will outline best practices to limit development to prevent ecosystem encroachment.

Wetlands and Buffers with Watershed Delineation

Wetlands are essential components of the Middlesex County landscape as they provide invaluable ecosystem services to all residents and inhabitants. [(15)] Wetlands are vital to the health of our waterbodies and the quality of our drinking water, as they filter pollutants created by urban land uses. Wetlands can take the form of forested swamps, emergent marshes, and watercourses; they provide critical habitats for abundant flora and fauna to ensure native biodiversity conservation. Additionally, natural wetlands serve as carbon sinks that help to reduce greenhouse gas emissions. [(16)] The vegetation in wetlands, especially forested wetlands, reduces air pollution by cleaning the air and mitigating the negative impacts of urban heat islands. [(17)] Importantly, wetlands also regulate water levels within each watershed. They slow and catch stormwater, which reduces flooding intensity, while they help store groundwater reserves, reducing drought intensity. Areas with diminished or destroyed wetlands suffer more intense damage during flooding events and amplify negative impacts during heat waves and droughts. Wetland preservation and protection enforcement are critical for the continued provision of irreplaceable ecosystem services.

Protecting wetlands and waterbodies from degradation through buffer establishment is beneficial and essential for the best ecosystem functioning. The Freshwater Protection Act regulates wetlands and associated buffers. [(18)] Allowed activities include "normal property maintenance," such as regular tree pruning or mowing existing lawns. Regulated activities include other disturbances, such as soil or natural vegetation removal to create new lawns or structures within protected buffers, which require general or individual permits. [(19)]

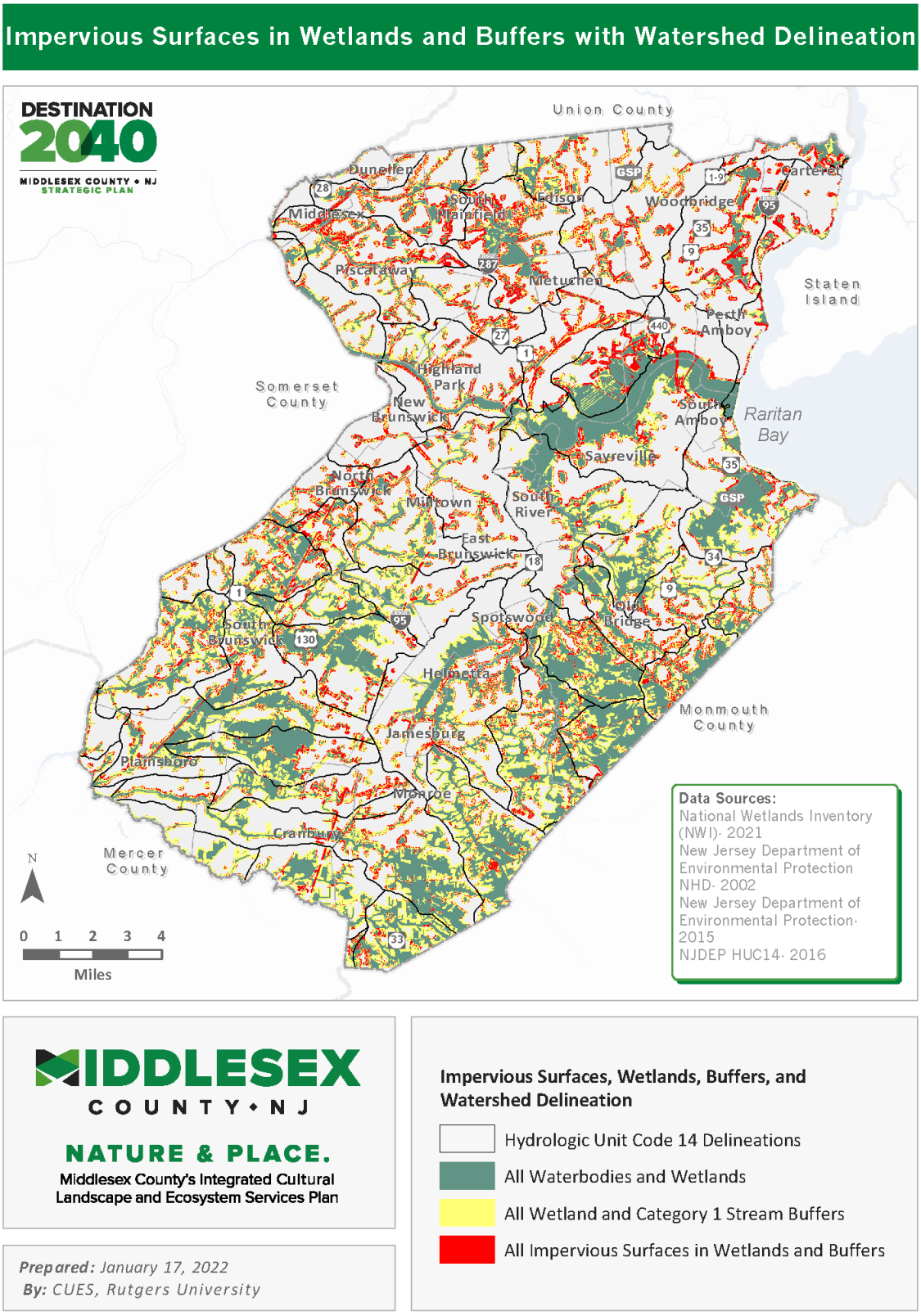
Figure 2: Wetlands and Buffers with Watershed Delineation



The wetland and stream buffers definition includes “land area adjacent to a wetland which minimizes adverse impacts on the wetland or serves as an integral component of the wetland ecosystem.” [20] These areas are also referred to as as riparian zones, transition areas, or water protection areas. Healthy wetland buffers improve wetland and waterbody health and the associated ecosystem services abilities. Buffers help wetlands filter and capture stormwater, prevent flooding, mitigate urban heat, store carbon, and clean and store groundwater. [21, 22] Buffers help conserve wildlife habitats and ensure ecosystem health by absorbing adverse edge effects to enhance the core ecological communities. Edge effects result from an abrupt transition between two different habitats, such as a developed landscape and a wetland. Additionally, buffers provide room for wetland migration in coastal areas because of sea-level rise and help protect coastlines against intense storm surges. [23]

Differing wetland conditions and stream types have varying minimum buffer widths. [24] Category one (C1) streams and all associated upstream and regulated waters have the largest buffer requirement of 300 feet. [25, 26] NJDEP states C1 streams have “exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resources.” [27] "Exceptional” wetlands require a 150 feet buffer as they either drain from trout waters or contain threatened or endangered species habitats. All other wetlands require a 50 feet buffer.

Figure 3: Impervious Surfaces in Wetlands and Buffers with Watershed Delineation



Encroachment of developed land and impervious surfaces within wetlands and adjacent buffers is a leading cause of degradation and loss of ecosystem service function. [28, 29] More residents suffer negative impacts from flooding events, drought, and storm surges as more development occurs within buffers and wetlands.

Extensive impervious surfaces exist within wetland-adjacent buffers throughout the County, ***Figure 3, Table 3***. The most conservative buffer, though not required, is 300 feet for all wetland types. The best management strategy considers mitigation within 300 feet of all wetlands. Approximately 9,363 acres (27 percent) of the 300 feet buffer is impervious, ***Table 3.*** The ideal scenario includes prioritizing impervious surface removal and land use mitigation within all C1 stream's 300 feet buffers. Discrepancies in understanding "exceptional" wetland locations requiring a 150 feet buffer are the assumed cause for an outstanding 33% impervious surface coverage in the 150 feet wetland buffers.

Furthermore, 14 percent of 50 feet buffers are impervious. Only grandfathered and permitted structures can occupy this buffer, but existing enhancements will improve or remove structures to aid wetland protection. Across all wetlands and buffers, 18 percent of the land area is impervious. Improvements prioritizing impervious surfaces within wetlands, adjacent areas, and C1 stream buffers will improve these statistics, directly enhancing the quality of life for residents.

Table 3: Acreage of Wetlands, Buffers, and Impervious Surface Types in Wetlands and Buffers

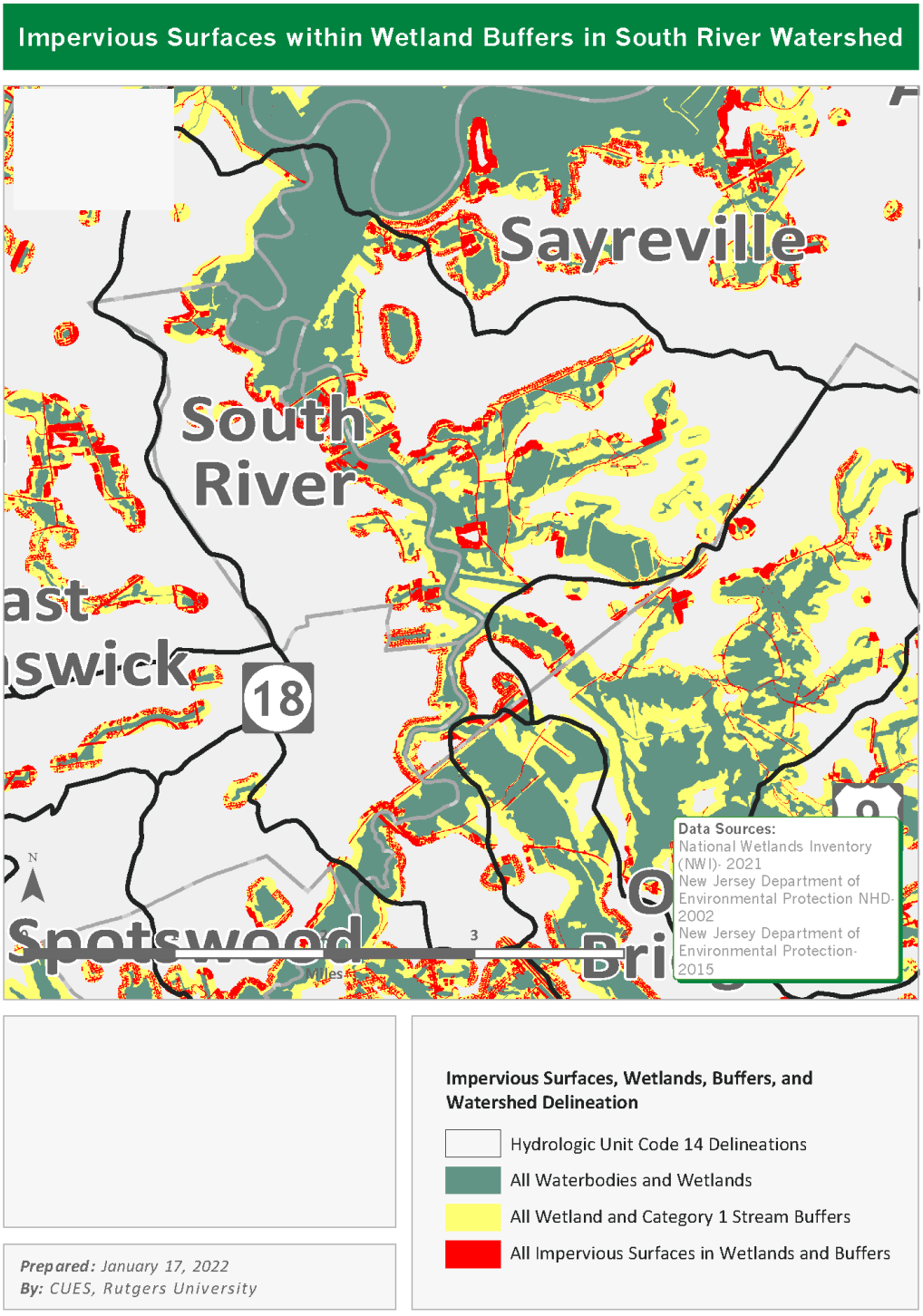
	Total Acres					Percent
Wetland or buffer type		**Buildings**	**Roadways**	**Parking lots, driveways, sidewalks, and other**	**All impervious surfaces**	**All impervious surfaces**
Wetlands	40,733	58	157	364	579*	**1%**
0-50 feet buffer area	14,469	238	736	1,094	2,067	**14%**
50-150 feet buffer area	26,105	1,515	2,568	4,523	8,606	**33%**
150-300 feet buffer area	34,168	2,337	2,562	4,465	9,364	**27%**
Total of wetlands & buffers	**115,475**	**4,147**	**6,022**	**10,466**	**20,615**	**18%**

Sources: National Wetland Inventory (NWI), ESRI GIS Field Calculator acres, 2021.
PCS: NAD 1983 State Plane New Jersey FIPS 2900 Feet.
NJDEP, Land Use Land Cover 2015 Impervious Surfaces, ESRI GIS Field Calculator acres
PCS: NAD 1983 State Plane New Jersey FIPS 2900 Feet
*Totals include bridges and roads over water.

It is essential to know where impervious surface types exist within wetland buffers because different impervious surfaces have differing limitations for mitigation strategies. For example, more cost-effective approaches include improvements to parking lots, driveways, and sidewalks instead of more costly buildings and major roadway changes. For instance, permeable pavers can replace impervious driveways and paths. [30] Moreover, buffer encroachment of parking lots, driveways, sidewalks, and other impervious surfaces is greater than buildings or roadways, ***Table 3***. As an example, ***Figure 4*** illustrates the presence of buildings, roadways, and other impervious surfaces within wetland buffers in South River.

Wetland health is imperative to restore and conserve to improve ecosystem service function and quality of life for residents. Over time the negative impacts of climate change and sea-level rise will increase, and restoration and conservation of wetland ecosystem services will become more critical. The *Actions* chapter will further outline how replacing impervious surfaces with permeable materials in the wetland buffer zones can substantially reduce the impacts of stormwater and pollutants on waterways and wetlands. [31] Progressive, adaptive, and ecologically sensitive land management and restoration within buffers and wetlands can mitigate current ecosystem service losses, improve ecological function, reduce negative stormwater impacts, and enhance residents' quality of life.

Figure 4: Impervious Surfaces Within Wetland Buffers in South River



The impervious surfaces within wetlands and buffers in South River.

Priority Flood Mitigation Ranks

Flooding is a severe and growing threat to many Middlesex County communities, exacerbated by climate change and increased development. [32, 33] The climate change variables that factor into escalated flooding threats are sea-level rise, amplified storm intensity, and increased severe storm frequency. These factors, coupled with increased development and impervious surfaces, place more people and built capital at risk within each watershed. Amplified stormwater impacts—such as erosion, flooding, and pollution— pose severe threats to water quality and existing natural lands, including wetlands and riparian corridors, home to threatened and endangered species.

FEMA flood risk zones (FIRM), NOAA 2-foot sea-level rise prediction, and NOAA and FEMA Category 4 hurricane storm surge predictions (SLOSH model) identify the County's flood risk, ***Figure 5, Table 4***. These factors combined defined four ranked flood mitigation zones (0-3) and established priority flood mitigation areas.

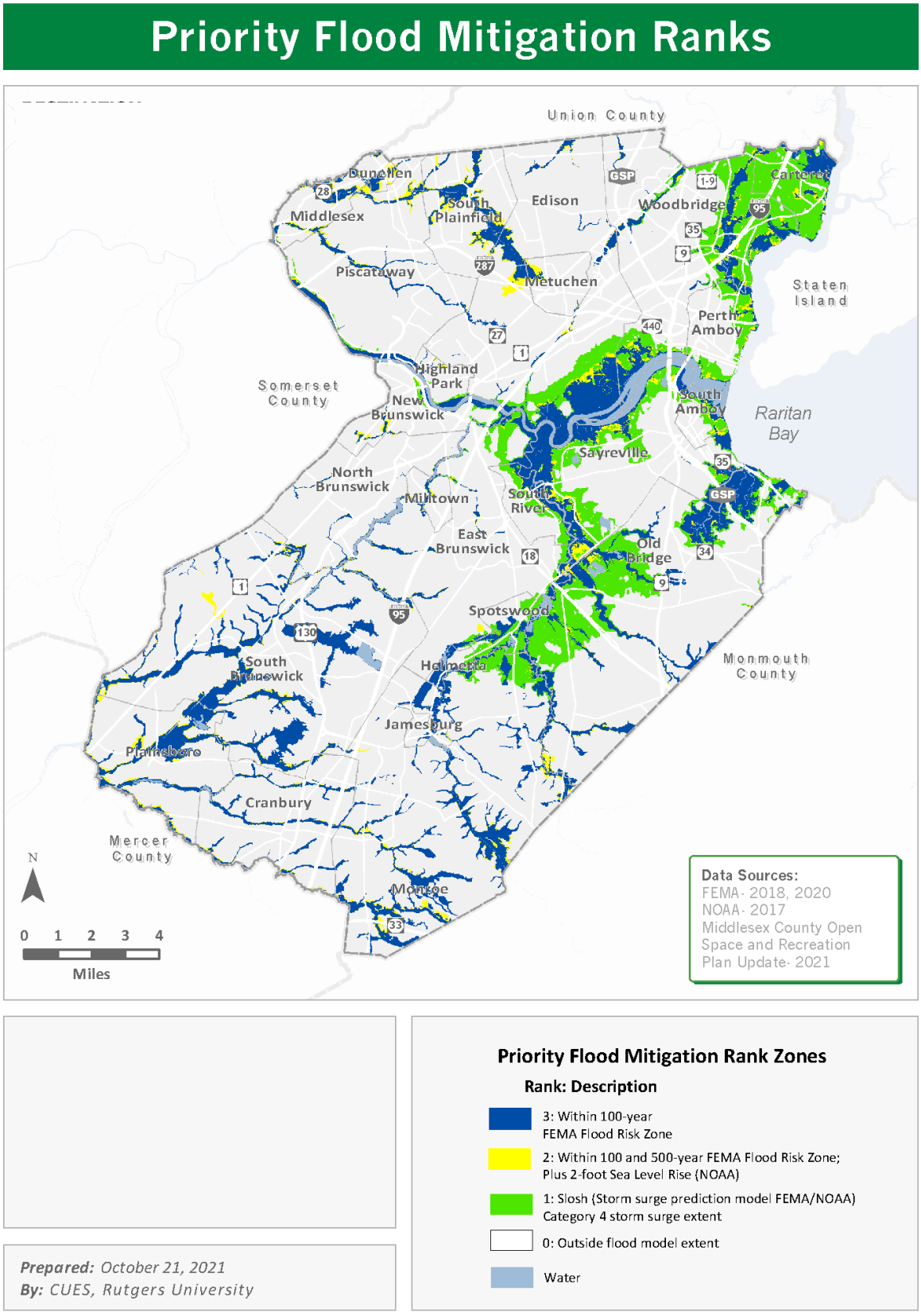
Table 4: Priority Flood Mitigation Ranks

Flood Mitigation Rank	Description
3	The extent of the 100-year flood zone is delineated by the FEMA flood hazard database.
2	The extent of the FEMA 500-year flood zone with the addition of the NOAA 2-foot sea-level rise predictions. *
1	Extent of a category four storm surge. This extent used the NOAA SLOSH model and included considering the increasing storm frequency and intensity expected with climate change.
0	Does not fall within the extent of any of the flood models listed above.

Sources: Middlesex County Open Space and Recreation Plan Update, 2021. Pending Approval.

*The 2-foot sea level rise is based on information provided in the "Middlesex County Climate Change Assessment." This study shows that a 1.5-foot sea level rise is a reasonable expectation by 2040.

Figure 5: Priority Flood Mitigation Ranks



Large expanses of *Flood Mitigation Rank 3* exist along all the major rivers within the County, ***Figure 5***. The spatial extent of *Rank 3* areas along waterways is a function of topography and elevation; these locations bear the most significant flood and storm surge damage risks. *Rank 3* areas are in the most danger of flood damage as the climate changes. *Rank 2* areas exist at a slightly higher elevation than *Rank 3*-adjacent areas, while *Rank 1* areas are at risk of category four storm surges. *Rank 1* areas are next to *Rank 3* and *2* parcels along tidally influenced and coastal waterbodies, the Arthur Kill, Raritan Bay, Raritan River, and South River. The *Rank 1* areas expansively occupy all Carteret and large sectors of Woodbridge, Perth Amboy, Edison, South Amboy, Sayreville, South River, Old Bridge, Spotswood, and Helmetta. Even outside the 100- and 500-year floodplains, these locations bear an increasing risk from coastal storms as climate change projections and sea-level rise amplify detrimental flooding effects.

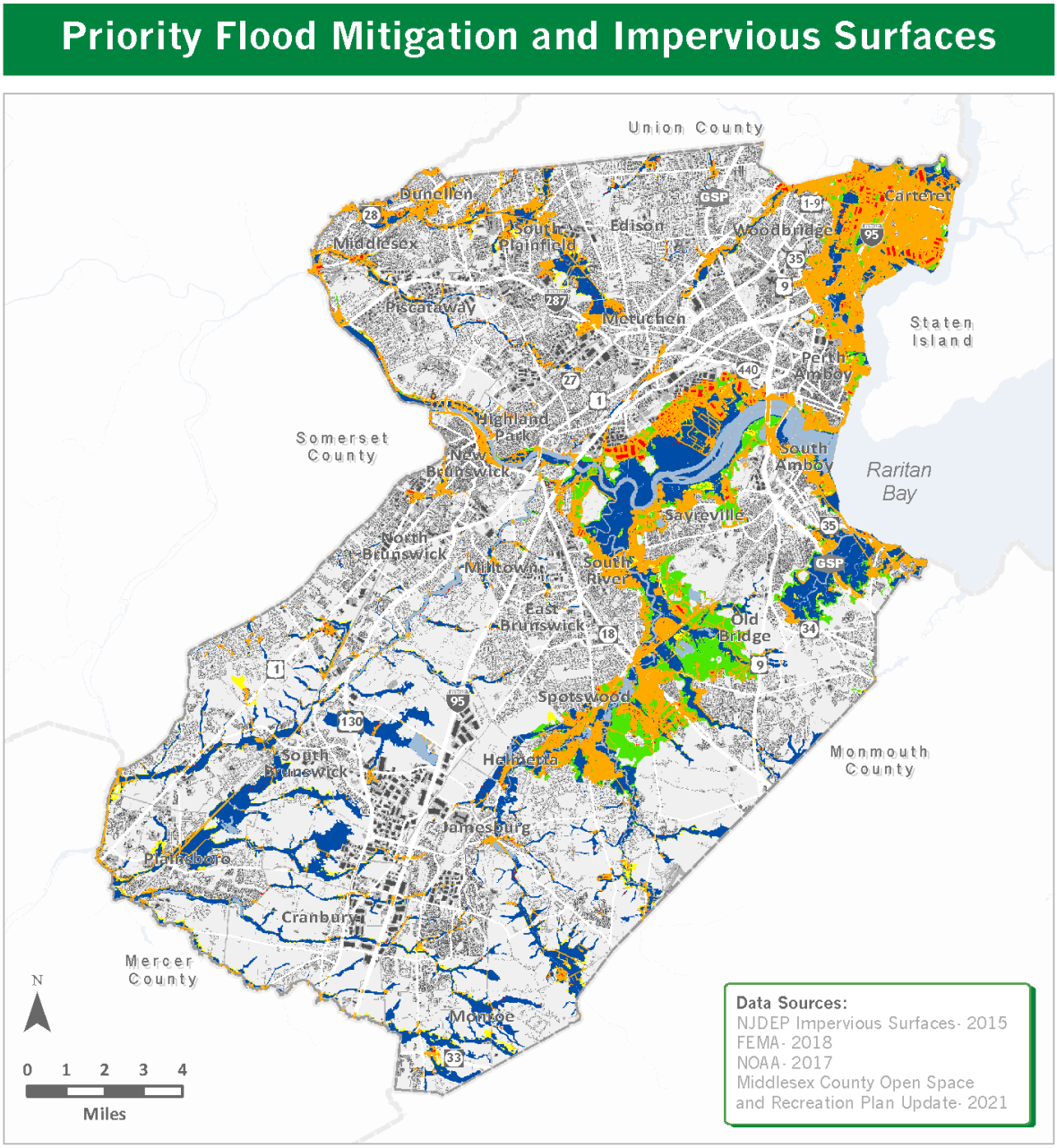
Priority Flood Mitigation and Impervious Surfaces

Impervious surfaces within flood-prone areas amplify flood impact severity within a given community or watershed. [34] ***"One percentage point increase in impervious basin cover causes a 3.3% increase in annual flood magnitude, on average."*** [35] Therefore, augmented flood risk is in areas dominated by impervious land cover or urbanized landscapes where "the inflow of stormwater exceeds the capacity of drainage systems to infiltrate stormwater into the soil or to carry it away." [36] Urban areas have the highest population densities, subjecting more residents to flooding impacts such as drinking water pollution, property damage, and even loss of life. The threat of flooding impacts directly affects property values and the quality of life for residents that live in urban areas and within flood mitigation zones. As climate change and sea-rise threats increase over time, it is critical to identify areas with the most risk and take steps toward mitigation and land use improvements. The bottom-line goal is to reduce the amount of runoff by providing more land for floodwater flow, capture, and storage.

The flood mitigation zones dominated by natural land are more resilient to damage as native plant communities in these zones have evolved to handle flooding impacts and protect inland and upland areas. Yet, this is not the case for many areas within the County's priority flood mitigation areas, ***Figures 6, 7, & 8***. Flood mitigation areas dominated by impervious surfaces force elevated stormwater stressors onto the few natural areas left, which serve to absorb flooding and storm surge impacts. Over time, amplified flooding effects—caused by displaced stormwater runoff from impervious land cover in floodplains—overwhelm remnant natural areas causing degradation and reduced ecosystem service benefits. [37,38] This scenario decreases natural land resilience and reduces the protective capabilities that natural lands could otherwise have provided to adjacent developed land.

First, it is essential to identify where the most impactful flood mitigation area improvements occupy the landscape. The most at-risk areas for priority flood mitigation are where the highest impervious surface cover exists within wetlands and buffers. This determination combines the ranked flood mitigation zones and impervious surfaces. This analysis determines priority locations for mitigation actions to reduce stormwater runoff resulting in increased water infiltration.

Figure 6: Priority Flood Mitigation and Impervious Surfaces



Prepared: *October 21, 2021*
By: *CUES, Rutgers University*

Figure 7: Priority Flood Mitigation and Impervious Surfaces by Rank

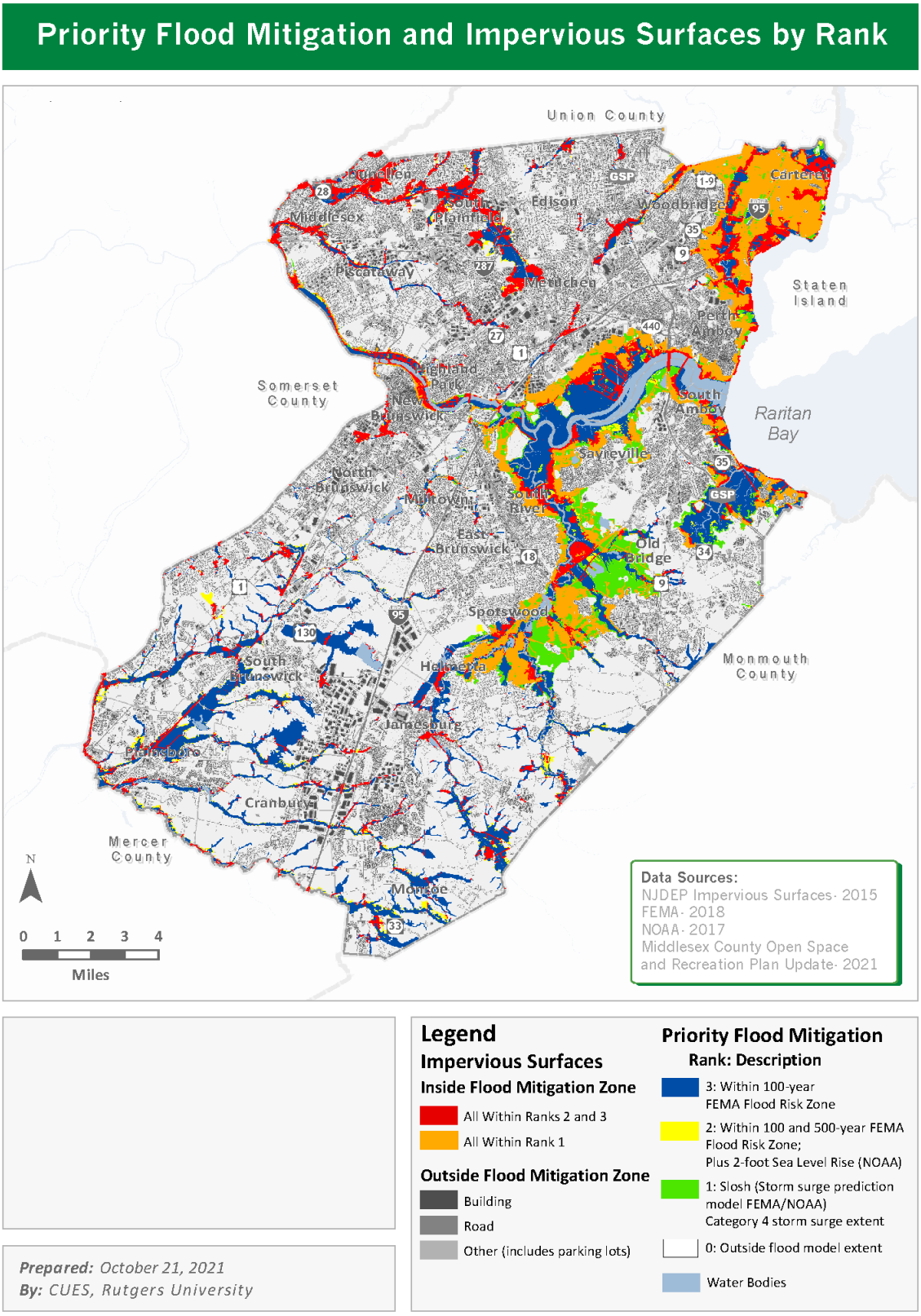
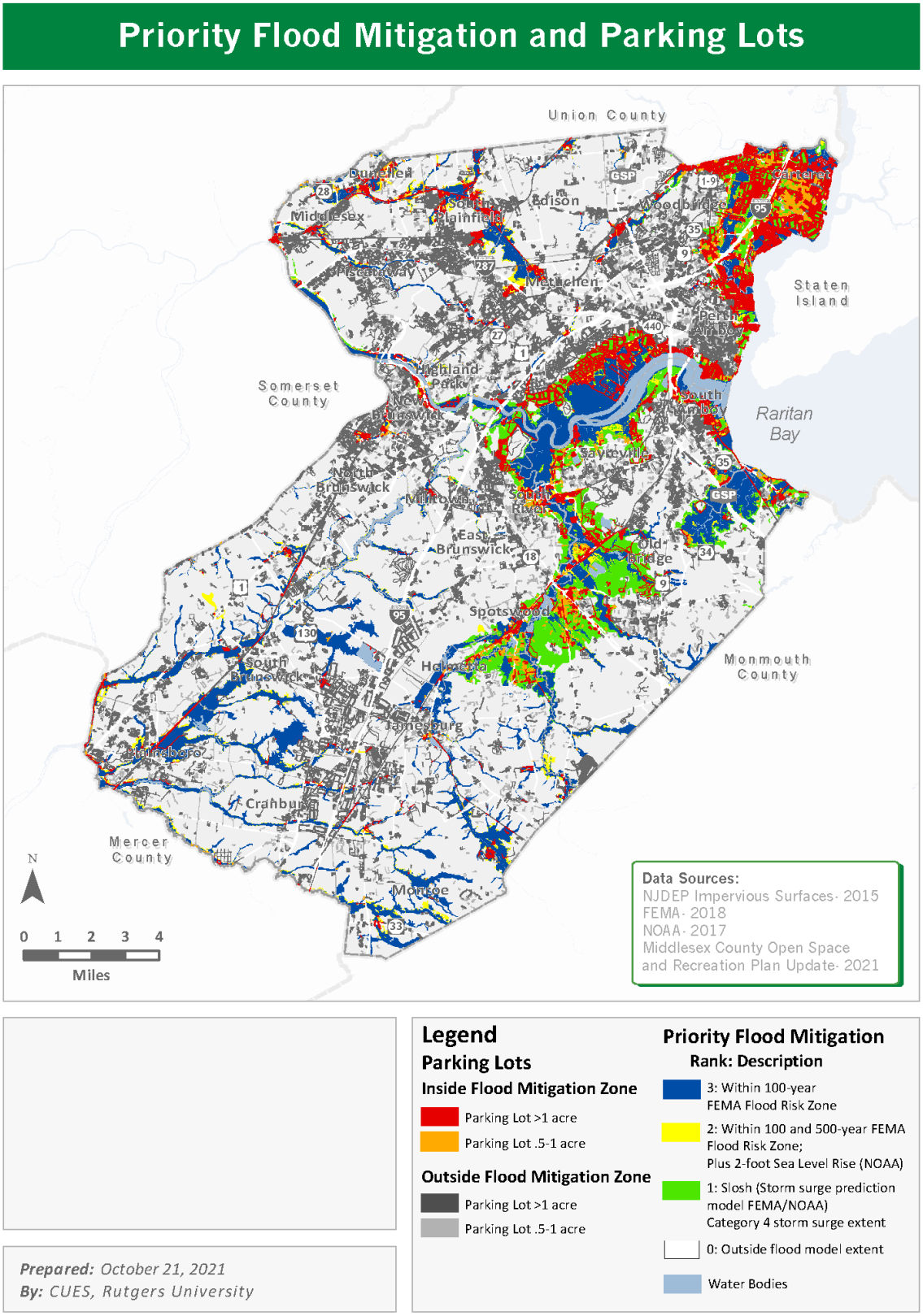


Figure 8: Priority Flood Mitigation and Parking Lots



The most extensive impervious surface cover within flood mitigation zones occurs throughout Carteret and parts of Woodbridge, and Perth Amboy, ***Figures 7***. This entire area needs flood mitigation improvements as it is one sizeable impervious surface area (roughly over 12,000 acres calculated in ArcGIS) within a significant coastal storm surge zone (*Rank 1*) and within the 100-year and 500-year flood risk zones *(Ranks 2* and *3*), ***Figure 7****.* Impervious surface areas within *Ranks 2* and *3* zones near waterbodies are priority sites for impervious surface reduction. Nonetheless, any reductions of impervious surfaces within contiguous flood mitigation zones will help the entire community and local watershed.

The impervious surfaces most easily removed or converted to permeable alternatives are parking lots and other paved lands within the "other" category. In this northeast, parking lots greater than one acre dominate the land cover, ***Figure 8***. Reducing parking lots will be crucial for Carteret, Woodbridge, and Perth Amboy. Stormwater runoff reduction in Perth Amboy is essential to lower water volume reaching the Combined Sewer Overflow system along the Raritan River and Raritan Bay (Inventory chapter).

In the northwestern part of the County, flood mitigation zones with impervious surfaces follow several watercourses, ***Figure 6***. Notably, the Bound Brook tributary has the highest areas of impervious surface within the flood risk zone (*Ranks 2* and *3*), ***Figure 7***. These same areas contain many parking lots greater than one acre in size, ***Figure 8***. Other targeted watercourses have priority sites of lesser extent for improvements.

Large pervious tracts of land occupy the flood mitigation zones along the Raritan Bay and Raritan River, ***Figure 6***. However, impervious surfaces occupy adjacent areas of each ranked flood mitigation zone, ***Figure 7***. This primarily exists along the Raritan River, comprised of parking lots over one acre in size, ***Figure 8***. Some parking lots are next to the waterbodies with no natural land to catch and filter polluted stormwater runoff. Prioritization of impervious surface removal and replacement with natural ground covers will help remove pollutants before reaching the Raritan Bay.

The tidally influenced flood mitigation zones along the South River are far-reaching into Helmetta, Spotswood, and Old Bridge, with coastal storm surges affecting the floodplain, ***Figure 6***. Impervious surfaces cover approximately half of the flood mitigation zones around the South River and its tributaries. Most of the impervious surfaces in the flood mitigation zones fall within *Rank 1,* ***Figure 7***. Yet, there are several substantial impervious areas within *Ranks 2* and *3* zones along the South River; most are parking lots greater than one acre in size and the highest priority for intervention, ***Figures 7, 8***.

Watercourses in the southwest have much less impervious surface infringement than other areas, ***Figure 6***. Nonetheless, each municipality contains impervious surfaces within *Rank 2* and *3* flood mitigation zones, ***Figure 7***, many of which are parking lots, ***Figure 8***.

The northeast contains the most impervious surfaces in flood mitigation zones along the Raritan River, South River, and the Bound Brook, ***Figure 6***. Impervious surfaces directly abut watercourses in these same regions of *Ranks 2 and 3, **Figure 7***; these are the highest priority locations for impervious surface reduction and restoration of natural lands.

Table 5: Impervious Surfaces by Types in the Priority Flood Mitigation Ranks

Flood mitigation rank	FMR total acres	Acreage of all impervious surface types	Building acres	Road acres	Other acres: parking lots and paved surfaces	Percent of all impervious surfaces
3	29,946	2,427	306	621	1,500	8%
2	4,507	1,609	331	373	905	35%
1	16,630	7,822	2,038	1,623	4,161	47%

Source: Middlesex County Open Space and Recreation Plan Update, 2021. Pending Approval.
NJDEP, Land Use Land Cover 2015 Impervious Surface, ESRI GIS Area (ac) Field Calculator,
PCS: NAD 1983 State Plane New Jersey FIPS 2900 Feet

Table 6: Parking lots and "Other" Impervious Surfaces in the Priority Flood Mitigation Ranks

Flood mitigation rank	FMR total acres	All "other" impervious surface acres, including parking lots	Parking lots 0.5-1 acre	Parking lots >1 acre
3	29,946	1,500	89	1,210
2	4,507	905	52	705
1	16,630	4,161	390	3,110

Source: Middlesex County Open Space and Recreation Plan Update, 2021. Pending Approval.
NJDEP, Land Use Land Cover 2015 Impervious Surface, ESRI GIS Area (ac) Field Calculator,
PCS: NAD 1983 State Plane New Jersey FIPS 2900 Feet

Improvements within the flood mitigation zones are critical to the quality of life for Middlesex County residents. The *Actions* chapter will outline measures to combat detrimental flooding effects, including reducing impervious surfaces within flood mitigation zones either by removal or replacement with more permeable alternatives. Updated parking lot, driveway, and sidewalk designs can encourage more permeability by removing and replacing impervious materials. Increasing porous open space and natural land covers such as forests, swamps, and marshes serve as a buffer for flooding and storm surges. At the same time, they capture stormwater runoff and its pollutants, which filter water before entering waterways or the groundwater table. [(39)]

Tree Canopy Cover and Impervious Surfaces

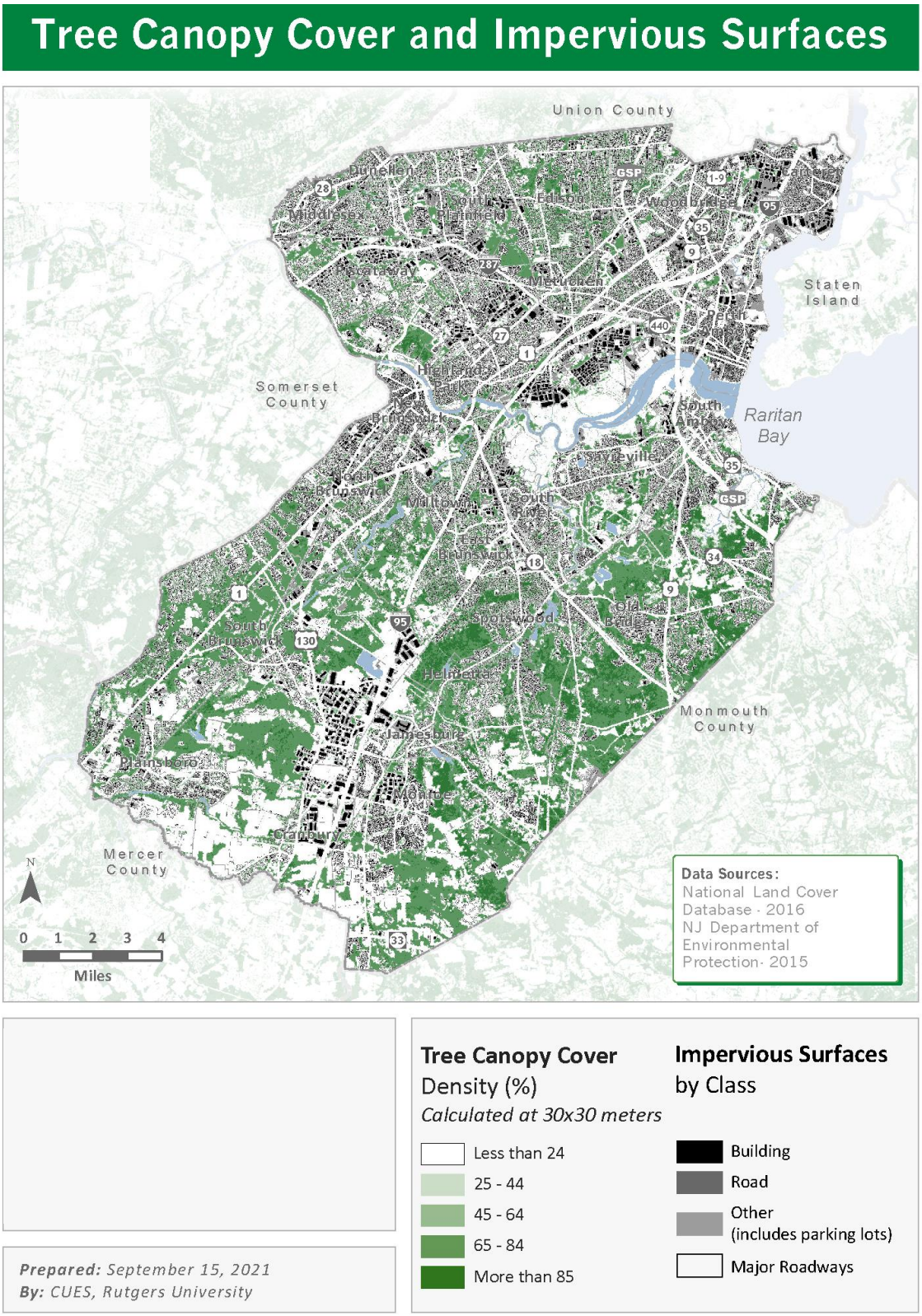
As described in the previous section, impervious surfaces increase stormwater runoff and prevent water infiltration. [40] In addition, impervious surfaces exposed to the sun increase air temperatures, contributing to the urban heat island effect. [41,42] The addition of trees is one way to combat both negative environmental impacts. With properly retrofitted beds, trees in urban settings can intake stormwater and allow for infiltration, which reduces runoff, pollution, and flooding. [43, 44] Tree canopy cover helps to cool urban areas as they shade impervious surfaces. [45] Additionally, trees filter air pollutants and work to provide clean air to Middlesex County communities. [46] Whether shade trees in cities or within forested natural areas, all trees supply critically essential services to Middlesex County that help mitigate negative impacts created by urbanization and climate change. [47,48,49]

It is essential to understand where tree canopy cover serves the County and which areas need more trees to mitigate adverse environmental impacts and create a more resilient Middlesex County for residents. The inventory revealed that most of Middlesex County's landscape has less than 24% tree canopy cover. The highest concentrations of impervious surfaces (buildings, roads, parking lots, and others) correlated with less tree canopy cover, ***Figure 11***.

Figure 10: Tree Canopy Cover, Edison Industrial Park

Source: CUES, Rutgers University. Photograph. 2021.
(Right) Old-growth trees in a swale; (Left) New tree planting along the forest edge.

Figure 11: Tree Canopy Cover and Impervious Surfaces



The County's northern portion has less canopy cover than impervious surface cover, ***Figure 11***. The scattered forested parks and older suburbs are the locations that maintain canopy-covered areas north of the Raritan River. South of the Raritan, more and larger forested open space parcels account for more significant canopy-covered areas.

The most urbanized and industrial locations have minuscule canopy cover areas, ***Figure 11***. One main section lacking canopy cover stretches from the extensively urbanized municipalities of Carteret, Woodbridge, Perth Amboy, and lower portions of Edison by the NJ Turnpike Interstate-95. Large parts of South Amboy, Sayreville, South River, New Brunswick, and North Brunswick have sparse canopy cover. Furthermore, the lower Interstate-95 corridor from Helmetta to Cranbury lacks sufficient canopy cover.

The most urbanized locations lack canopy cover and would benefit most from shade tree planting investments. The *Actions* chapter will discuss methods for tree pit renovations to help tree canopy health and longevity by creating more rooting space and improving soil drainage. In industrial and corporate parks, like Edison or South Amboy, target shade tree areas can replace the lawn, help cool the local climate, and significantly improve water infiltration capabilities as trees are much deeper rooted than turfgrass. Other industrial locations that currently do not have lawn cover can still add tree planting locations that do not interfere with industrial activities by shading parking lots, buildings, and roads.

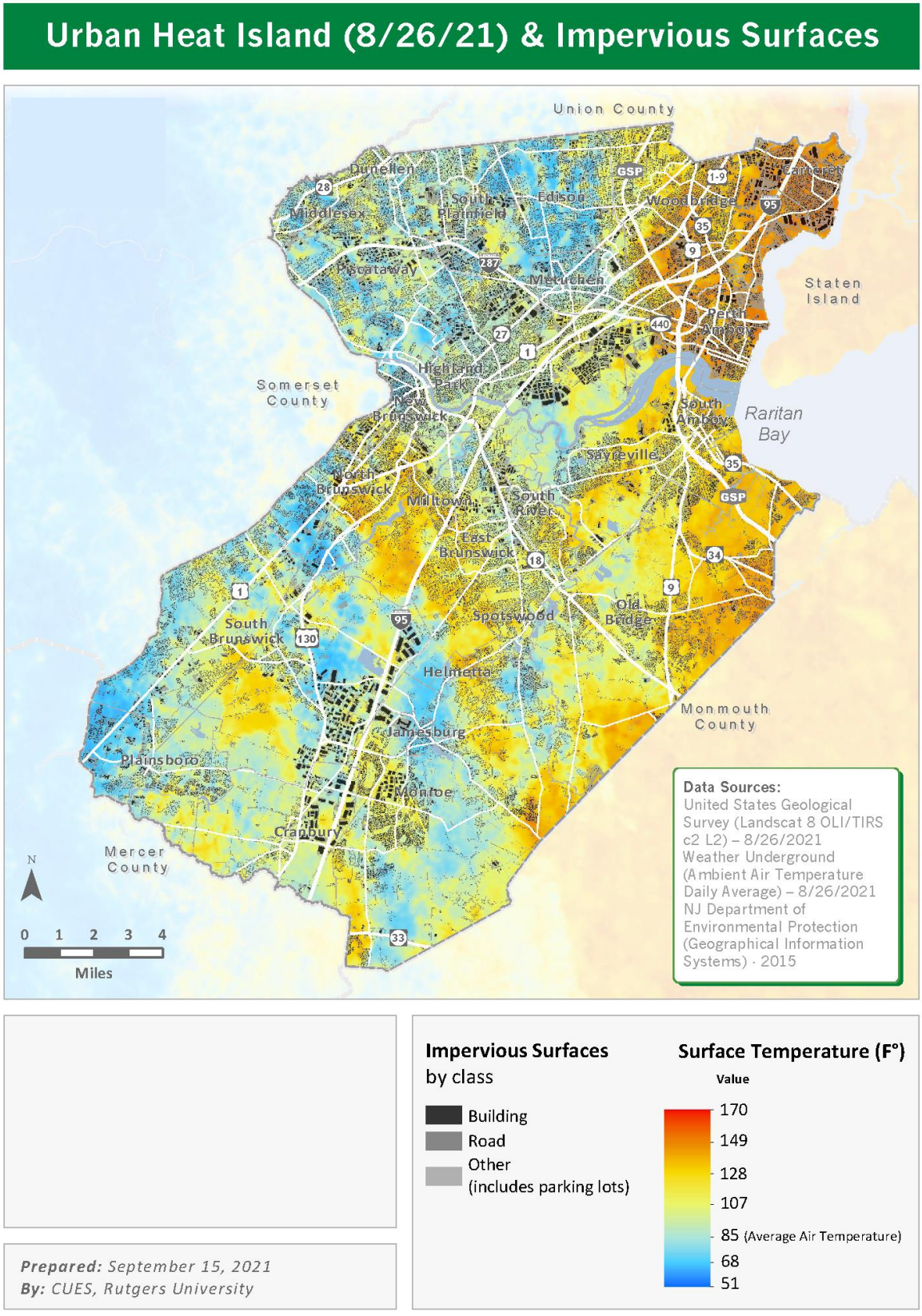
Urban Heat Island (8/26/2021) & Impervious Surfaces

The urban heat island effect decreases the quality of life for residents of urban areas. High temperatures combined with lower air quality harm human health in many ways. [50] The increased need for cooling buildings pushes energy consumption and increases cooling costs. Moreover, a feedback loop of greater energy consumption, like excessive air conditioning usage during heat waves, increases air pollutants and greenhouse gas emissions that work to elevate temperatures further. [51] As heatwave days grow with climate change, urban heat island effects will be even more severe and longer-lasting.

Following the goal to reduce the intensity and extent of urban heat within communities and on a County-wide scale, the first step is finding the locations of urban heat islands. The inventory chapter outlined key hot spot locations, generally in urban centers and industrial zones. The next step is analyzing contributing factors to urban heat islands. Dark impervious surfaces such as parking lots and roads absorb solar radiation and increase the ambient air temperature. [52] In addition, areas that lack sufficient tree canopy cover do not maintain natural shading to interfere with solar radiation absorption.

In Middlesex County, highly urbanized areas with little to no tree canopy cover, ***Figure 11***, and greater impervious surface area have the highest ambient air temperatures or urban heat island effect, ***Figure 12***. The most elevated temperatures and density of impervious surfaces correlate within the most urbanized county sector stretching from Carteret and Perth Amboy City. Higher-than-average air temperatures occur in scattered pockets associated with urban centers like South Amboy, Sayreville, and North Brunswick. Furthermore, areas along highway corridors, like the Turnpike and the Garden State Parkway, and in cities where many cars are in traffic also amplify the urban heat island effect through exhaust emissions. [53, 54] Motorized vehicles factor into the amplified urban heat island effect in areas with more impervious surfaces as they rely on the pavement and emit harmful gasses. It is important to note that ambient air temperatures (used to create urban heat island maps) shift according to weather patterns, wind speed, and time of year, even though warm areas surround urban centers.

Figure 12: Urban Heat Island (8/26/2021) & Impervious Surfaces



Cooler temperatures occur in areas with less impervious surfaces shown in ***Figure 12*** and more extensive tree canopy cover, ***Figure 11***. Notably, areas near open spaces, forests, or communities with mature shade trees maintain cooler temperatures within Middlesex County. Planting shade trees in proper places is one of the most critical ways communities can mitigate urban heat island effects. Removal of unnecessary pavement and using reflective material on roofs can help reduce the absorption of solar radiation. Overall, reducing car emissions and carbon dioxide pollution will also help reduce urban heat island effects. The *Actions* chapter will identify strategies for reducing urban heat island effects.

Overall, urban heat island effects are most significant in the most urbanized locations of Middlesex County as they have the least amount of tree canopy cover and the greatest density of impervious surfaces, such as roads and parking lots. The most affected municipalities are Carteret, Woodbridge, and Perth Amboy. Nonetheless, every municipality has hot spots, and they are the locations to focus tree planting and impervious surface alteration or removal efforts. Action items will further include green roofs and green facades because of the cooling effect of the plant's evapotranspiration.

Ecosystem Services Summary

Protecting Middlesex County's natural resources and improving environmental and ecological conditions will increase the quality of life for residents. Environmental issues caused by urbanization and climate change create stormwater and flooding threats, urban heat island effects, drought conditions, waterway and groundwater pollution, and natural heritage and biodiversity loss. This County-wide natural, ecological, and environmental resources analysis examined leading factors contributing to environmental issues informing actions to mitigate the result of these stressors.

An outstanding 100,000 acres (almost half) of Middlesex County's (primarily wetlands and forests) terrestrial landscapes occupy ecological habitats of concern that support threatened and endangered species. The ranked ecological habitats of concern show imperiled species habitats compared to protected open space and preserved farmland. ***The most critical habitat (Rank 3) provides resources for the most imperiled species and occupies 23% of the County's landscape, while 65% of that total exists on unprotected land; 73% of ranks 1-3 occupy unprotected land.*** The *Action* chapter will include open space acquisitions and environmental zoning within these habitats in the high priority actions to mitigate environmental issues such as flood risks, urban heat island effects, and pollution.

Waterbodies, wetlands, and buffers extend throughout the County's landscape. Differing buffer size requirements and laws depend on the associated wetlands or stream types. Buffers help protect wetlands and the essential ecosystem services they support County residents, such as reducing the negative impacts of flooding and stormwater runoff. The largest buffer size (300 feet) is the most conservative and considered the best practice for land managers in any scenario. High impervious surface cover throughout the County amplifies adverse stormwater impacts. ***The analysis revealed that 18% of impervious surfaces cover the County's wetlands and buffers.*** Impervious surface reduction within wetland buffers will become increasingly important to ensure functioning ecosystem services within each wetland, waterbody, and buffer zone.

Identifying priority areas for stormwater management and flood protection improvements is essential. ***The 100-year flood risk zone (the most at-risk) occupies almost 30,000 acres across the County.*** The second priority, 500-year flood risk areas encompass 4,500 acres in the County. The third priority is coastal storm surge zones along the tidally influenced waterways. These large areas occupy all of Carteret, regions of Woodbridge, Perth Amboy, Edison, South Amboy, Sayreville, South River, Old Bridge, Spotswood, and Helmetta. Municipalities have shared stormwater management responsibilities as upstream activities affect downstream locations.

Impervious surfaces cover half of the coastal storm surge zone (Rank 1), a third of Rank 2, and 8 percent of Rank 3. Although the least impacted area is at the highest risk, it is still essential to improve each ranked zone as upslope improvements benefit areas at lower elevations. Parking lot improvements can be the most cost-effective. Parking lots and other paved surfaces occupy the largest areas within each flood mitigation rank compared to buildings and roads. Parking lots greater than one acre dominate each rank. Actions to reduce the size of impervious parking lots will drastically improve Middlesex County's stormwater management opportunities.

Natural floodplain restoration from converted parking lots and other impervious surfaces will enhance water infiltration to protect upland structures better and restore ecosystem service capabilities. ***Programs like Blue Acres have already helped transform developed lots into new forests in multiple areas in the County. Resilient New Jersey is an ongoing grant-funded program that identifies actions to help reduce flood risks and stormwater impacts on local and regional scales.*** The *Actions* chapter will further discuss an integrated approach to improve flood mitigation zones on all scales.

Impervious surfaces amplify stormwater runoff and flooding. They contribute to the urban heat island effect by decreasing the quality of life through increased air pollution, cooling costs, and energy consumption, resulting in harm to human health. Carteret, Woodbridge, and Perth Amboy have the most intense urban heat islands and higher impervious surface cover. The County's coolest ambient air temperatures are associated with forests and mature shade tree cover in older suburbs. ***Increasing canopy cover is one of the best management practices to combat urban heat as trees provide shade and help filter air pollutants.*** Dense urban areas with high impervious surface cover have the least tree canopy cover. Still, they will benefit most from urban street tree planting and converting impervious surfaces to vegetated areas where possible.

Best land management practices, including tree plantings, reduced impervious surfaces, flooding impacts, urban heat, pollution, and stormwater runoff, will improve air, water, and habitat quality. Open space acquisitions are beneficial within ecological habitats of concern to help imperiled species, preserve natural heritage, capture stormwater, filter pollutants, clean drinking water, store carbon, and clean the air.

CULTURAL LANDSCAPE ANALYSIS

Introduction

The industry standard understanding of cultural landscapes from the National Park Service, the Cultural Landscape Foundation, and the European context of historical heritage in the landscape informed the *People and Space* inventory (culture) throughout Middlesex County, showing where mapped culturally relevant areas exist. The *People and Space* inventory, paired with the demographic data, highlighted critical elements for further study in this *Cultural Landscape Analysis*.

The Cultural Landscape Foundation highlights the human role in forming the cultural landscape, a landscape "affected, influenced, or shaped by human involvement… and can be associated with a person or event." [55] Following this standard, the inventory documented historic landscape features and assets. The National Park Service (NPS) highlights a more vital link between history and nature by defining the cultural landscape as "a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or exhibiting other cultural or aesthetic values." [56] The *Inventory* chapter thoroughly recorded historic urbanization of the landscape and land use progression, ecological habitat patterns remnant of past activities, historic districts and properties, demographics, open space, and agricultural lands—all considered cultural landscapes.

An online photo survey asked community members to name their favorite outdoor place, submit a photo, and give a brief statement of why they liked it, informing this cultural landscape analysis. It became evident that a favorite place in the landscape holds more than natural beauty or historical significance; it is a place with a personal memory of individual or group experiences. Because the (re-)creation of shared narratives by residents is happening every day at special events or at casual, regular interactions, the analysis of the cultural landscape acknowledges that culture happens every day at every place. ***Therefore, a definition of the suburban cultural landscape of Middlesex County includes historic properties, natural features, and living ornaments, along with indicators of everyday human interaction of a diverse population:***

> *As defined in this plan, a cultural landscape is an outdoor space of any scale experienced by people. The value of a cultural landscape develops from a historically significant event or era, religious correlation, or emotional response that evokes memory, identity, or spiritual connection to a place. The cultural landscape can be natural in form or entirely built. Still, it is always an outdoor space directly or indirectly experienced by people tied to a perceived intangible and subjective value based on cultural preference.*

The Destination 2040 Strategic Initiatives support this definition of the suburban cultural landscape focusing on the human experience of suburban space:

1. *Revitalize walkable town centers, downtowns, and commercial corridors.*
2. *Develop the Arts Institute of Middlesex County into a hub for all arts, cultural and historical programming.*
3. *Provide safe, innovative, inclusive, and sustainable parks and recreation services.*

The *Cultural Landscape Analysis* section studies two cultural landscape components: the physical landscape objects as manifested in *Cultural Landscape Features and Assets* and the *Cultural Landscape Perception* as understood through *Engagement Analysis*. Both sections help identify landscape threats, challenges, and opportunities and inform the development of landscape types. The assessment of landscape threats and opportunities according to landscape types will guide the definition of action items discussed in the *Landscape Types* section and applied in the *Actions* chapter.

The first section, *Cultural Landscape Features and Assets* analyzes Middlesex County's existing physical features through online mapping and the research team's site studies. The first comparison overlays historic districts and properties, arts and cultural centers such as museums, and historic routes to identify the County's historically and culturally relevant landscape elements. These elements provide opportunities for a maintained historical character, linear recreational opportunities, and cultural experiences related to the County's historical narrative. Additional analysis through the research team's inventory studies the County's viewsheds, bolstering the need to protect these elements. The *Character of Place Analysis* reveals how the County's architecture categorizes and organizes the County's cultural landscapes, and the *Downtown Analysis* of all municipal downtown locations in Middlesex County assesses both downtown type and quality to outline opportunities.

The second section, *Cultural Landscape Perception: Engagement Analysis*, explores the community's perception of the landscape, revealing how a space becomes a place with meaning. The ***Nature & Place.*** Photo Survey results analysis concludes that memory and self-identity in a place link narrative to landscapes giving them purpose and importance. An analysis of the D 2040 Public Outreach reveals landscape attributes people see as lacking, recognizing opportunities for landscape enhancements aligning with the community's cultural preferences. In addition, the Municipal Engagement Outreach summary lists key topics municipal representatives acknowledged as essential landscape elements to their residents.

This section concludes with a link between the two terms, *nature* and *place*. Human use defines landscape types, while the ecological landscape is closely associated with each category. The term nature encompasses the environmental component of the landscape, while the term place represents the human connection to a physical space. The previous *Ecosystem Services Analysis* paired with the *Cultural Landscape Analysis* shows that humans directly impact nature, and nature directly impacts people. The *Nature* and *Place* approach expresses a landscape urbanist ideal, designing cities with the surrounding natural landscape considered at the core of the decision-making framework to state how ecological and cultural landscapes directly impact health and perception supporting the other.

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Cultural Landscape Features and Assets

Cultural Landscape Features and Assets represent the cultural landscape's traditional understanding, including historical features, historic district designations, viewsheds, downtown areas, and materials. *Cultural landscape features,* defined in this plan, consist of the physical landscape components identifiably linked to a historical-cultural significance or the physical experience of nature.

The *Cultural Landscape Features and Assets* definition is based on the National Park Service (NPS) understanding of the cultural landscape in the American context. The NPS details a cultural landscape methodology categorized by four groups: historic designed (momentous), historic vernacular (everyday function), historic agricultural (agricultural use), and ethnographic (ethnicity). The four characteristics vary widely across the landscape and represent a range of services, events, periods, and environments always linked to the natural landscape.

The NPS outlines 13 Cultural Landscape characteristics, including and defined as:

- **Natural Systems and Features:** geology and ecological function formed the landscape
- **Spatial Organization:** framed views, vistas, building clusters*,* layout, etc.
- **Land Use:** land activities shape the landscape
- **Circulation:** historic routes
- **Cultural Traditions:** practices that have altered style *and* materials and represent cultural preference in the built form
- **Topography:** *historical* features that illustrate how humans have shaped the ground plane*,* which might include earthworks and cultural or traditional adaptations of land use in response to *the* natural topography
- **Vegetation:** functional or ornamental plants representing cultural practices
- **Cluster Arrangement:** buildings grouped together
- **Buildings and Structures:** These include houses, barns, stables, schools, churches, factories, bridges, windmills, gazebos, silos, dams, power lines, culverts, retaining walls, dikes, foundations, etc.
- **Views and Vistas:** linear lookout points offering an expansive visual experience
- **Constructed Water Features:** built features and elements that utilize water for aesthetic or utilitarian functions in the landscape, such as fountains, pools, ponds, cascades, canals, and reservoirs
- **Archeological Sites:** ruins, mills, etc.
- **Small-scale Features:** small-scale historically significant features may include benches, fences, monuments, road markers, flagpoles, signs, *footbridges*, curbstones, trail ruts, culverts, and foundations [(57)]

These 13 cultural landscape characteristics are tools used to analyze Middlesex County's cultural landscape relating to the County's historical components and viewsheds to identify the place-specific character. Historic features encompass historic districts and properties and associated arts and cultural centers such as museums representing the area's history.

Traditional Ian McHarg overlay mapping methods identify historic properties and districts overlaid with historic trails and arts and cultural centers to understand where historical and cultural landscape assets overlap. A viewshed analysis builds from the cultural landscape characteristics identified by the NPS through a viewshed and topography comparison. The overlay moves beyond traditional GIS mapping to show the varied landscape characteristics across the County, such as the northern industrial waterfront and the southern wetlands and agricultural land. Topography and the associated viewsheds highlight the character of the natural landscape.

Additional physical elements within the built environment help establish a *Character of Place* analysis determining the County's unique landscape types and identifying a cultural understanding of the built form through an analysis of architecture, associated landscapes, and various land uses. This analysis identifies cultural landscape types within broad land use categories such as industrial, commercial, residential, agriculture, barren, mixed, and open space.

The *Character of Place* analysis leads to the *Downtown Character Analysis* defining the County's diverse land use areas within commercial and town centers. This section highlights the unique characteristics of the individual downtowns existing in Middlesex County. Downtown areas offer outdoor commercial and social experiences, acting as central locations for cultural landscape experiences, though not in the traditional sense. This analysis reveals three downtown cultural landscape categories specific to Middlesex County: Urban City Center, Suburban Town Center, and Rural Village Center. Municipal-scale study of these downtown areas reveals opportunities to inform general downtown enhancements.

Historical and Cultural Assets Analysis

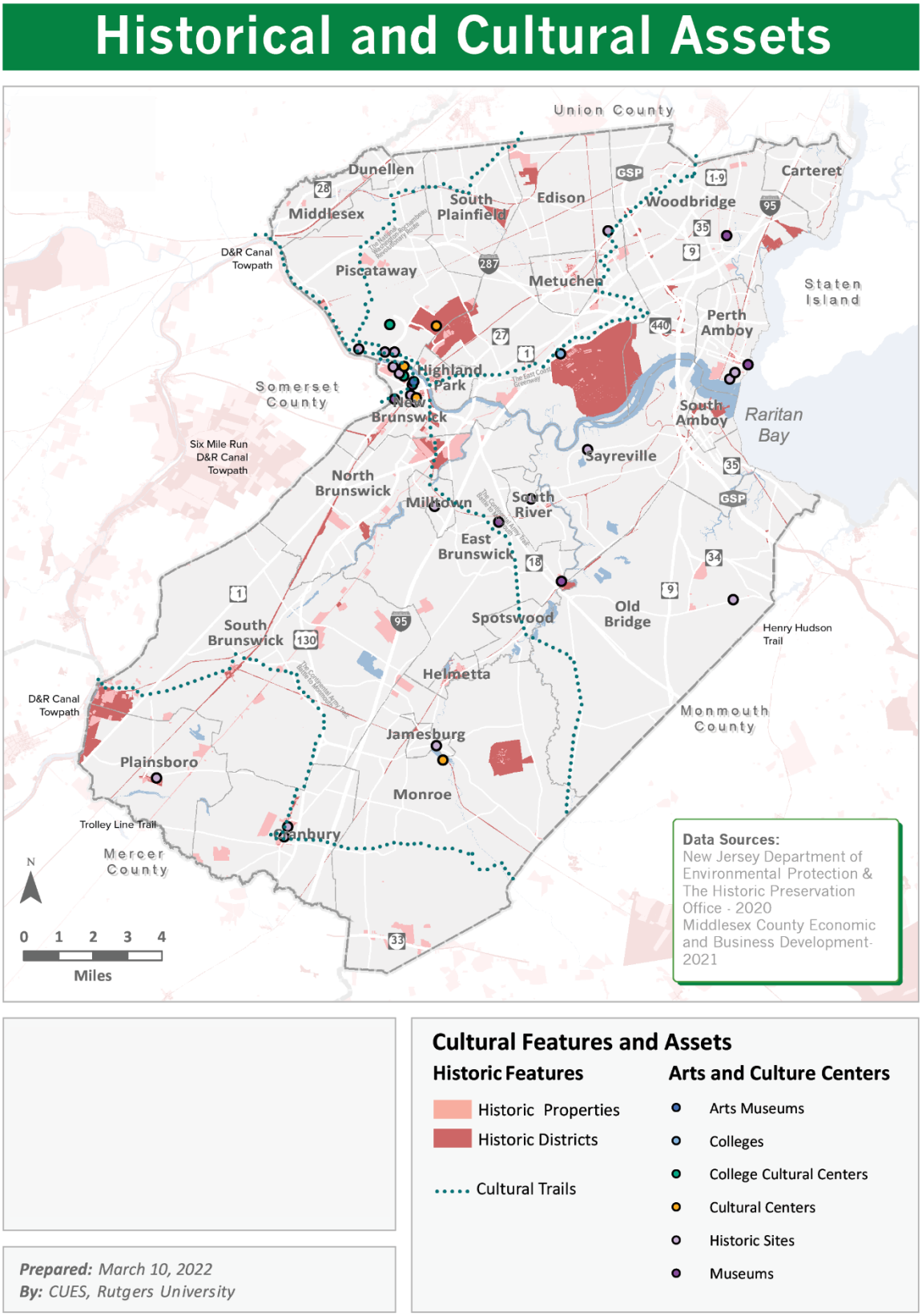
Historic features are one of Middlesex County's many defining cultural characteristics. The *Inventory* chapter identified historic districts and properties and separately located arts and cultural centers. This analysis overlays these components with historic trails to identify cultural overlap and opportunities to inform cultural landscape enhancements (*Actions* chapter).

Historic properties, districts, and arts and cultural centers are cultural assets that allow people to experience site-specific culture in one place. Historic districts encompass a broader area supporting a regional identity. Historic districts include multiple properties and linear paths or right-of-ways occupied by transmission, rail, and highway infrastructure, highlighting the County's industrial heritage occupied by abandoned or active lines. Arts and culture centers, such as museums, allow people to experience cultural relics and the historical character of the surrounding community through educational programming.

Historic design standards specific to the historical period accompany historic districts and properties. These culturally accepted design standards celebrate the area's historical significance by those who choose to live there today. The design maintenance in historic communities supports the identifiable historical features, fostering the cultural identity rooted in the area's history. Historic designations protect the area's integrity through regulations, whereas historical features lacking historic designations may be subject to identity loss with new development. The County has many larger Historic Districts representing the local community's history; the inventory chapter identifies the most prominent 15 *(Historic Properties and Districts).*

Historic battles, discussed in the *Inventory* chapter, link to the County's extensive history. Historic battle trails marked throughout the County's landscape associated with the Country's revolutionary history serve as spaces for cultural activities such as reenactments or simply landmarks. These trails include the Continental Army Trail: Battle of Monmouth (west to east) and the National Washington-Rochambeau Revolutionary Route (west to northeast), shown in ***Figure 13***. Bolstering these trails with a designated greenway provides an opportunity to protect their path permanently. Currently, signage is the only indication of these fragmented trails. The Delaware and Raritan Canal Towpath lends homage to the County's industrial heritage through a marked contiguous open space trail owned and maintained by the State (along the western border from New Brunswick into Somerset and Mercer Counties).

Figure 13: Historical and Cultural Assets



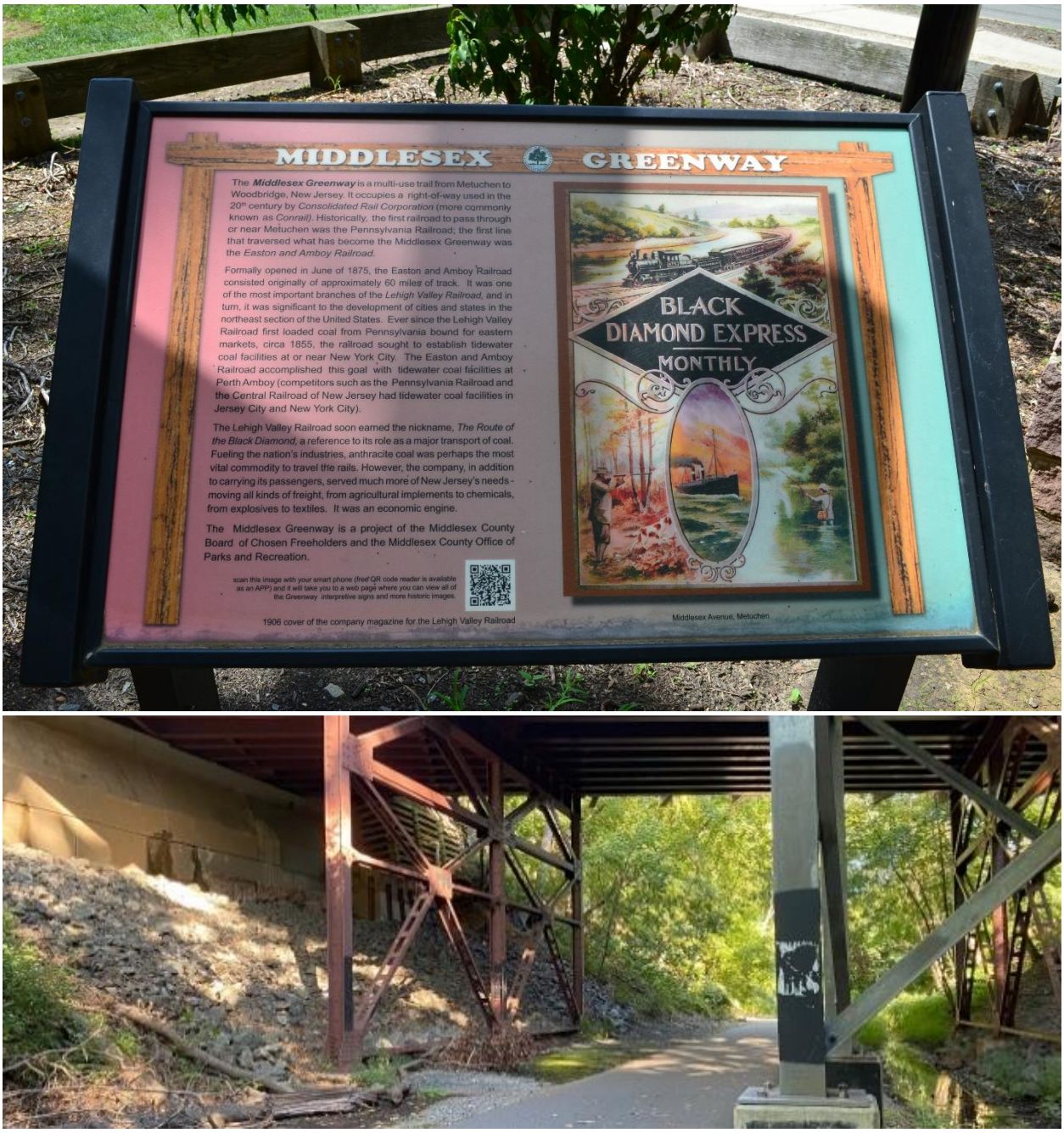
Prepared: *March 10, 2022*
By: *CUES, Rutgers University*

Middlesex County's historic properties and districts exemplify the local character and preservation impact shown through historic downtowns and linear districts (downtown areas discussed in further detail in the *Downtown Historic Districts Analysis* section). Downtown Cranbury's historic district has two museums related to the community's past and present architecture and associated landscape features like the Women's Monument at Brainerd Lake. New Brunswick and Perth Amboy are also home to many varied arts and cultural centers that express the surrounding community's cultural heritage, especially in their downtown areas. Notably, six downtown areas occupy historic district/property designations (discussed in *Downtown Historic Districts Analysis*).

Multiple linear historic districts exist in Middlesex County, such as the Camden and Amboy Railroad Main Line Historic District, Delaware and Raritan Canal Historic District, Lehigh Valley Historic Railroad District, Pennsylvania Railroad New York to Philadelphia Historic District, Metuchen to Burlington Transmission Line, Garden State Parkway Historic District (Middlesex), PSE&G Company Northern Inner Ring Transmission Line, and the New York and Long Branch Railroad Historic District, ***Figure 13***. These linear corridors serve as potential outdoor spaces connecting people directly to the County's historical culture. Infrastructure remnants add characteristics making a trail unique and visually stimulating. Identifiers such as signage and trail markers along these corridors suitable for pedestrian traffic can add historical significance to a potentially undesirable viewshed inhibitor such as a transmission pole.

Historic abandoned rail lines are opportunities for postindustrial pedestrian and bicyclist connections, such as the County's Middlesex Greenway, ***Figure 14***. The existing Middlesex Greenway sits on a portion of the abandoned Lehigh Valley line in Metuchen, Edison, and Woodbridge. This Greenway, managed as a County Park, is an extraordinarily successful open space serving as an excellent role model for developing a County-wide Greenway system. It exemplifies the area's industrial and rail character through bridge material and rail remnants, highlighting historic moments along the route with signage, ***Figure 14***. Enhancing public access to historic linear systems (where abandoned) will support the County's industrial heritage by providing access to these open spaces.

Figure 14: Middlesex Greenway, Metuchen



Source: CUES, Rutgers University. Photograph. 2021.

Above: Informational signage along the greenway; Below: Infrastructure displaying the historical character

Active transmission lines are ideal locations for linear paths based on their physical characteristics. These lines cut across the County, often gravel or vegetated, and physically link to the community, creating easy access points. The Metuchen to Burlington Transmission Line Historic District runs from Metuchen into Mercer County, meeting with the Trolley Line Trail in West Windsor. Today, this active transmission line consists of a readily accessible gravel path. The transmission line lends to the cultural character of the area and is a location marker easily identifiable in the landscape. The tree line vegetation management provides a cultural feature related to Middlesex County's transmission lines and industrial heritage, depicted in ***Figure 15***.

Figure 15: The Metuchen to Burlington Transmission Line Historic District, South Brunswick

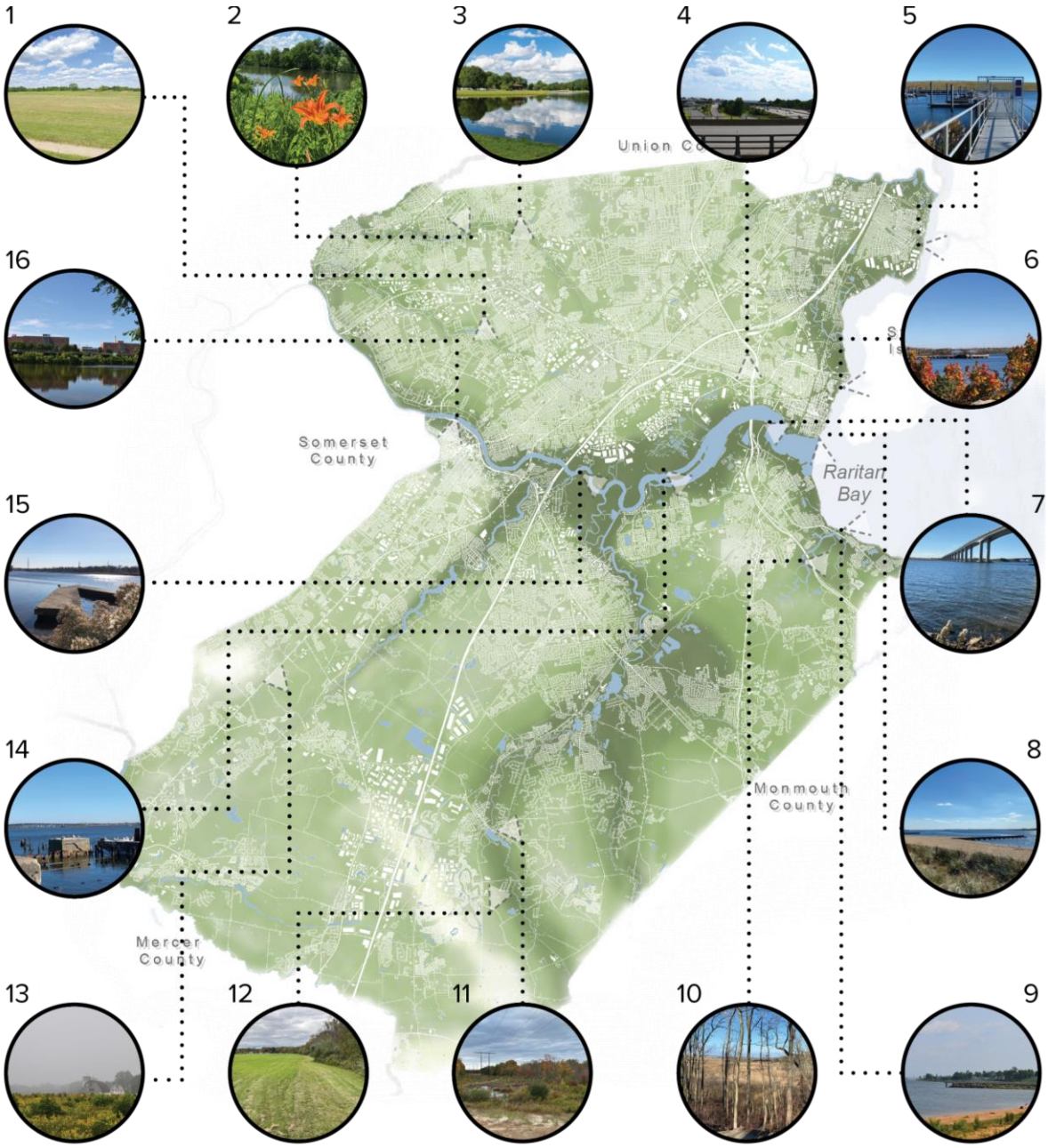
Source: CUES, Rutgers University. Photograph. 2021.

It is important to consider maintenance methods to keep historic character intact that may eventually be subject to redevelopment. The County's natural and built landscapes are continually changing. Placing a high cultural value on historic landscape features such as vegetation maintenance, trails, and infrastructure will help develop a community's desire to protect these characters and the landscapes. Considering how to repurpose these spaces respectfully to the County's past and future ideals is necessary to honor the community's historic character. Historic preservation of culturally relevant areas is an example for other communities that may be apprehensive about enlisting preservation status.

Viewshed Analysis

A viewshed is a cultural landscape characteristic defined as a linear lookout from a particular vantage point highlighting the natural landscape. Topography and built infrastructure play an integral role in viewsheds by framing views and providing height for lookout points. These features add texture and dimension to viewsheds but risk jeopardizing the viewshed depending on placement. This viewshed analysis is an initial selection from the research team's site visits to identify the County's landscape diversity. More viewsheds are possible.

Figure 16: Viewshed Analysis



The viewsheds in Middlesex County frame the various landscapes that comprise the County's landscape character, such as agriculture, beach and river waterfronts, wetlands, forests, parks, urban areas, and industrial skylines. The research team's field visits captured several County viewsheds, revealing the various cultural landscape characteristics defining the surrounding area.

The lower-lying topography of the County's east coast and riverfront brings people to the shoreline to experience the waterfront viewsheds. In contrast, the steeper topography allows the onlooker an overhead advantage. Flatter terrain in the County's southern region is home to agricultural land uses and wetland landscapes providing expansive views of fields, meadows, and marshes. The northwest is home to hidden gems such as suburban park ponds, lakes, and remnant agricultural fields interspersed in suburban areas.

County defining landscape elements such as the Raritan River and Arthur Kill deliver desirable viewshed opportunities. The Raritan River cuts west to the east through the center of the County and has multiple locations for lookout vantage points, ***Figure 16***. The Raritan River western lookout points capture New Brunswick, Piscataway, and Highland Park's waterfronts showing parks on either side, such as Johnson Park, Boyd Park, and Donaldson Park. New Brunswick's skyline's historic and contemporary architecture is an additional defining viewshed, ***Figure 16, Item 16***. The industrial ports and the Raritan River Boat Club along Edison's Raritan River edge frame viewsheds across and down the river of industrial skylines, bridges, and the rolling topography defining the County's horizon line, ***Figure 16, Items 15 and 16***. Edison's waterfront is not only home to the Raritan River viewsheds but also views of hidden waterbodies buzzing with wildlife near the Raritan Center, ***Figure 18***. It is essential to protect these natural landscapes to maintain the associated viewsheds.

Numerous waterfront viewsheds at the Perth Amboy waterfront highlight the Raritan River, Raritan Bay, and Arthur Kill. Along the Raritan River waterfront on Riverview Drive in Perth Amboy sits the marked Riverview Bridge Outlook and a small unnamed park under Victory Bridge which deliver waterfront access and viewshed experiences, ***Figure 16, Item 7***. Perth Amboy's east coast on the Arthur Kill is a defining viewshed of the waterfront area that looks out to the Raritan Bay, Arthur Kill, the industrial skyline, and the Outerbridge Crossing bridge into New York, ***Figure 17, and Figure 16, Item 6***. Carteret and Woodbridge's waterfronts also consist of these expansive water viewsheds looking out to the Staten Island landfill's rolling hill landscape beyond the Arthur Kill, ***Figure 16, Item 5***. The Old Bridge and South Amboy waterfronts look out into the Raritan Bay and expansive beachfront view of the Atlantic Ocean, ***Figure 16, Items 8 and 9***. The Raritan River, Raritan Bay, and Arthur Kill waterfronts provide

breathtaking views of the natural water habitat, such as the tidal marsh and the human impacts through the industrial skyline.

Figure 17: Perth Amboy Waterfront Viewshed (Figure 16, Item 6)

Source: CUES, Rutgers University. Photograph. 2020.

Waterfronts offer idyllic views, but Middlesex County's diverse landscapes portray the County's cultural landscape significance as it relates to the County's agricultural heritage. The landscape is widely agricultural land interspersed with forested landscapes in the southwest. These agricultural viewsheds, such as Heathcote Farms and other private farmsteads, ***Figure 16, Items 12 and 13,*** foster the expansive terrestrial landscape viewshed. Piscataway's ex-rural character offers few but memorable agricultural viewsheds, ***Figure 16, Item 1***. These viewsheds are vast fields framed by tree lines. It is essential to establish agricultural viewshed protection standards in areas where suburban landscapes and industrial land uses replace former agricultural fields.

The south holds a mix of wetland, vegetated, and waterfront landscapes. Monroe Township's wetland landscape viewshed preserved by the powerline offers a unique natural and industrial viewshed with the powerline acting as a wayfinding landmark, ***Figure 16, Item 11***. Vegetation management under the powerline right-of-way maintains the viewshed instead of obstructing forest growth. Similarly, the wetland landscapes In Old Bridge's Cheesequake State Park frame the onlooker's view of the rolling suburban horizon through the hardwood forest, ***Figure 16, Item 10***.

Suburban parks house some of the County's most accredited viewsheds. Although the County's northern regions have smaller pockets of natural land and open space than the south, the parks along the County's waterways have pristine views offering solace in a more urbanized area. Columbus Park in Piscataway on the Bound Brook at Lakeview Avenue holds a suburban lake viewshed. The lake viewshed blocks the industrial rail line and buildings sitting just behind the tree row, ***Figure 16, Item 2***. Spring Lake County Park in South Plainfield is another defining viewshed in Middlesex County, offering a viewshed in a busy suburban area, ***Figure 16, Item 3***. Of course, the southern regions of the County also contain these park viewsheds. Helmetta Pond is one southern example of an expansive waterfront within a protected open space.

Figure 18: Pond on Unprotected Land in Edison (Figure 16, near item 14)

Source: CUES, Rutgers University. Photograph. 2021.

Pedestrian viewshed experiences are significant to support throughout the County. These experiences connect people to nature, identifying important places to protect and enhance. Pedestrian experiences are essential, but the human landscape experience from motorized vehicles is similarly crucial. Roadways offer viewsheds experienced at different speeds. A great example of the driver viewshed experience occurs when driving in the northeast on U.S. Route 1 and 440, framing the surrounding vegetation buffers and skyline, ***Figure 16, Item 4*** (view from the pedestrian bridge over the highway). The motorized vehicle viewshed experience is essential to foster and avoid blocking since a great deal of the visual landscape experiences take place in motorized vehicles along major roadways.

The County has many natural landscape viewsheds supported by topography and surrounding infrastructure. Although many more viewsheds likely exist throughout the County, this viewshed analysis captures the County's unique and diverse landscape characters in each region, displaying the south's rural and wetland character, the beachfront east coast, and industrial lined Raritan River. Not only do the County's many viewsheds express the County landscape character, but also highlight how important it is to value and protect the County's viewsheds not to lose landscape experiences associated with County residents and the landscapes that define the region's cultural identity. Ways to preserve viewsheds include monitoring development and structure heights within the viewshed, vegetation management, and providing access to view them.

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Character of Place

The *Character of Place* analysis focuses on the physical characteristics that define the County's unique landscape narratives beyond historical significance to characterize the County's cultural perception of landscapes associated with land use types and structural organization of the County's physical landscape. Traditional planning through zoning organizes the County's landscapes by land use types such as residential, commercial, industrial, barren or vacant, agriculture, natural land or open space, or mixed land use areas. However, the cultural perception of the County's character varies widely throughout these land use categories, ***Figure 19***. For example, an industrial-zoned refinery along the Perth Amboy waterfront has a very different character than an industrial warehouse in Cranbury. Residential dwellings in Monroe Township's agricultural areas are very different from homes on the suburban fringe of Perth Amboy. Cultural preferences define these spaces' needs and uses, leading to design opportunities and landscape performance expectations.

Identifying varied landscape types through a *Character of Place* analysis is essential to determine the best landscape enhancement strategies. For example, a rain garden on a half-acre residential property will be smaller in scale than a rain garden or detention basin on a warehouse property. This character analysis informed by site visits and mapping exercises locates landscape types throughout the County. It categorizes them based on the cultural understanding of these places in form and function. *Character of Place* is always subject to change as it is a subjective interpretation of land use and land development heavily influenced by cultural preference.

Figure 19: Middlesex County Character Photo Collage

Source: CUES, Rutgers University. Site Visit Photographs in Middlesex County. 2021-2022.

Landscapes such as natural areas, designed social parks, farm fields, water features, rail lines, downtown streetscapes, residential dwelling styles and lawns, shopping centers, parking lots, and more define the County's cultural landscapes. These cultural landscape features define Middlesex County's landscape narrative as distinct places, exemplifying the South's rural and railroad character and the North's industrial and waterfront heritage, ***Figure 19***. The County ranges in landscape types from urban centers to natural landscapes. The characteristics falling within the urban to natural landscape gradient support the County's character analysis through building type and associated landscapes.

Urban cities, such as Perth Amboy and New Brunswick, portray many culturally identifiable features within the mixed-use development. Perth Amboy has a historical and industrial waterfront. The buildings in Perth Amboy are typically older, 2-4 stories, and have wood or brick exteriors. Perth Amboy consists of older historic homes, high-density residential, mixed commercial and residential, industrial refineries, and open spaces such as social parks and greenway trails (Perth Amboy bike trail). The industry holds a strong presence at the waterfront through refineries, warehouses, and the remanent industry through vacant and barren lands. Open space nestled along the industrial waterfront offers access points to the waterfront.

New Brunswick is situated in the County's southern half (south of the Raritan River). Still, the dense urban core and industrial production relicts portray more similarities to the northern County. The city represents the community's history through architecture and landmarks while fostering city growth with current cultural preferences such as high-rise buildings and glass building facades, new plazas, and outdoor space integrated into new development. Over time, New Brunswick's landscape transformations exemplify ties to the hospital campuses, Rutgers University, and rich immigrant heritage. The building structures in New Brunswick are a mix of historic brick buildings and new sky-scraper developments with a suburban fringe. Not only is New Brunswick's character urban, but it has a solid connection to the Raritan River and surrounding open spaces.

Figure 20: New Brunswick Skyline view from the Raritan River

Source: CUES, Rutgers University. Photograph. 2020.

Middlesex County's suburban communities are unique from the cities in that their mixed land uses and commercial cores are smaller in scale. Suburban communities are predominantly residential, with industrial and commercial properties interspersed throughout the landscape or clustered in commercial districts. Suburban communities link to major roadways and accompany commercial buildings such as strip malls (Midstate Mall in East Brunswick), indoor malls (Woodbridge Mall in Woodbridge), outdoor mall plazas (The Shoppes at North Brunswick), and single stand-alone commercial properties. Industrial areas in suburban communities consist of warehouses where production and storage occur, such as Cranbury, Piscataway, and Carteret, or clustered light industrial buildings like along Lincoln Boulevard in Middlesex Borough.

Some residential communities include older suburbs and typically smaller, medium, and high-density single-unit homes closer together. Older development occurs across the County in Dunellen, Edison, Highland Park, Woodbridge, Carteret, Jamesburg, Helmetta, South River, Spotswood, and Old Bridge. At the same time, southern communities consist of larger low-density suburban developments, typically newer, with homes further spaced from one another. Suburban homes range from low-density farmsteads to high-density suburban apartment complexes (lacking commercial properties at the ground level). The older suburbs are beginning to undergo home conversions into larger structures through additions and replacements, as shown in ***Figure 22***.

Figure 21: Suburban areas in Highland Park and Metuchen High-Density Residential

Figure 22: Highland Park home expansion

Source: CUES, Rutgers University. Photograph. 2020.

Newer suburbs are replacing rural landscapes. In the southern half of the County, East Brunswick, North Brunswick, parts of South Brunswick, areas of Old Bridge, Monroe Township, and Plainsboro Township are composed of newer development, rural landscapes, and widespread suburban neighborhoods. Piscataway, North Brunswick, South Brunswick, and East Brunswick are larger ex-rural townships linked to major roadways. North Brunswick and East Brunswick are developing new town centers along the County's major highways on once industrial, agricultural, or vacant land.

The character in these southern communities represents the cultural shift from widespread agriculture to suburban living and car dependence. Large shopping centers are located along major highways like U.S. Route 1 and U.S. Highway 130. Piscataway Township is similarly an ex-rural area replaced with suburban developments marked by unincorporated suburban communities with associated commercial uses such as strip malls and shopping plazas. This is most obvious in the large shopping plazas and strip malls near Route 287. Pockets in the northern sections of Edison are also experiencing a shift into newer suburban developments and larger-scale homes.

Ex-rural communities also have ample space for newer industrial development, including warehouse development along major roadways. Throughout communities linked to major roadways are warehouses. Rapid industrial growth occurs in Piscataway's industrial area along Route 287 and Hoes Lane, N.J. Route 18 with large-scale warehouses. Cranbury Township is experiencing similar industrial area development along Interstate 95 and U.S. Highway 130.

Figure 23: Low-density suburban development on former agricultural land

Source: CUES, Rutgers University. Photograph. 2020.

Campuses are a unique landscape type with mixed commercial and public services. A campus differs from an office park (also seen in the County) due to the cultural association with the land use. The extensive campus grounds of Rutgers University and Middlesex College contribute significantly to the Middlesex County landscape experience. Rutgers University occupies portions of Piscataway and New Brunswick, while Middlesex College resides in Edison in the *Edison Facility Historic District*. College campuses are communities, places of work and school, and cultural cores offering various cultural events. College campuses benefit the surrounding community through entertainment offerings, educational opportunities, and potential environmental impacts through private open spaces. Many people identify with their college alma mater.

Open space, natural land, and farmland occupy a great deal of land in the County's southern region. Plainsboro, South Brunswick, Monroe Township, and Old Bridge are composed of large swaths of preserved open space and farmland, not to mention wetlands and forest cover outside of park boundaries. The southern regions' County parks consist of larger-scale natural areas. Nature parks include Plainsboro Preserve in Plainsboro and the Ireland Brook Conservation Area in North Brunswick. These natural and recreational lands also include social parks and golf courses. Social parks exist throughout the County; Roosevelt Park in Edison and Spring Lake Park in South Plainfield are two examples. Social Parks link to natural areas through riparian corridors, such as the link between Roosevelt Park and Merrill Park by the South Branch Rahway River between Edison and Woodbridge.

Figure 24: Social Park at Roosevelt Park, Edison.

Source: CUES, Rutgers University. Photograph. 2019.

The County's *Character of Place* analysis reveals various landscape types falling within the broad base zoning umbrella of residential, commercial, industrial, barren or vacant, agriculture, natural land or open space, or mixed land use. Within these broad categories, landscape character related to architecture's assumed age, and type reveals cultural landscapes specific to the land use types. The cultural perception of each landscape type interpreted by the research team through the *Character of Place* analysis helps understand the cultural value of each landscape. It informs suggestions to enhance the function and perception of these spaces. The *Landscape Type* section further categorizes and details cultural landscape types informed by the *Character of Place* analysis.

Downtown Analysis

Downtown areas are the cultural cores where commerce and gathering take place. People frequent these areas for events or shopping and dining, among other activities. People frequent these places alone, with a small group, or in a largely populated setting. Downtowns exist at the community's commercial center and vary in character across Middlesex County, from urban city centers to rural villages. Most municipalities have a unique downtown area displaying the community's architectural history and the municipality's cultural preferences through restaurant and store offerings.

Downtown Analysis Criteria

Many factors contribute to the success of a downtown area. This section identifies analytical criteria to study the quality and categorize Middlesex County's downtown areas by municipality. Critical components include historic designations, local character, open space connections, and population density. The components define the existing downtown character and mixed-use town center types.

A study conducted through the University of Wisconsin's *Center for Community Economic Development* (2005) analyzed 11 successful downtown areas summarizing overlapping features to establish a well-activated downtown community. [58]

Key findings from the study impacting the landscape include:

- Captivating, vibrant storefronts that engage the customer
- Walkable areas near transit options (bus routes and train stations)
- Sensory experiences such as public art
- Landscaping and sidewalk amenities
- Entertainment as the central downtown offering bringing people to the area

Prosperous downtown areas have commercial establishments with curb appeal, are easy to navigate, keep people stimulated as they occupy the street, and have landscape features such as street trees, planters, and parklets. Entertainment brings people to the area for cultural experiences such as arts, concerts, theaters, shopping, and dining. Attracting people to a community's town center is essential in supporting a thriving cultural core. What happens once people are there is crucial to the success and continued use and value of public places within the town center. A high cultural value, though intangible, can lead to economic prosperity for local store owners and a positive perception associated with a specific municipality. One component highlighting the cultural value is the designation as a historic district.

Downtown Historic Districts

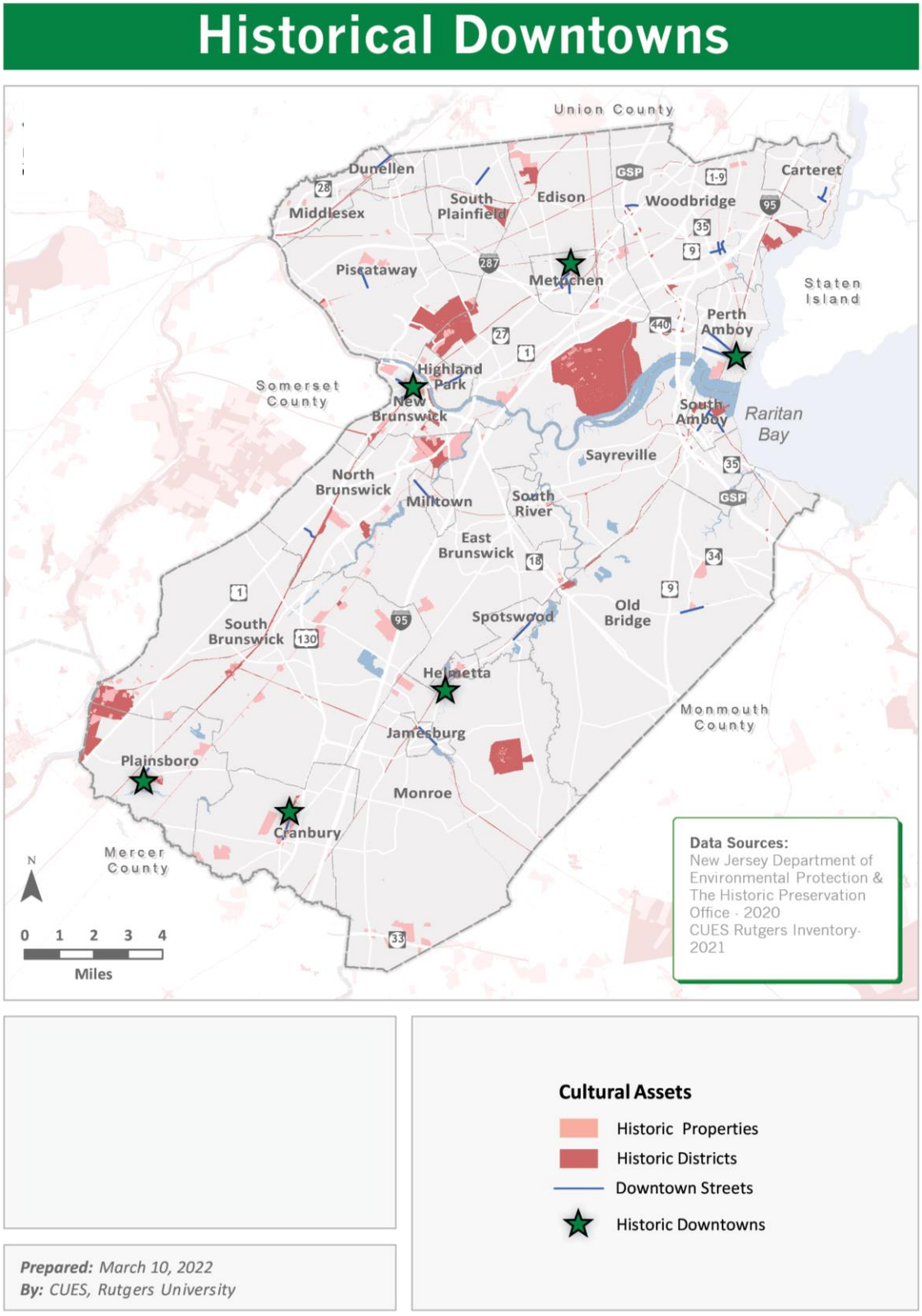
Historic cultural landscape characteristics portray an area's cultural aesthetic and link to the area's history. As defined in the *Inventory* chapter (*Historic Properties and Districts*), the NJDEP certifies that the New Jersey Register of Historic Places and the National Register of Historic Places list specific historic districts and properties. These associations or local entities hold the power to certify historic districts and properties recognized by the National Park Service governed under a state or local authority that actively seeks the protection of historic resources. [59]

Out of the 20 downtown areas in Middlesex County, ***Figure 30***, six hold a historic district designation, including Cranbury shown in ***Figure 25***, Plainsboro, Perth Amboy, New Brunswick, Helmetta, and portions of Metuchen, ***Figure 26***. While the remaining downtown areas reflect remnants of the community's growth over time, they are entirely subject to aesthetic change under the municipality's authority. The historic designation protects the unique appearance of these six sites as valuable cultural assets.

Figure 25: Downtown Cranbury

Source: CUES, Rutgers University. Photograph. 2021.

Figure 26: Historical Downtowns



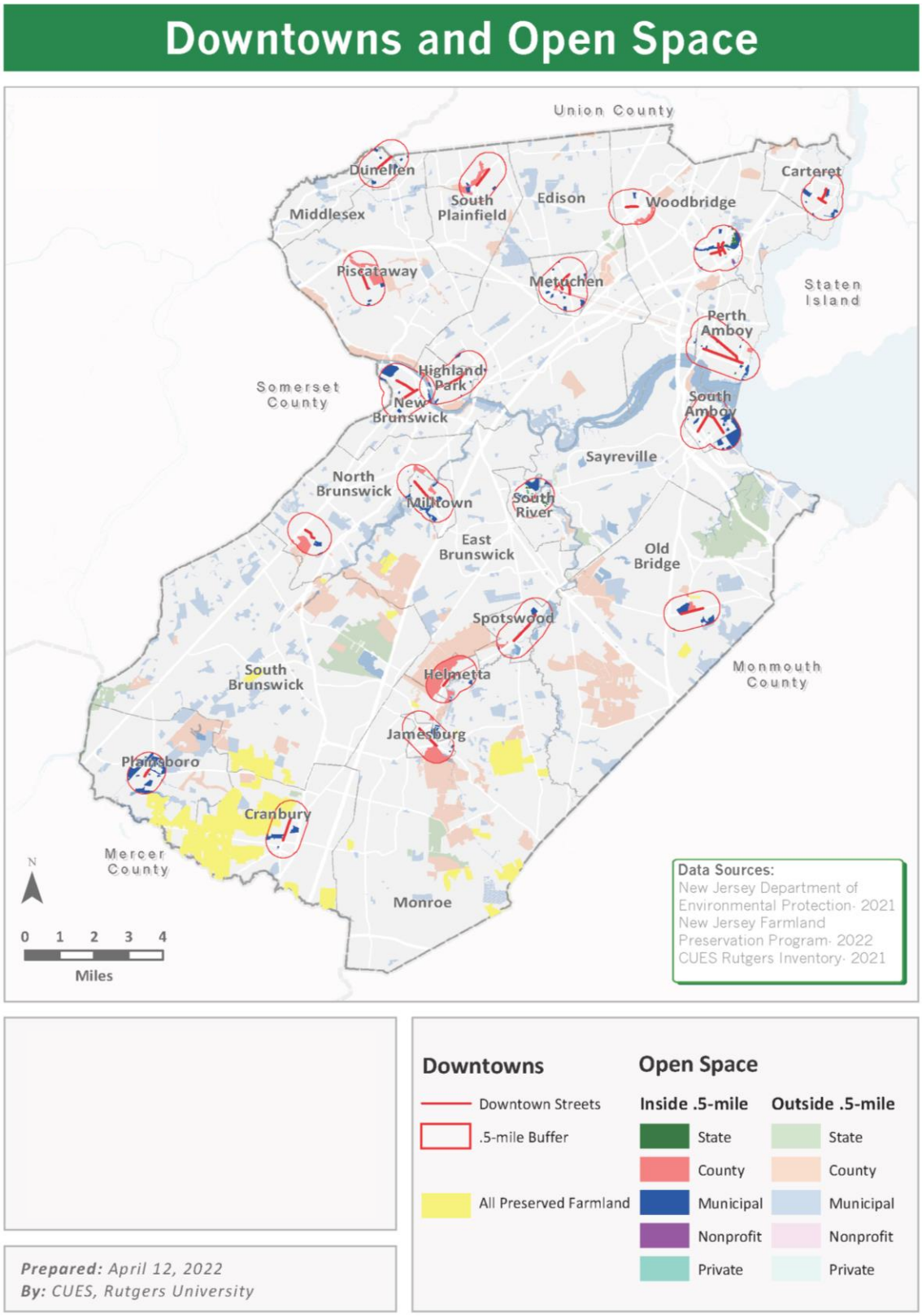
Downtown Open Space

An essential component of a downtown area for residents' and visitors' quality of life is fostering connections to nature. In Middlesex County, all identified downtown streets are located near designated open spaces shown in ***Figure 27***. A ten-minute walk to a park is an appropriate walking distance used by the National Park Service. This analysis applies a .5-mile (10-minute walk) radius to downtown streets (not linear distance) to locate designated open spaces in the surrounding area. ***Figure 27*** reveals that all downtown streets identified have some connection to open space, mainly County or Municipally owned parks within the .5-mile buffer. However, park accessibility through connected sidewalks, awareness, and wayfinding within the .5-mile radius of the downtown area connecting to local parks is often lacking.

Designated open space occupies land within a .5-mile buffer of all 20 identified downtown areas. South Amboy and Perth Amboy are adjacent to the Arthur Kills and Raritan Bay waterfront parks. Carteret, Dunellen, Old Bridge, Spotswood, Cranbury, South River, Piscataway, Metuchen, and North Brunswick downtown areas are near municipal parks. County-owned parks occupy the .5-mile buffer in Highland Park, Piscataway, South Plainfield, Woodbridge, Iselin, Metuchen, Milltown, Plainsboro, North Brunswick, Helmetta, and Jamesburg shown in ***Figure 27***. Wayfinding and greenway network opportunities exist to better connect downtown areas with surrounding open spaces (discussed in the *Action* chapter).

Downtown areas near open spaces can foster connections between people and nature through open space and downtown links supported by the greenway opportunities network. The character of these downtown spaces tied to the character of the surrounding open space bolsters an enhanced outdoor identity. This is evident in the link of Spring Lake County Park in South Plainfield, acting as the focal point of the downtown area.

Figure 27: Downtowns and Open Space



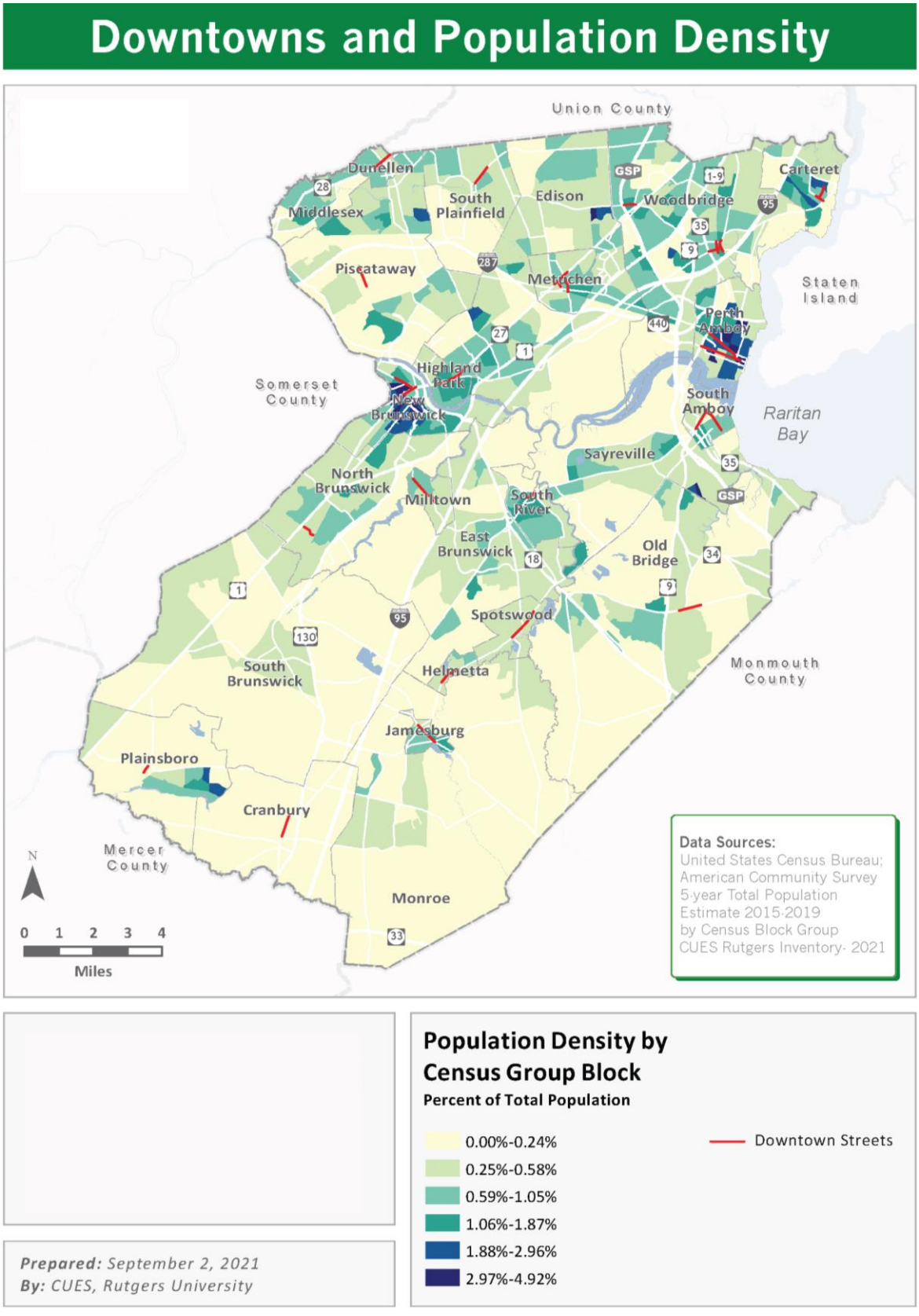
Downtown Population Density

Population Density reveals an urban to rural gradient throughout the County defined by the placement of people. The *Population Density Inventory* concluded that the cities of Perth Amboy and New Brunswick have the highest population densities. These two cities have downtown areas with the highest population densities contributing to their urban character. Carteret's downtown area is less dense (0.59-1.05% of the total Middlesex County human population lives in this census block) but still highly populated, categorizing Carteret's downtown area as a Suburban Town Center, ***Figure 29***. Places with the lowest population density in the downtown areas include Plainsboro, Cranbury, Piscataway, and portions of Old Bridge in the more rural areas. A comparison of landscape character will reveal if these downtown areas are truly urban, suburban, or rural.

Figure 28: Downtown Street use in Highland Park, Summer 2021.

Source: CUES, Rutgers University. Photograph. 2021.

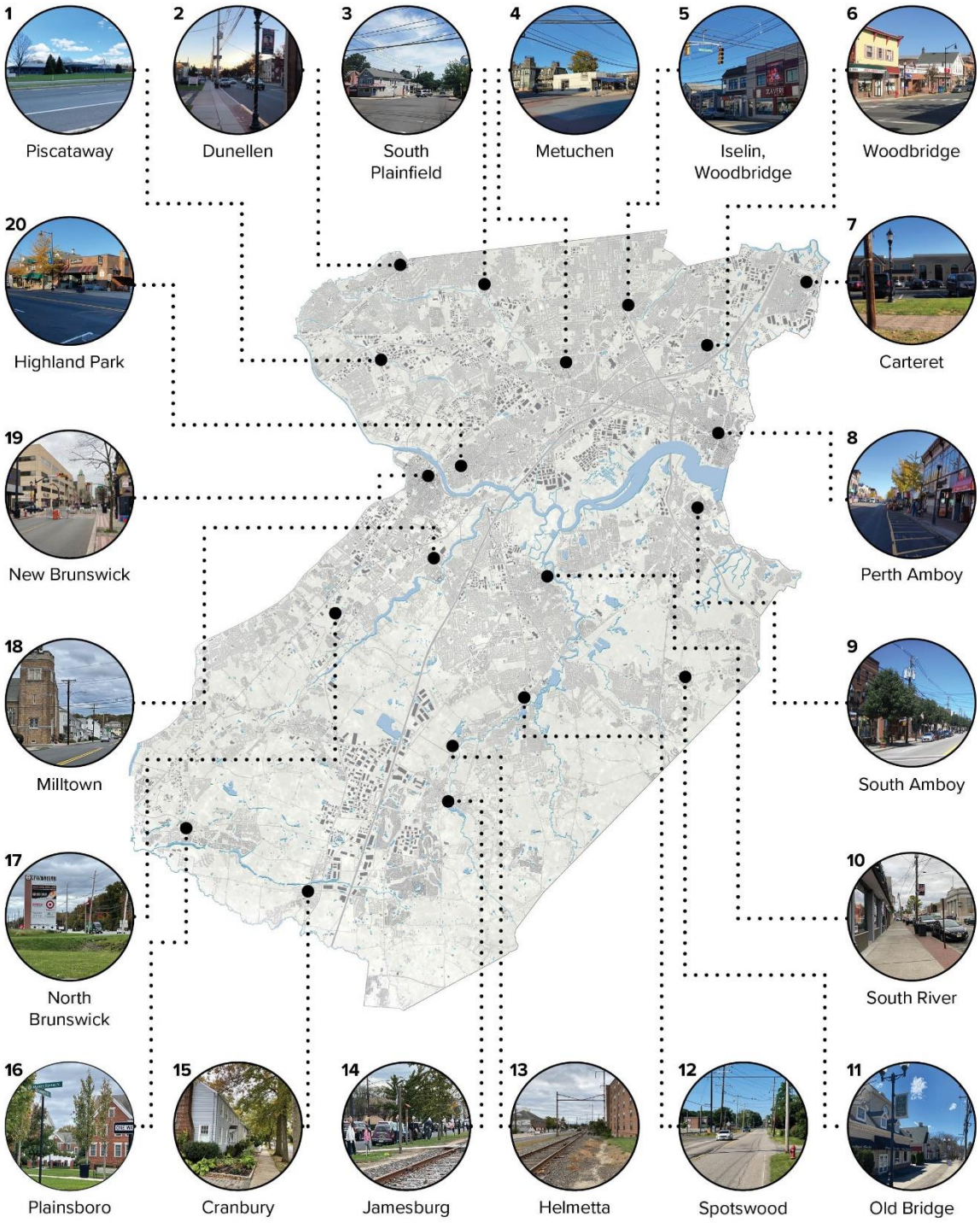
Figure 29: Downtowns and Population Density



Downtown Character

The *Downtown Character Analysis* identifies the unique downtowns throughout Middlesex County, ***Figure 30***. The analysis leads to downtown types identifying positive existing qualities and opportunities for enhancement in downtown areas.

Figure 30: Identified Downtowns



Downtown Character Descriptions

20 Downtowns exist in Middlesex County. The following numbered list correlates to ***Figure 30,*** showing general locations and images of each municipal downtown.

1. Piscataway:

Downtown Piscataway Township occupies Hoes Lane (N.J. Route 18) and heavily depends on the highway network. Public buildings such as the High School, YMCA, Police Station, and Public Library reside in this area. Pedestrian overpasses, bike lanes, and a pedestrian trail provide safe pedestrian access. Car centricity is a focal point in this area.

2. Dunellen:

Downtown Dunellen is a small suburban center featuring the Dunellen Train Station. This area is walkable with train and bus transportation opportunities. An unmistakable character is evident in the downtown area, noted by the building structures and store offerings. Temporary conversions of outdoor space for pedestrian use provide an opportunity to enhance this area with permanent pedestrian spaces.

3. South Plainfield:

Downtown South Plainfield's focal point is Spring Lake County Park. The downtown area is heavily car-centric but shows a clear military history of Middlesex County with historic battle trail signage and a small memorial park, Monument Park. More walkability and an identifiable pedestrian area outside the County park would make this area feel more like a downtown center.

4. Metuchen:

Downtown Metuchen expands multiple streets and has a prominent character. Pedestrian centricity appears dominant in downtown Metuchen, linked to the Middlesex Greenway and the Farmers Market pedestrian plaza. Maintaining the historical character is essential in this area which is experiencing redevelopment.

5. Iselin, Woodbridge:

Downtown Iselin represents an evident cultural character supporting Middlesex County's diversity and exemplifies the Asian Indian community's cultural preferences. Storefronts are colorful and vibrant with a marked street sign titled "Indian Square."

6. Woodbridge:

Downtown Woodbridge, although not a historic district, represents the cultural history of Woodbridge through the architectural style of brick buildings and train heritage. This area has a "Main Street" character and industrial history narrative. Woodbridge is experiencing redevelopment efforts throughout, establishing the importance of maintaining local character and identity in redevelopment design standards.

7. Carteret:

Downtown Carteret is the central area where public buildings are located. Although this area has sidewalks, it appears less walkable than other downtown locations and lacks space for exciting entertainment opportunities along the streetscape.

8. Perth Amboy:

The downtown area has two designated historic districts: The Perth Amboy Commercial Historic District and Clay Revival Historic Districts. Not only are the cultural qualities exemplified through the historic character of architecture and district signage, but culturally relevant storefronts represent the prevalent Latinx community. Open space and the waterfront are essential experiences to foster for Perth Amboy residents in the highly urbanized setting.

9. South Amboy:

South Amboy's Main Street occupies the waterfront area. The downtown is quaint with street trees, and local businesses occupy storefronts. The area zoned for redevelopment along the waterfront provides the perfect opportunity to incorporate green infrastructure into new development to support a resilient identity.

10. South River:

Downtown South River is located along Main Street and is a remnant of an industrial downtown. Currently, many stores are empty, showing the trend shifting away from downtown use. Vacant stores offer the opportunity to bring in new and exciting retail and entertainment options that will utilize the streetscape.

11. Old Bridge:
The Downtown area in Old Bridge links to the surrounding highway network within the farmstead and wetland landscape. Standalone stores and strip malls occupy the length of Old Matawan Road (County Road 527). An intermittent sidewalk accompanies the County Road and a marked bike trail in the Village Center shopping mall. Flags are calling attention to Old Bridge pride line historical light poles. Residents in this area could benefit from a linked sidewalk along the length of Old-Matawan Road connecting the surrounding open spaces.

12. Helmetta:
Downtown Helmetta is a small village linked to a commercial roadway. Helmetta is a prime example of the Historic Registrar's status maintaining the area's character. The core of Helmetta occupies the G.W. Helme Snuff Mill Historic District, with the repurposed snuff factory and Helmetta Pond as the central features. The area lacks a prominent character and walkability once outside the snuff factory complex.

13. Spotswood:
Downtown Spotswood is a quiet downtown area along Main Street (County Road 613). Commercial standalone buildings predominantly line the streetscape, and the area is less pedestrian-friendly even though lined with sidewalks. The downtown area is adjacent to Duhernal Lake and open spaces but lacks a clear identity and distinction of where Main Street life begins and ends.

14. Jamesburg:
The railroad line defines and divides Downtown Jamesburg's Main Street. The line makes the street challenging to cross and starkly separates both sides of the road. The downtown area links to the County-owned Thompson Park. Community art installations line the grass strip along the rail line between the two sides of the street. There is a mix of commercial and residential dwellings with moderately wider sidewalks for potential outdoor enhancements and pedestrian use to make the streetscape livelier.

15. Cranbury:
The Cranbury Historical District defines downtown Cranbury with historic architecture and historical markers. Historic homes line the street, marked with plaques to show Cranbury's colonial history. Historic farm properties such as Barclay Farm in Cranbury maintain the farming history tied to the area. At the same time, two museums tell the narrative of Cranbury's history the Cranbury Museum and the Cranbury History Center.

16. Plainsboro:
Downtown Plainsboro represents a rural village center with a central area surrounded by public buildings and residential dwellings. The Historic Village Center is walkable and pedestrian-friendly. The Plainsboro Village Historic District designation defines the Plainsboro Village downtown area. Redevelopment efforts in this area aim to maintain Plainsboro's historic character through building layout, organization, and materials.

17. North Brunswick:
The newly developed North Brunswick Main Street will become North Brunswick's new downtown area. The soon-to-be train station and Transit Village Designation make this area a desirable place to live, with apartments and condominiums that occupy the space near the train line. Larger franchise stores with associated parking lots occupy this newly developed area. The area is suburban and linked to U.S. Route 1. Newer developments create a blank slate somewhat void of an identifiable unique identity.

18. Milltown:
Downtown Milltown has a small hometown feel with a military character. Small municipal and private outdoor spaces lend homage to military history through statues and memorials such as the American Legion. Saint Paul's Church of Christ church is a landmark located downtown. Trees line the street but with quiet storefronts. There is an opportunity to add more exciting features to the streetscape.

19. New Brunswick:
The urban downtown area of New Brunswick represents the unique and diverse communities that occupy the city, such as the hospitals, Rutgers University, and Hispanic or Latinx communities. New Brunswick serves as a commuter city to New York City and is a central, regional hub for all Middlesex County with theaters, entertainment, shopping, and many restaurants.

20. Highland Park
Downtown Highland Park's Main Street is a local hub for residents and visitors. The area is vibrant with art installations, tree-lined streets, and rain gardens. This area has a pedestrian plaza on a converted parking lot where the Farmers Market stands, while the *Highland Park Downtown Alliance* supports community growth and maintenance.

Downtown Types

The Downtown Analysis identified characteristics to categorize the County's downtown areas. The three dominant categories within the mixed commercial and residential areas include Urban City Centers, Suburban Town Centers, and Rural Village Centers, ***Figure 31***.

Urban City Centers are mixed-use commercial and residential areas serving areas with the highest population densities, ***Figure 29***. Urban City Centers have various building types and heights with parking garages and street parking. The road network spans multiple blocks, has distinct sections, and links to major transportation networks. The Urban City Centers in Middlesex County include New Brunswick City and the City of Perth Amboy. The Urban City Centers act as regional destinations and promote walkable neighborhoods.

Suburban Town Centers accompany suburban areas and directly serve the local residential communities with mixed-use commercial and residential buildings. These areas are much smaller in scale than Urban City Centers, with higher population densities than the surrounding residential land uses but less dense than Urban City Centers. Suburban Town Center buildings do not exceed five-story buildings (generally) and are a mix of older and newer developments. The Suburban Town Center acts as a local destination and may not be easily walkable. Suburban Town Centers in Middlesex County occur in Carteret, Cranbury, Dunellen, Highland Park, Iselin-Woodbridge, Jamesburg, Metuchen, Milltown, North Brunswick, Old Bridge, Piscataway, South Amboy, South Plainfield, South River, Spotswood, and Woodbridge.

Rural Village Centers exist in the southern half of the County. These areas are small commercial cores nestled within predominantly rural landscapes. Limited walkability occurs beyond the Rural Village Center due to the rural landscape scale, but the village is highly walkable with paths and pedestrian areas in the central area. The population density is lower than in Urban City Centers and Suburban Town Centers. The Village Center layout extends from a major feature such as a building or landscape element with higher-density residential dwellings to accompany the village center. Two Rural Village Centers exist in Middlesex County in Plainsboro and Helmetta.

Figure 31: Downtown Types

From left to right: Urban City Center, New Brunswick; Suburban Town Center, Woodbridge; Rural Village Center, Plainsboro.

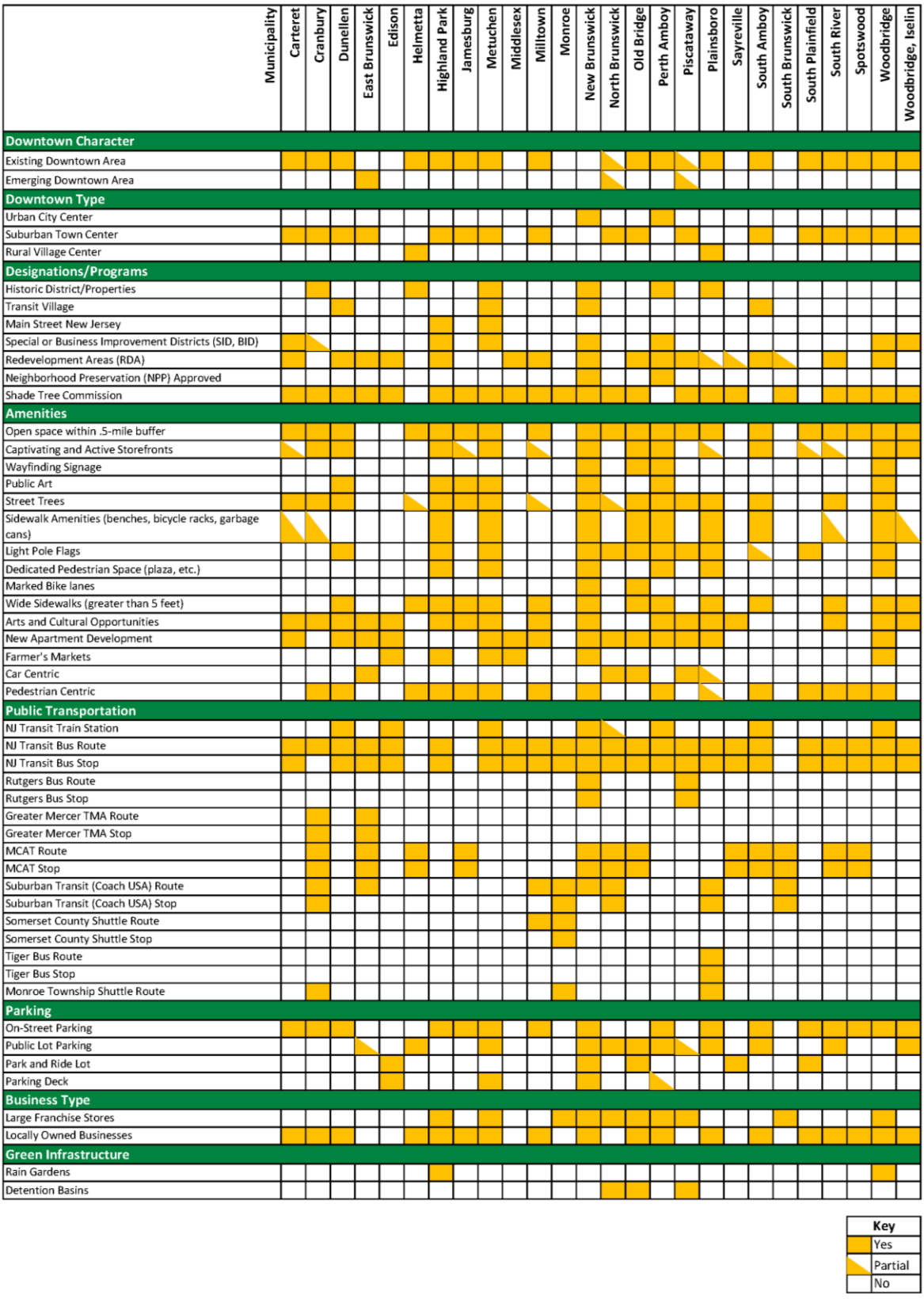
Downtown Existing Quality Analysis

Middlesex County's downtown areas are widely unique across municipalities. Downtown neighborhoods range from urban to rural characters. County or Municipally-owned open spaces reside within a .5-mile radius of all downtown areas, while Historic Preservation designations preserve only six downtown characters. As evidenced by the *Downtown Character, Downtown Population Density,* and *Downtown Types Analysis* Urban City Centers typically have higher population densities serving a more expansive area. In contrast, Suburban City Centers and Rural Village Centers have lower to the lowest population densities serving the local community. Middlesex County's 20 downtown areas fall within this gradient from urban to rural downtowns with varying qualities and amenity offerings. ***Figure 33*** outlines the municipalities in Middlesex County with downtown areas, the associated downtown type, and the qualities that enhance the downtown area. These qualities establish the downtown as an ideal place to frequent, as identified through the research team's site visit studies (see ***Appendix 1*** for complete matrix item definitions).

Figure 32: Piscataway Town Center Pedestrian and Bicycle Path

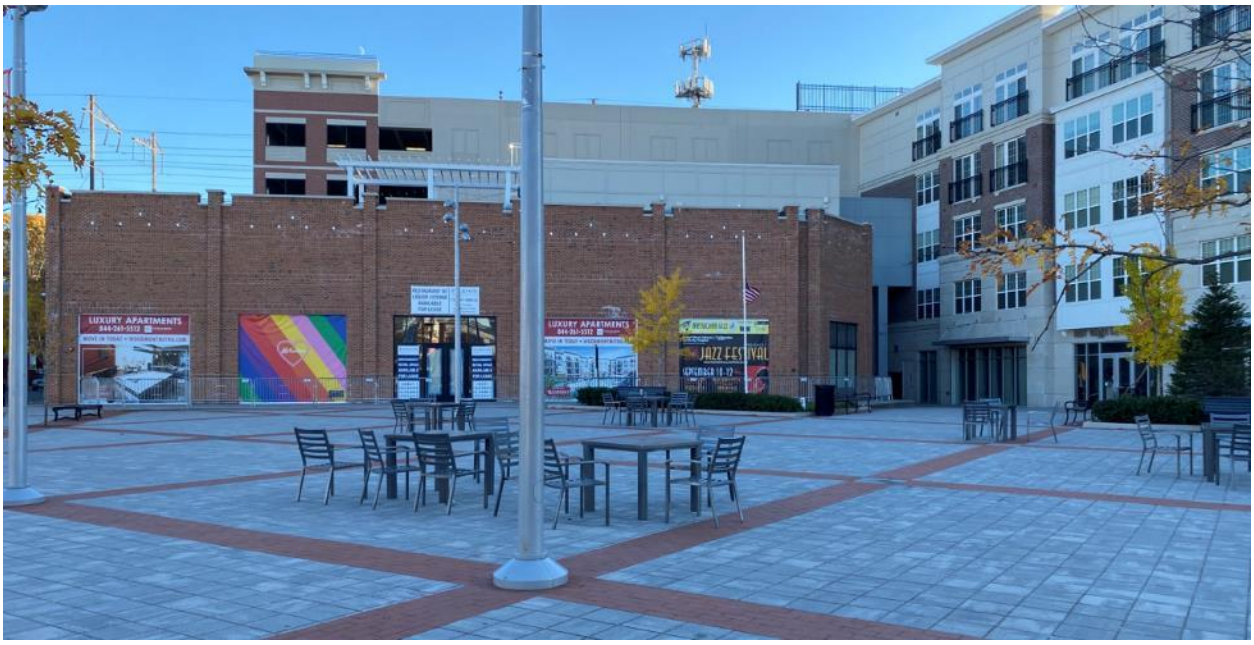
Source: CUES, Rutgers University. Photographs. 2022.

Figure 33: Downtown Existing Quality Analysis Matrix



Middlesex County has many examples of successful downtown features. Metuchen Borough is a prime example of a well-activated downtown linked to open space. Metuchen is a transit hub within a historic district and directly connects to the Middlesex Greenway, a 3.5-mile trail. The Greenway has multiple egress points, connecting this open space with downtown. Walking around downtown Metuchen with sensory stimulation such as artwork, vibrant storefronts, signage, and historic architecture is pleasant. The *Metuchen Downtown Alliance* maintains the downtown area and helps support programmed activities. The right-of-way consists of benches, planters, street trees, and bike racks along the sidewalks. Wayfinding signage guides pedestrians throughout the town. Downtown Metuchen's shopping, dining, transit, and the Middlesex Greenway attract people across the County. Temporary street closures offer additional pedestrian space on summer weekends to accommodate customers and local businesses, while the Metuchen Farmers Market pedestrian plaza permanently caters to foot traffic, ***Figure 34***. Only New Brunswick and Old Bridge have marked bike lanes.

Figure 34: Downtown Metuchen pedestrian plaza



Source: CUES, Rutgers University. Photographs. 2021.

Metuchen is one of the many examples of a well-activated downtown in Middlesex County. Highland Park, Cranbury, Dunellen, Perth Amboy, South Amboy, New Brunswick, Milltown, and Jamesburg are additional examples of downtowns with activated spaces. Dunellen utilizes overabundant parking in the municipal lot as temporary pedestrian space, while Highland Park has a permanent parking lot conversion for the Farmers Market. Milltown shows an apparent military heritage linked to the main road with accessible outdoor gathering space at the American Legion. Storefronts in downtown South Amboy captivate pedestrians with evident sidewalk use from restaurants, adorned with benches, garbage cans, lighting, and flower pots.

Figure 35: Food truck at Dunellen train station

Source: CUES, Rutgers University. Photograph. 2021.

Many factors bring people to downtown areas, including access, parking, arts and cultural experiences, transportation such as train stations and bus stops, and the overall aesthetic quality of the downtown area. Coalitions and designations support design standards and help communities gain resources to enhance the amenities people desire for their downtown areas. Seven downtown areas have Special Improvement Districts (SID), while Redevelopment Areas (RDA) occupy eleven downtown areas, ***Figure 33.*** [60,61]

Figure 33 reveals additional room for improvement throughout the downtown areas in Middlesex County. Simple modifications such as municipally specific flags, updated lighting, street tree planters, sidewalk enhancements, benches, and wayfinding signage would help increase the user experience of the downtown area.

Connections to open spaces through trails would increase the opportunity for people to connect with nature. Pathways will connect people to open spaces and foster safer pedestrian access to emerging car-centric areas, including Piscataway, North Brunswick, and East Brunswick's planned downtown growth. Small pocket parks and parking lot conversions provide an opportunity to increase outdoor space use while giving local establishments more outdoor seating for their customers, supporting economic prosperity.

Public transportation connects people throughout the County utilizing alternative travel methods than the personal car. Every municipality and downtown area uses some form of public transportation. The transportation inventory reveals that nine NJ Transit Train Stations service the County. The NJ Transit Train services more widely cover the north than the south (excluding New Brunswick and South Amboy). NJ Transit's bus routes and stops run more widely into the central municipalities and north but limit south access to only Plainsboro. Local lines service southern municipalities, including the Middlesex County Area Transit (MCAT) line connecting New Brunswick down to Cranbury and north to South Amboy, ***Figure 33***. Although Piscataway utilizes the Rutgers bus network to connect with New Brunswick, limited public transportation access is available, especially near the emerging downtown area. All other downtown areas connect to a public transportation network.

Green infrastructure such as rain gardens and vegetated detention basins offer a visual experience of nature, stormwater filtration and storage, and a habitat for beneficial wildlife. Traditionally green infrastructure promotes ecological and environmental benefits. However, their installation enhances the overall visual quality, adding an even higher intangible cultural value. Updates and broader use of these tactics will enhance downtowns everywhere. Highland Park and Woodbridge implemented rain gardens along the downtown streetscape.

Although Middlesex County's downtown areas are widely unique from town-to-town New Brunswick, Metuchen, Highland Park, and Perth Amboy offer the most well-rounded downtown experiences (according to this analysis), including train stations, bus stops, sidewalk amenities, exciting storefronts, historic qualities, outdoor space connections, and more. These areas hold numerous designations or coalitions that help secure planned growth and maintenance resources. This correlation expresses the importance of a planning task force working for the greater good of the downtown community.

Cultural Landscape Features and Assets Summary

Middlesex County's cultural landscape features and assets range in character defining various sections across the County such as downtown character, place types, viewsheds, and historic areas. Historic features are one of Middlesex County's many defining cultural characteristics.

Historic districts, trails, and arts and culture centers identified potential cultural asset overlaps with available online data. Culturally accepted design standards accompany historic districts and properties by indefinitely preserving their historic and cultural aesthetics. Arts and culture centers such as museums narrate the area's history. Historic battle trails marked throughout the County's landscape associated with the Country's revolutionary history serve as spaces for cultural activities such as reenactments and historic landmarks.

Multiple linear historic districts exist in Middlesex County serving as potential outdoor spaces connecting people directly to the County's historical culture. Historic abandoned rail lines hold opportunities for postindustrial pedestrian and bicyclist connections such as the County's Middlesex Greenway. Active transmission lines are ideal locations for linear paths based on their physical characteristics. It is important to consider maintenance methods to keep historic character intact that may eventually be subject to redevelopment.

Viewsheds are cultural landscape characteristics that frame the County's various landscape characteristics such as agriculture, waterfronts, wetlands, forests, parks, urban areas, and industrial skylines. County defining landscape elements such as the Raritan River and Arthur Kill deliver desirable viewshed opportunities. Waterfronts offer idyllic views but Middlesex County's diverse landscapes portray the County's cultural landscape significance as it relates to the County's agricultural heritage in the south with wetland, vegetated, and waterfront landscapes. Suburban parks house some of the County's most accredited viewsheds throughout highly urbanized and suburban neighborhoods. Many more viewsheds likely exist throughout the County, the viewshed analysis captures the County's unique and diverse landscape characteristics about each region displaying the south's rural and wetland character, the beachfront east coast, and industrial lined Raritan River. The *Actions* chapter outlines Viewshed protection strategies.

The *Character of Place* analysis focused on the physical characteristics that define the County's unique landscape narratives beyond historical significance to characterize the County's cultural perception of landscapes associated with land use types. It is important to identify varied landscape types through a *Character of Place* analysis to determine the best landscape enhancement strategies. The cultural landscapes fall under broad land use categories industrial, commercial, residential, barren, agriculture, mixed-use, and open space. More specific

landscape types include but not limited to high-low-density residential, urban agriculture, rural agriculture, warehouses, refineries, strip malls, standalone commercial buildings, shopping plazas, natural parks, social parks, mixed land uses, and town centers. The cultural landscape types provide an organizational structure for action implementation in the *Actions* chapter.

The full downtown analysis section overlayed inventory elements to assess downtown analytical criteria such as historic downtowns, open space adjacency, and population density to identify three downtown types: Urban City Center, Suburban Town Center, and Rural Village Center. The overlay analysis located the six downtown historic districts in Cranbury, Plainsboro, Perth Amboy, New Brunswick, Helmetta, and portions of Metuchen. Historic Preservation protects the downtown character. Higher population densities revealed the Urban City Centers of Perth Amboy and New Brunswick, while the downtown character solidified the three downtown types and variations within each category.

From these analytical criteria, downtown types identified the existing and emerging downtowns across Middlesex County through an existing downtown character analysis matrix. This analysis outlined which municipalities contained specific designations, amenities, and characters to detect opportunities for downtown enhancement. New Brunswick, Perth Amboy, Metuchen, and Highland Park include most of the characteristics studied. The *Actions* chapter will further outline tools and methods to enhance downtown areas increasing cultural value and in turn the cultural landscape based on appropriate actions for the three varied downtown types.

These physical cultural landscape features and assets provide spaces and character for the human experience. The community's negative or positive outdoor space perception decides the perceived quality and value. The following section focuses on the community's perception and identified opportunities to enhance the user experience of outdoor space; and links a narrative to the cultural landscape adding community ownership making a space worth preserving and enhancing.

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Cultural Landscape Perception: Engagement Analysis

Cultural Landscape Perception refers to the human experience through emotional connections to the landscape. The visual quality of an outdoor place enhances or detracts from an experience forming a cultural landscape perception and applying an intangible cultural value, whether negative or positive. Groups or individuals may share cultural landscape perceptions, but perception derives from cultural preference. The *Inventory* chapter explored four defined constructs of *culture.* Two pertain to cultural landscape perception: culture-as-dialogue defining the group members as the fundamental authors of their culture through dialogue amongst themselves; and culture-as-identity, the subjective component associated with belonging to a group based on shared morals, values, and ideals. [(62)] Developing one's narrative through group dialogue and identification through shared values shapes our cultural acceptance of space.

Middlesex County community members supplied valuable insight into the landscape's strengths and needs through the Destination 2040 outreach conducted by the CUES ***Nature & Place.*** team through the (L-Plan) Photo Survey (2021), the Voorhees Transportation Center Public Outreach and Engagement Team (POET, 2018), and D 2040 Municipal Engagement meetings (2021). These events revealed landscape expectations based on cultural preference and applied an intangible value to outdoor spaces supported by an emotional connection.

Nature & Place. outreach focused on the community's perception of outdoor space through the photo survey. The CUES ***Nature & Place.*** (L-Plan) Photo Survey's goal was to gather data about the individual's favorite outdoor place by asking the community to name their favorite outdoor place and the visual and cultural qualities aligned with that preference. Key survey findings revealed that identity and memories link narratives to landscapes, and viewsheds are a high-quality experience. These applied narratives add an intangible cultural value and understanding to the outdoor spaces.

During the D 2040 early outreach (2018), community members expressed their opinions about the County, focusing on parks, commercial centers, transportation, and more. Outreach, hosted by POET, such as *Set the Table*, County-wide comment boxes, email comments, and in-person events with various groups, including *English as a Second Language, Disabled populations, Veterans,* high school student*s*, and senior citizens, to better understand the diverse needs of the Middlesex County population. Key findings from the outreach revealed that residents require better access and quality outdoor spaces, more exciting downtown areas, safer walkability throughout their community, and educational opportunities relating to ecology and open space.

Municipal engagement meetings (2021) offered insight into municipal professionals' and representatives' perspectives about the County and their towns. Key findings include the support and desire for a County-wide greenway network, ecological education, and methods to reduce the negative impacts of flooding.

This analysis focuses on the outreach components that state the community's perspective on the cultural landscape and open spaces. This analysis helped the research team decipher where people want to be, why they like to be there, and where intervention can enhance the landscape to foster local identity and increase the quality of life for the Middlesex County community.

Nature & Place. Photo Survey Analysis

Middlesex County's ***Nature & Place.*** Photo Survey portrays the cultural link between outdoor spaces and human experiences, defining a space as a place. Identity and self-expression depict what landscapes mean for the Middlesex County community. The meaning of space gives a place cultural value. Culturally valuable places are places people want to be and places people care to protect. This section analyzes the ***Nature & Place***. Photo Survey Results outlined in the *Inventory* chapter identify qualities that give a place a narrative defining it as a cultural landscape. The ***Nature & Place.*** The Photo Survey concluded with 229 responses between June 30, 2021, and December 31, 2021. Although we attribute the COVID-19 pandemic (2021) to the lower response rate, the responses are still valuable, expressing individual experiences, group trends, and photographs of the County's landscapes. (Please see the ***Nature & Place.*** Photo Survey Inventory section for full response details).

Water is a particularly desirable landscape feature. Water supports life and holds many cultural meanings. ***Nearly half of the favorite outdoor place photos submitted to the survey included a form of water (24 out of 50).*** This observation supports the assumption that water features are an ideal focal point and viewshed, making a place desirable. Two survey participants mentioned that Roosevelt Park in Edison is important because of its connection to the water. One participant gained a crucial memory while "walking around the lake." The second noted they enjoyed Roosevelt Park because "there is a fresh spring." Water features bring people to outdoor spaces for the visual experience and associated emotional response. Memorable visual experiences add value to places solidified by emotional reactions.

Figure 36: Photo Submissions with Water

Images from left to right. Plainsboro Preserve Lake, Weston Mill Ponds view from Rutgers Gardens.

The visual experience of the submitted photos highlighted nature, water, and natural vistas. ***49 percent of the photo survey participants specified that their favorite outdoor place allows them to connect to nature.*** The survey photos displayed Middlesex County's waterfronts, sunsets, and natural landscape viewsheds. One participant noted that ***Sayreville Kennedy Park has "the best sunsets.*** Physically being in an open space connects people to nature, while the viewsheds enhance the experience and connect people to nature inside and outside of parks. The viewshed becomes an experience linked to the outdoor space. Viewsheds exist in parks, while driving across the County at all speeds, or looking out the office window, to mention a few examples. Highlighting and connecting natural spaces and vista opportunities through the open space network will allow more people to experience and hold memories tied to the County's natural viewsheds, conjuring positive emotional responses linked to outdoor space.

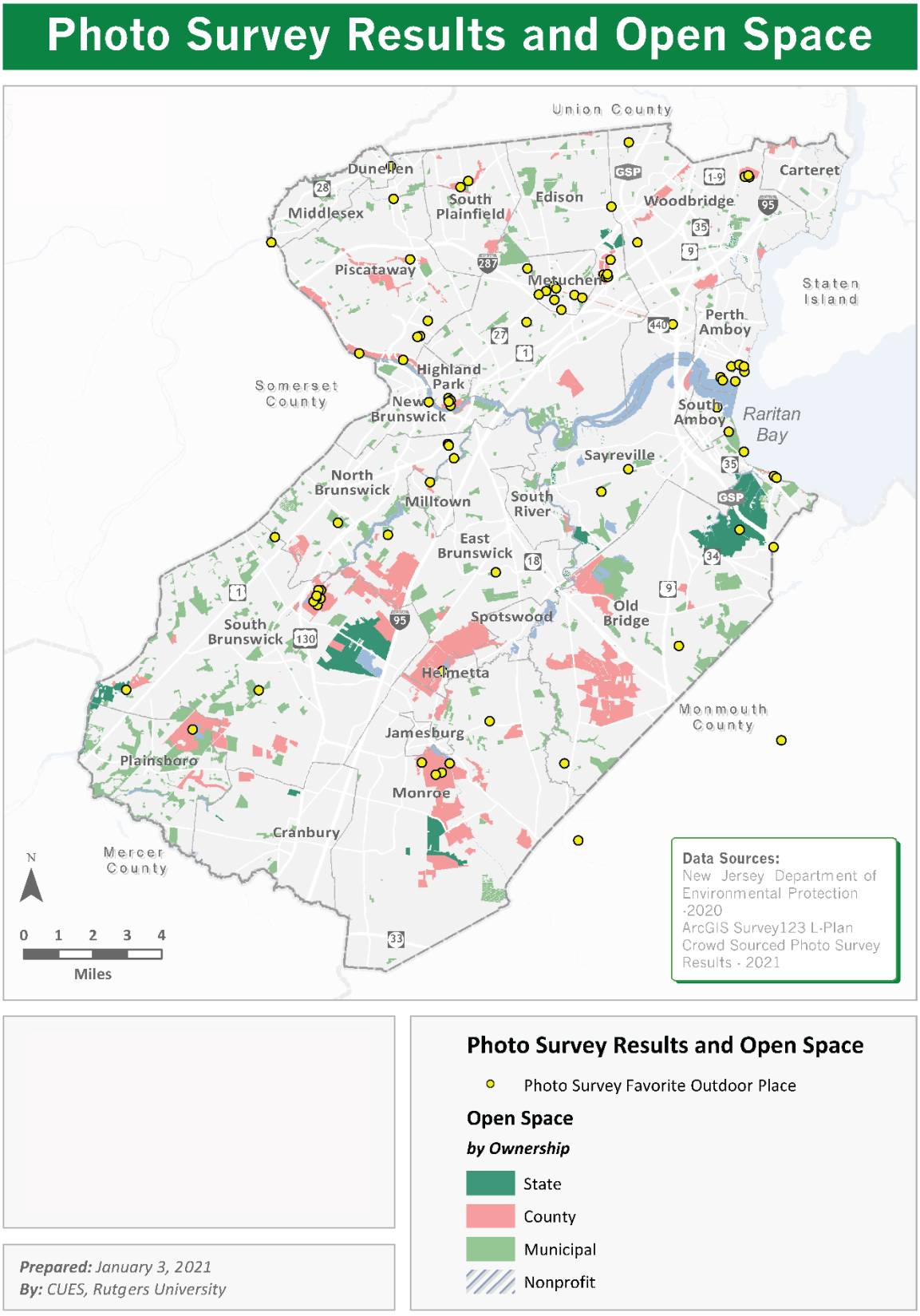
Figure 37: Sunset viewsheds submitted to the photo survey

Images from left to right. Old Bridge waterfront sunset; Sayreville Kennedy Park sunset; sunset over Helmetta Pond.

Memory and self-identity were among the top reasons people identified their favorite outdoor space, evidenced by 43 percent of survey participants selecting this place "holds an important memory for me" when asked, "why this place is important." Residents "watched their children grow up" at Donaldson Park, Highland Park, and walks at Spring Lake Park, South Plainfield fostered a relationship between two married partners. County Parks were the top identified places for promoting memories, ***Figure 38*****.** However, providing places for group and individual experiences in and out of parks can foster new memory creation. It is important to support a high-quality outdoor experience across landscape types whether that experience is walking down a sidewalk through a residential neighborhood, commercial area, or downtown street.

Additional favorite places submitted valued programming. Davidson's Mill Pond Park Earth Center in South Brunswick and Roosevelt Park in Edison were in the top answers due to programmed activities such as educational experiences, arts, and concerts. Outdoor places offer backdrops, educational opportunities, and leisure experiences. Enhancing local parks for potential programming can add more accessible neighborhood-scale programmed spaces throughout the County.

Figure 38: Photo Survey Results and Open Space



Although parks are the top answers for favorite outdoor spaces, Rutgers University Livingston Campus is a favorite outdoor place due to “this place holding an important memory.” College campuses hold a distinct cultural value unique to their community. Universities offer private open spaces with well-programmed uses. Memories and community establishment are closely associated with college campuses. Middlesex County has multiple college-campus associations in the North, Central, and South regions (Middlesex College, Rutgers University, and the James Forrestal Campus of Princeton University).

Figure 39: Rutgers University Livingston Campus Photo Survey Submission

Rutgers University Livingston Campus, New Brunswick; Photo Survey submission, 2021.

A linked narrative makes a place desirable and adds an intangible cultural value. People are willing to protect and frequent places with quality outdoor offerings and experiences that evoke emotional experiences. Not only is a narrative important and derived from memory and identity, but the community’s needs are essential to consider in outdoor space planning to foster positive memories and correlations. The following section pairs the notion of landscape narrative with community needs through the D 2040 Outreach assessment to assess the perception and cultural value of the existing County landscape offerings.

D 2040 Public Outreach

Middlesex County's landscapes, people, and municipalities are diverse, with distinct needs for open space, recreational activity, outdoor access, and the downtown experience. As shown in all D 2040 public outreach events, people named ideal places. They noted locations within the state, county, municipal parks, and downtown areas. They were even identifying their own homes. People expressed what they liked about these areas, desired to change, and how the quality of, and connections to, Middlesex County's landscape affected their lives. This analysis focuses on the D 2040 public outreach landscape components through cultural, recreational, and environmental topics. The responses analyzed paint the picture of the community's landscape perception.

Comment boxes revealed that Middlesex County residents enjoyed a variety of different place types, such as "small towns, rural areas, and urban places." [(63)] People expressed the desire to experience the "diversity of place types," with further specifications on the ideal downtown area. The desire to access quality downtown areas enhanced by open space connections was recurring. The *Set the Table* event captured community members' perceived perfect downtown.

> *"Our ideal community has a clean downtown with curb appeal; it is also safe and walking-friendly, access to mass transit, small, medium, and large retail options (excluding big box), generally business-friendly, well lit, diverse food/restaurant options, green and smart, theater and arts program, low taxes, quality education for all, and has parks and recreation."*
> *-Set the Table*

The ideal downtown includes green space, diverse retail options, entertainment, and cultural experiences closer to home. These components contribute to the demand for quality downtown areas which are the base for cultural community cores and centers. ***The CUES downtown inventory (Inventory chapter) identified 20 municipalities with downtown areas. Yet, a consistent comment noted by several community members was that their municipality lacked a downtown area or they lacked sufficient access to the existing downtown.*** One community member named a placemaking potential for downtown areas and listed Downtown Somerville in Somerset County as an example destination pedestrian street with a desire to see this emulated in Middlesex County.

> *"Create destinations, "placemaking" to act as economic anchors and attract investment; create more pedestrian malls (like the one in Somerville)" -Set the Table.*

Figure 40: Division Street Somerville Pedestrian Street, Somerset County

Source: CUES, Rutgers University. Photograph. 2021.

Fostering and enhancing existing downtown areas is essential to improve the user experience. Encouraging downtown growth where downtown areas are not readily accessible will greatly benefit Middlesex County's cultural landscape and expand the understanding of outdoor space. Access to downtown areas through safe walkability, trails, and public transportation is vital to downtown offerings. These offerings help ensure community members' access downtowns and can find or experience the local cultural core.

Open space offers high-quality outdoor gathering space. The D 2040 public outreach exemplified County members' high value for open space and associated needs. Participants want added open space closer to home with increased access. In some instances, programmed open space is only accessible by car and is much more challenging to access using public transportation. Improved access to open spaces and parks supports the need for a County-wide greenway that expands across the existing quality open space borders connecting people to outdoor gathering spaces.

"There are lots of parks, but reaching them requires a car… There should be greenways and open space connected with dedicated bikeways" – Set the Table

Open space and connections are essential for human health and well-being, but these corridors can support ecological habitats. Comment box participants (24) said that there is a need for more open space; some noted that land preservation is essential for Middlesex County's ecosystems. Land preservation through open space designations is crucial because it provides places to experience nature, land for wildlife, and many ecosystem services protecting our communities. These comments show that the community values healthy ecological landscapes.

There is a need for more open space and educational opportunities to increase awareness regarding ecological habitats such as wetlands. Wetlands (and other viable ecological habitats) exist on private and public properties. The community expressed the need for a more robust, ubiquitous understanding of these landscapes and habitat-specific management needs.

"Develop conservation in and education for the wetlands" -Set the Table

Open space and conservation are essential for landscape preservation, but recreational offerings are necessary for the growing Middlesex County community. Many people supported the need for enhanced recreational opportunities by wanting more inclusive and age-appropriate amenities such as more benches and intergenerational activities in parks, more trees throughout the landscape, and increased water access locations, specifically along the Raritan River. People genuinely enjoy the water features throughout the County but desire more kayaking, swimming, and boat docking locations along Middlesex County's waterways.

"More access to the Raritan River with trails and kayaking/water access" – Set the Table

Trails in parks and nature walks are great opportunities to increase recreational activities, but a County-wide trail network offers added advantages beyond recreational usage. Providing safe pedestrian travel away from busy roads will enhance pedestrian circulation. People require safe pedestrian travel to work, home, and leisure places. Ensuring pedestrian and cyclist safety measures make a place ideal to live where residents feel safe. Enhancing pedestrian safety across parking lots and providing more direct alternative routes away from busy roadways will improve pedestrian experiences. Additionally, pedestrian travel can link across municipalities to cultural centers and parks through a greenway network providing an active transportation route.

Pedestrian safety is essential. Roadways are often unsafe for walking and, at times, not well lit. Direct pedestrian and bicycle paths to open spaces, places of work, and places for other everyday needs will be more convenient for community members without a car. Participants of the *English as a Second Language (ESL)* outreach event noted that travel around the County was difficult and limited when they did not have a car. Providing safe pedestrian and bicycle paths throughout the County is essential to incorporate the needs of all populations.

> *"More walkable areas, connections for commuters when parking is limited, more bike and walking trails, connect to downtowns through trails" -Set the Table*

Consistent mention of parking lots occurs in public outreach. People commonly discuss the need for more parking and pedestrian safety in parking lots. Limited parking links to high population density and connecting people to commuter lots through a greenway network is an opportunity to enhance user experiences. Landscape features incorporated into parking lot design will improve pedestrian safety and support the growing demand for "open-air activities" by temporarily converting lots to outdoor space, enhancing the visual experience and landscape function. The parking lot design can have designated pedestrian paths and areas seen in ***Figure 41*** at a shopping plaza in North Brunswick.

Figure 41: Pedestrian Friendly Shopping Center in North Brunswick

Source: CUES, Rutgers University. Photograph. 2021.

Municipal Engagement

Professional municipal representatives provide a transparent view of the community's needs at the site-specific and municipal scale. The municipal engagement meetings helped the research team understand the professional and municipal representative's opinions of their residents' needs. The main themes addressed at the municipal engagement meetings were ecological, ecosystem services, cultural resources, and a potential greenway network throughout the County.

Municipal representatives noted the need for homeowners' ecological habitat education, flood management priorities and interventions, preservation priorities, and greenway opportunities. Plainsboro and Piscataway representatives mentioned the importance of open space in municipal parks, large County parks, preservations, and farmland preservation. Old Bridge representatives stated that wetland property owners are unaware of the best land management strategies for wetland habitats, while many municipalities expressed concerns about future flooding. ***All municipal engagement participants agreed that a greenway or greenway extension would benefit their community.***

Cultural Landscape Perception Summary

Public engagement is an appropriate method to understand the communities' cultural perception of the landscape. Photo Survey responses revealed that identity and memories link narratives to a place through emotional responses. These emotional responses apply an intangible cultural value to the County's cultural landscapes. Connections to nature, memories, and viewsheds are why people named their favorite outdoor place through the ***Nature & Place.*** Photo Survey. Fostering connections between outdoor spaces, highlighting their viewsheds, and considering private open spaces such as university land in planning are essential components for establishing community connections and supporting better-quality open and outdoor spaces.

D 2040 public outreach exposed the cultural expectations from outdoor spaces through shared group values expressed in various outreach components. Municipal engagement meetings portrayed the local government's representation of the community's needs aligned with D 2040 public engagement comments. The outreach components showed the community's perspective on quality downtown place types, open space needs, pedestrian safety, recreational enhancements, viewsheds, and greenway opportunities.

People expressed the desire to experience the "diversity of place types" across Middlesex County's diverse landscapes through food choices, shopping experiences, and cultural events. Many expressed their desire for safe, clean, and exciting downtowns that they could easily access. Although many people wanted the experience downtown, few noted the high quality of the current downtown offerings in the County.

Open space is significant to Middlesex County community members, and participants want additional open space closer to home with increased access. Participants noted the ecological value, the need for more trees, and the views framed by the landscape. People require safe pedestrian travel to work, home, leisure, and recreation places. Roadways often appear as unsafe for walking and, at times, not well lit. Providing safe pedestrian and bicycle paths throughout the County is crucial to incorporate the needs of all populations.

The need for a County-wide greenway network is clear, and there is a strong desire. Community members mentioned that a greenway system would provide safe pedestrian and bicycle travel and recreational opportunities. A greenway is a vital link to connect people to outdoor spaces and their communities and provide safe pedestrian and cyclist travel. The *Action* chapter outlines the greenway opportunities, which is a supported idea by municipal representatives throughout Middlesex County.

Nature and Place

Nature's ecological habitats provide ecosystem services benefiting humans. Ecological habitats, recreational purpose, and aesthetic value connect to humans by defining a culturally understood meaning of outdoor space. These aesthetic and recreational values provide people with invaluable 'cultural services.' Cultural Services include aesthetic inspiration, cultural identity, sense of home, and spiritual experience, which were evident reactions to outdoor space in the photo survey. [64] The landscape's cultural service experience links a narrative to an identifiable and valuable place thus forming the social interpretation of the cultural landscape.

Natural landscape enhancements support healthy ecological function and positive perception. Ecological enhancements support safer living conditions through air filtration, water filtration, water storage, beneficial wildlife such as pollinating insects, promoting human health and well-being through mental and physical experiences, etc. While supporting function, ecologically viable landscapes increase sensory experiences through the five human senses.

The idea of the cultural landscape links nature and places through the human experience, redefining the limits of the cultural landscape beyond the literal connection to wild nature and interweaving natural processes and functions into everyday landscapes. The cultural landscape brings the experience and function of nature to cities (built areas) through *landscape urbanist* ideals. James Coroner defines the core concepts of landscape urbanism as "the ability to shift scales, situate cities in their regional and biotic contexts, and design relationships between dynamic environmental processes and urban form." [65] Meaning the city design should complement and support the surrounding ecological habitats and vice versa on all scales, considering the relationship to surrounding wetlands or rain gardens along the streetscape.

As Fredrick Steiner states, "We [designers and planners] continue to sort out the place of nature in the city." [66] As landscape designers and planners, we must consider the role our everyday landscapes play in supporting ecological function. How does the individual homeowner's yard impact ecological function, and how are cultural ideals influencing said function? Landscape influencers, ***Table 12***, directly affect the role of nature in cities by defining cultural expectations enacted through trend acceptance, ordinances, and laws.

Nature and place are directly linked to dynamic systems impacting the success of each other. Valuing landscapes expresses the importance of protecting ecosystems while ensuring high-quality cultural spaces. To enhance ecological function, cultural perception must shift to a demand for higher expectations from our natural spaces, cities, and the intermittent gradient. This will redefine cultural expectations of our surrounding cultural landscapes, supporting human health, well-being, and overall enjoyment.

Figure 45: Humans and Nature

Source: ***Nature & Place.*** Photo Survey Submissions. 2021.

Ernest L. Oros Wildlife Preserve, Woodbridge. (Left) Deer on path; (Right) Children viewing lake habitat.

Cultural Landscape Summary

The traditional understanding of cultural landscape is a historically relevant outdoor space connected to nature. This analysis incorporated the National Park Service's definition of cultural landscapes and expanded it to include the use of everyday landscapes in their current context. We have learned that Middlesex County's outdoor spaces are precious to the community as places that connect us to the County's heritage and as sites for self-identity, memory formation, gathering, and essential ecosystem services. This analysis first studied the traditional heritage components through history, viewsheds, place characters, and municipal downtowns. Then studied the community's perception through outreach analysis linking a narrative to place, solidifying a call to action and revealing the undeniable connection between humans and nature through *Nature* and *Place* research.

Key findings from this section reveal that Middlesex County's cultural landscape features and assets range in character, defining various sections across the County such as downtown character, place types, viewsheds, and historic areas. Culturally accepted design standards accompany historic districts and properties by preserving their historical and cultural aesthetics. Arts and cultural centers such as museums and historic, revolutionary battle trails marked throughout the County's landscape narrate the area's history. Eight linear historic districts exist in Middlesex County with potential for outdoor spaces connecting people directly to the County's historical culture. It is important to consider maintenance methods to keep historic character intact that may eventually be subject to redevelopment and consider how developing history factors into the County's landscapes representing the County's diverse population.

Viewsheds are cultural landscape characteristics framing the County's landscapes, such as agriculture, waterfronts, wetlands, forests, parks, urban areas, and industrial skylines. Specific to Middlesex County, viewsheds include the Raritan River and Arthur Kill waterfronts, the south's agricultural heritage, wetland landscapes, and suburban parks. Viewshed protection is essential to maintain access to the County's visual character experience.

The *Character of Place* analysis focused on the physical characteristics falling under broad land use categories residential, commercial, industrial, barren, agriculture, open space, and mixed-use. Specific landscape types include high-low-density residential, urban agriculture, rural agriculture, warehouses, refineries, strip malls, standalone commercial buildings, shopping plazas, natural parks, social parks, downtown areas, and more. The cultural landscape types provide an organizational structure for action implementation in the *Actions* chapter, further discussed in the *Landscape Types* section.

The *Downtown Character Analysis* revealed the character of 20 municipal downtowns connected to open spaces, highlighting six historic downtowns. Population density informed three downtown types: Urban City Center (2), Suburban Town Center (16), and Rural Village Center (2). The analysis highlights the importance of a downtown coalition working to improve the downtown experience, such as in Highland Park and Metuchen.

Public engagement reveals the communities' cultural expectations of the landscape. Photo survey responses indicated that identity and memories link narratives to a place through emotional responses applying an intangible cultural value to the County's cultural landscapes. Connections to nature, memories, and viewsheds are all leading factors why people named their favorite outdoor place in the ***Nature & Place.*** Photo Survey.

D 2040 public outreach showed the cultural expectations from outdoor spaces through shared group values expressed in various outreach components, such as the community's perspective on quality downtown place types, open space needs, pedestrian safety, recreational enhancements, viewsheds, and greenway opportunities. At the same time, the municipal engagement meetings solidified the need for a County-wide greenway system as a vital link to connect people to outdoor spaces and their communities supporting the strong link between nature and place.

OPEN SPACE AND RECREATION

The CUES team completed the Middlesex County Open Space and Recreation Plan (OSRP) technical update in close coordination with the Middlesex County Office of Planning, also known as the D 2040 ***Open Spaces*** functional plan. The plan received approval from the Middlesex County Planning Board on February 8, 2022. This report includes a summary of the OSRP results to inform the proposed ***Nature & Place.*** *Actions* chapter.

The open space definition originates from the OSRP. Open space is land that is accessible to the public and designed for recreation, habitat preservation, or both. Open space includes parks, nature preserves, greenways, and other intentional land preservation efforts. The OSRP identifies existing open spaces through GIS inventory; projects open space needs through GIS analysis and potential open space opportunities through GIS weighted overlays resulting in ranked parcels for preservation. The North Jersey Transportation Planning Authority (NJTPA) population growth projections (2015-2045) informed the analysis, concluding that the County needs additional open space to sustain human well-being and preserve habitat for a growing future.

Priority open space opportunity areas highlight locations in the County that contain valuable habitat and can serve as essential recreation locations for County residents, ***Figure 46***. The OSRP extensively inventoried and calculated ten definitive categories to identify these areas, including open space needs, development risk, flood mitigation areas, ecological habitats, water resource areas, and more.

The OSRP update fulfills the New Jersey Department of Environmental Protection (NJDEP) Green Acres Planning Initiative funding category mandate and follows NJDEP's OSRP guidelines. The OSRP establishes a philosophical and practical justification for protecting and preserving open space and recreation opportunities extended in this plan outside of park boundaries. Deviating from the previous OSRP from 2003, Middlesex County addresses farmland preservation in a separate Farmland Preservation Plan.

As part of the Middlesex County Destination 2040 strategic planning process, the OSRP goals align with the Destination 2040 Master Plan goals:

- *Provide a public system of major parks and open spaces that forever preserves sufficient land to accommodate a variety of recreational activities and conserve scenic, historic, cultural, and environmental features to enhance the quality of life for County residents.*
- *Assure that adequate recreational facilities are available to meet the needs of residents.*
- *Provide programs and facilities to ensure opportunities for cultural and heritage appreciation.*
- *Promote healthy and safe social and physical environments.*
- *Preserve and steward natural resources and wildlife habitats.*
- *Prepare for climate change.*
- *Enhance community resilience.*
- *Support residents in attaining their full health potential.*

To outline the future of open space and recreation in Middlesex County, the OSRP:

- Identified existing open space in Middlesex County
- Located areas in need of additional open space
- Identified essential resources for future open space
- Guided priority open space opportunities

Preserved open space makes up about 15 percent of Middlesex County's land. The County owns and maintains one-third of the open space. The municipal governments, the State of New Jersey, non-profit organizations, and private owners hold two-thirds of the preserved open space. Continuing coordination between authoritative entities to provide open space opportunities for Middlesex County will remain critical to the County's future open space expansion. Middlesex County is highly developed (60 percent urban land use), which gives open space land preservation a high urgency.

Methods such as preserving more open space or providing better access to existing open spaces will help satisfy the County's open space needs. Geographic Information Systems (GIS) modeling and recreation facility inventory determined the open space needs in the County. The research team identified existing recreational facilities and compared them to current and future population trend data.

The open space resource assessment outlines a conceptual vision for greenway opportunities (further discussed in the *Actions* Chapter) and locations suitable for future open space opportunities, ***Figure 46***. Using open space funds to secure and preserve critical ecological habitats and equal opportunity for open space and recreation options for County residents are strategic initiatives in the Destination 2040 planning process.

An action plan guides the implementation of the OSRP findings. The report separates the action items into short-term (1-2 years), medium-term (3-5 years), and long-term actions (5+ years) as follows:

Short-term goals (1-2 years)

- Develop a Landscape and Ecosystem Services Plan
- Develop a county-wide greenway network concept
- Create feeder bike lanes to the existing Middlesex Greenway
- Middlesex Greenway Extension
- Identify priority acquisition areas
- Review and Update Park Maintenance Regimes
- Identify strategies to address sea-level rise in existing parks
- Focus on acquisition in communities impacted by climate change
- Golf course management review
- Improve open space access for County Parks and work closely with State and Municipal governments to provide better access to State and Municipal open space
- Review the park categories to coordinate the management and marketing of parks more effectively

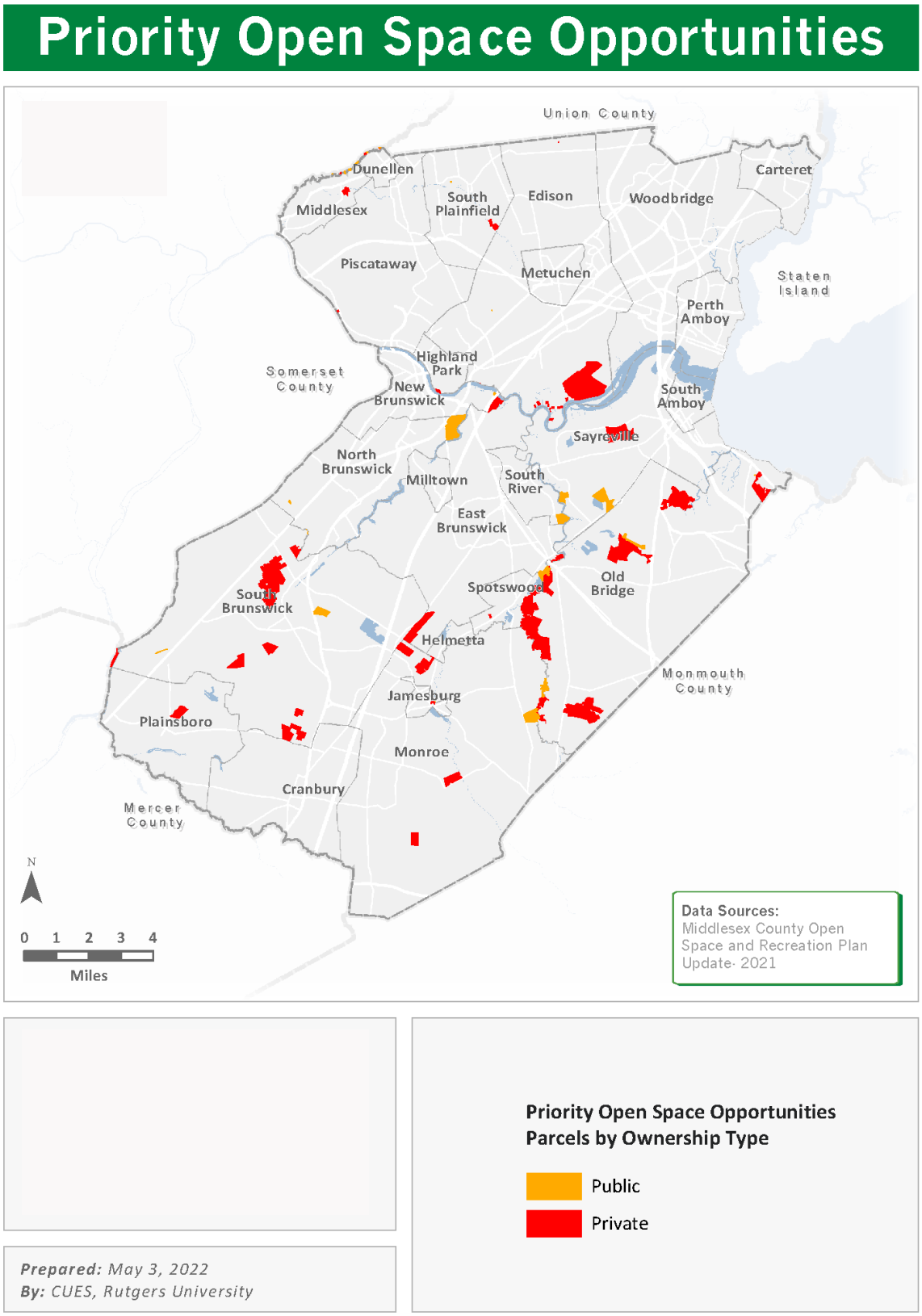
Medium-term goals (3-5 years)

- Identify landscape conditions through a Landscape and Ecosystem Services Plan
- Review the organization and overall amount of parking in County Parks
- Implement porous pavement in County Park parking lots
- Explore Middlesex County Welcome Center

Long-term goals (5+ years)

- Develop a Greenway Working Group
- Incorporate preservation areas into investment areas
- New construction of relocated County Park Facilities

Figure 46: Priority Open Space Opportunities



Additionally, the OSRP report includes Park and Conservation Area profiles for County-owned open spaces. These profiles provide basic information about the park, key attractions, facilities in the park, possible opportunities for improvement, a park map, and park photos. Example observations and possible improvements include sharing the road signs on park roads to accommodate bikers and planting vegetation around some of the streams to help stabilize the banks and prevent erosion.

The OSRP contains three main items aimed at advancing open space and recreation goals:

1. Identify and outline current open space and recreation opportunities in Middlesex County.
2. Guidance in locating open space opportunities.
3. Suggestions for managing County Parks under climate change considerations.

The *Integrated Cultural Landscape and Ecosystem Services Plan* (***Nature & Place.***) expands from the OSRP park inventory, analysis, and action plan to consider all 200,000+ acres of the County's landscape for intervention. The OSRP informed analytical categories and processes seen in the *Ecosystem Services Analysis.* Originally derived from the Landscape and Ecosystem Services Planning Action, this plan utilizes the park inventory to inform a full County ecosystem service and cultural landscape inventory (*Inventory* chapter), analysis (*Analysis* chapter), and action plan (*Action* chapter).

The ***Nature & Place.*** plan further assesses and incorporates multiple OSRP components with aligned goals, such as the Greenway Opportunities, further comprising municipal feedback and reassessment based on the research team's site visits. The result is a complex Greenway Opportunity network outlined in the *Actions* chapter. Additional incorporations include open space priority areas shown in ***Figure 46*** and open space landscape types developed through the OSRP, namely the revised park categories natural parks, social parks, neighborhood parks, sports parks, golf courses, and greenways (*Landscape Types* section).

The OSRP assessed the population's needs for open space and open space access. This plan stems from assessing ecosystem service capabilities of all County landscapes and delivers actions to protect undeveloped land for recreational and ecosystem service use. The following section provides an in-depth land at development risk analysis initially located by the OSRP overlay mapping techniques.

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LANDSCAPE THREATS

Middlesex County's industrial history and land use transformation, outlined in the *Land Use and Land Cover* section of the *Inventory* chapter, revealed the rapid urbanization of the County's landscape. Rapid urbanization threatens natural resources suppressing both ecosystem and cultural landscape value. The County's ideal location in central New Jersey and economic prosperity will cause continual growth and urbanization.

Considering open space and natural landscape preservation early in the planning process will maintain the County's quality of life while supporting the County's growth. Environmentally conscious planning is essential to lessen the damages caused by flooding and to preserve viable ecological habitats and potential land for recreational opportunities. It is crucial to maintain the landscape's cultural value because it contributes substantially to the County's attractiveness. This section analyzes Middlesex County's natural land at development risk, considers the existing base zoning identified as at-risk areas, and examines the land cover type at risk of development.

Figure 47: Forested Land for Sale

Source: CUES, Rutgers University. Photograph. 2021.

Land at Development Risk

Natural land in Middlesex County consists of vacant land, wetlands, agriculture, and forested land cover. The *Handbook for New Jersey Tax Accessors* defines vacant as "land above and underwater in its original, indestructible, immobile state. It is idle land, not actively used for agriculture or other purposes. It is unused acreage, approved subdivided land, or held for sale." [(67)] Vacant land is sometimes home to ecological habitats and provides ecosystem services to the surrounding area. Wetlands (including wetland forests) and upland forests contain valuable habitats inside and outside preserved open space and farmland boundaries. From an economic growth and municipal ratable perspective, these lands are ideal opportunities for building homes, businesses, and infrastructure. Therefore, municipal zoning approves most of the upland forests for development, creating a threat of natural land loss and resulting in a higher flooding risk.

Although various wetland laws and regulations protect wetlands, upland forests suffer a heightened risk of development as this habitat does not contain the same regulatory status as wetlands. Wetlands, buffers, and transition zone protection occur through the *Clean Water Act 404* (under Federal authority, enacted by the NJDEP) and the *Freshwater Wetlands Act* (NJDEP). The *US Endangered Species Act (ESA)* and NJDEP *Endangered or threatened wildlife or plant species habitats* designations can provide tools to protect upland forests. [(68)]

Non-preserved agricultural land has no level of protection. Landowners can sell agricultural land for development at their discretion. The New Jersey Farmland Preservation Program (NJFPP) offers an opportunity to preserve and protect the County's farmland through resources and grants. [(69)]

Land at development risk encompasses natural and vacant land in Middlesex County identified and scored through a Geographic Information Systems (GIS) ranking process (ranks 3-0) ***Figure 48, Table 8.*** The highest-ranked parcels (3) consist of undeveloped land zoned for development within a wastewater service area. The second highest-ranked parcels (2) are undeveloped lands zoned for development outside a wastewater service area. A lower rank (1) applies to undeveloped properties not zoned for development. In contrast, the lowest score (0) applies to preserved or "urban land" parcels. ***Figure 48*** differentiates open space and preserved farmland from urban land (0), further showing that development zoning occupies almost all available land.

Figure 48: Land at Development Risk

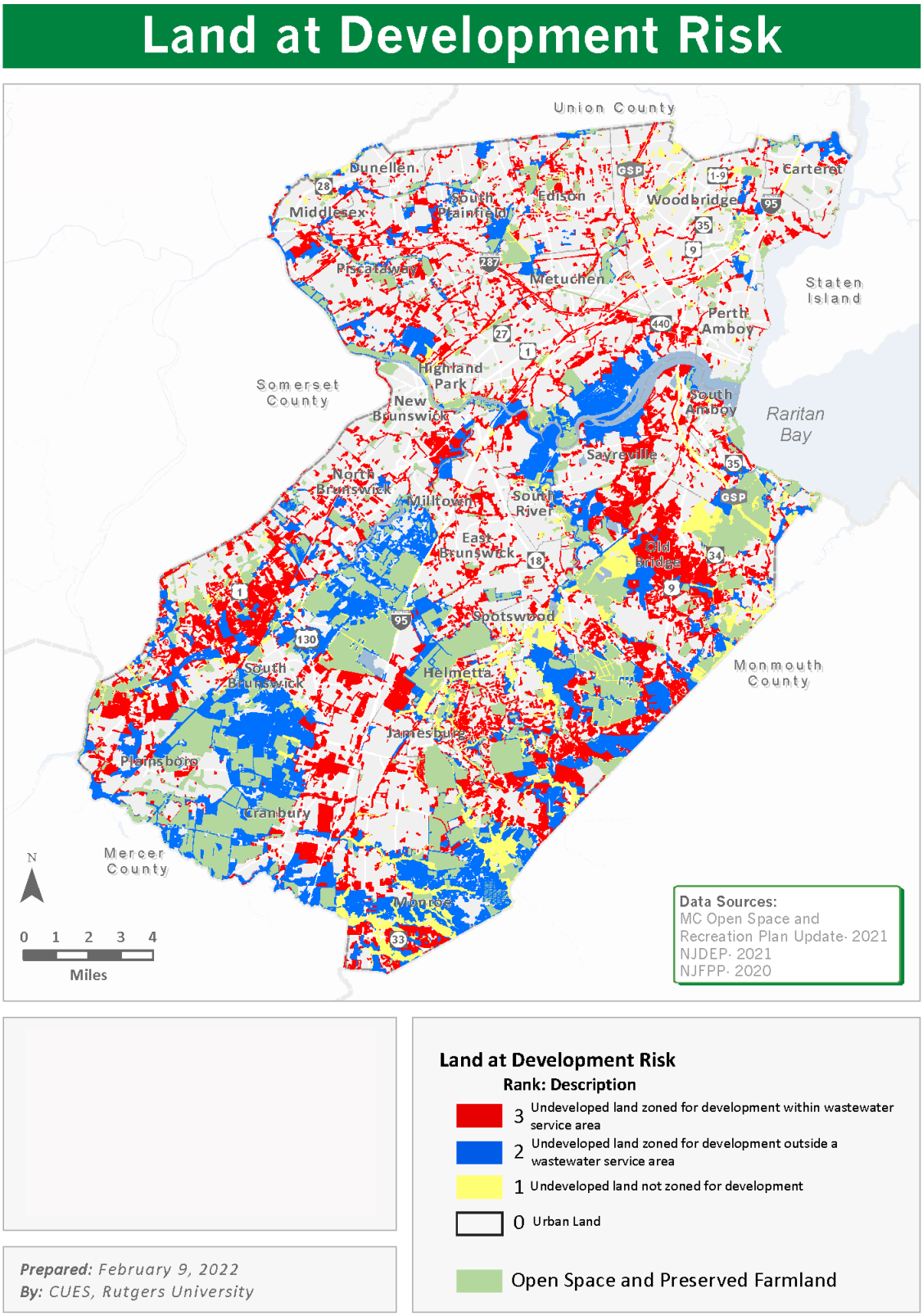


Table 7: Land at Development Risk ranks and descriptions

Land at Development Risk rank	Description
3	Undeveloped land zoned for development within wastewater service area
2	Undeveloped land zoned for development outside a wastewater service area
1	Not zoned for development
0	Preserved or "urban land" NJDEP land use (2015) category

Source: Middlesex County Open Space and Recreation Plan Update, 2021. Pending Approval.

Undeveloped land exists across the County's landscape, with the highest-ranked parcels (3) at development risk. Still, clusters occur along U.S. Route 1, in the southern County, along Route 287 in Piscataway, and Old Bridge Township (not limited to these areas). *Rank* 3 parcels exist in industrial, commercial, and residential zones, ***Figure 50***. For example, Edison Township has *Rank* 3 risk level areas throughout residential zones. Comparing ***Figure 48***, in Edison, with tree canopy cover in ***Figure 11*** and urban heat islands in ***Figure 12*** shows the correlation that the *Rank* 3 risk areas have a higher tree canopy cover density. This higher cover is presumably one of the factors resulting in lower surface temperatures in the surrounding areas. This correlation exemplifies the need for protecting natural and forested land cover to benefit from their ecosystem services.

Rank 2 parcels across the County occupy all zoning types. A notable example is the larger contiguous *Rank* 2 area identified along the Raritan River spanning from Sayreville and South River (South) and Edison and Woodbridge (north), ***Figure 48***. The mentioned area consists of wetlands and forested areas and is currently industrial/commercial zoned, ***Figures 50 and 51***. It is essential to monitor the spread of impervious surfaces in this area. These locations make up a core part of the *Rank* 3 priority flood mitigation area, evidenced in ***Figure 5***. In conjunction, ***Figure 5*** and ***Figure 51*** show that the flood-prone site is currently wetlands and identified as a *Rank* 2 risk of future development. Enforcement of the Flood Hazard Area Control Act Rules (N.J.A.C. 7:13) and the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A) is essential to protect the ecosystem service capabilities of this natural area to support flood risk reduction and habitat value. [70, 71]

Not currently zoned for development, *Rank* 1 areas have the least severe development threat and may contain "conservation zoning" by individual municipalities. These non-targeted areas encompass only 3 percent of the County, ***Table 8***, and potentially act as "low lying fruit" for natural land protection. *Rank* 1 areas are denser in the south and include the forest and wetlands in Old Bridge nestled between N.J. Route 18 and U.S. Route 9. Additional *Rank* 1 locations surround N.J. Route 33, Monroe Township, and small areas along U.S. Route 1, Plainsboro, ***Figure 48***.

The northwest has less land area of higher-ranking land at development risk. Still, these undeveloped lands can play an integral role in high flood-prone areas along the Raritan River tributaries such as the Ambrose Creek and Bound Brook, and serve as ecological and greenway corridors. In Middlesex, Piscataway, South Plainfield, and Dunellen, at-risk parcels occur more widely in industrial and commercial-zoned areas shown in ***Figure 50,*** like the *Rank* 2 properties on the northern waterfront, Carteret. These ranked areas show the potential for incorporating conservation and best land management ordinances into industrial and commercial redevelopment projects and potential incentives for retrofit scenarios.

Overall, the County's southern half has more undeveloped land at development risk than the North. As evidenced by the *Land Use Land Cover Inventory*, the County's northern half has more urban land cover and uses. More agricultural lands and wetlands occur throughout the South, resulting in natural land at risk of development, ***Figure 51***. Although various laws protect wetlands, there is still potential for zero net fill development and minor land alterations (discussed previously in the Wetlands and Buffers section). Agriculture land at risk of development may contain pasturelands, meadows, etc. If not preserved or in wetlands, these lands have minimal to no protection, potentially subject to future development. The overlap between *Rank* 3 agricultural land at development risk with industrial and commercial-zoned areas is evident in the South along Interstate 95, ***Figures 50 and 51***.

Figure 49: Forested Lands for Sale

Source: CUES, Rutgers University. Photograph. 2021.

Figure 50: Land at Development Risk and Base Zoning

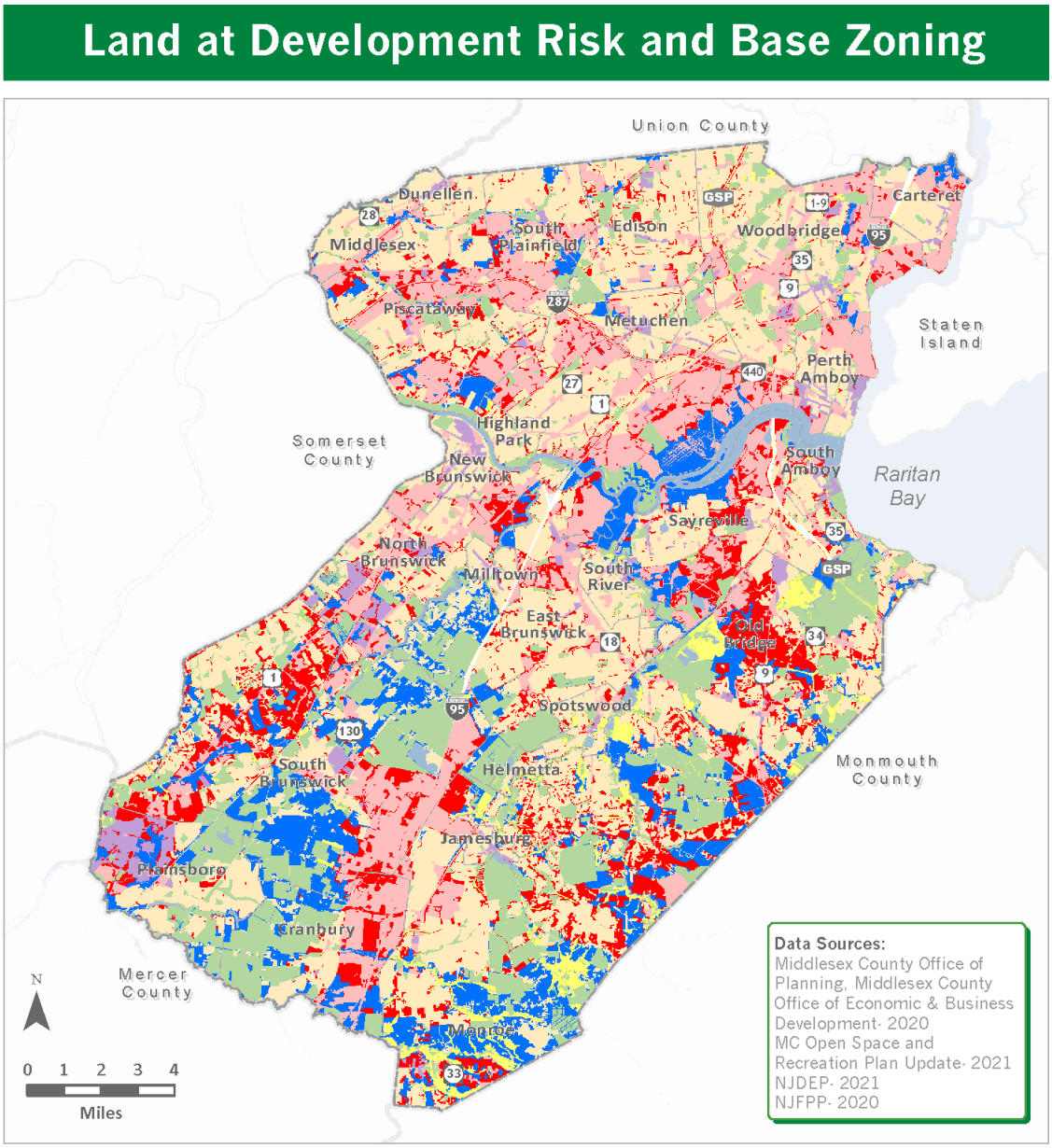


Table 8: Acreage of Land at Development Risk Ranks

Land at Development Risk rank	Rank total acres	Percent of total
3	22,548	13%
2	21,770	13%
1	5,802	3%
0	122,284*	71%
Total	172,404**	**100%**

Source: Middlesex County Open Space and Recreation Plan Update, 2021. Pending Approval.
PCS: NAD 1983 State Plane New Jersey FIPS 2900 Feet
* Urban Land Use Land Cover (2015) acres without preserved open space or farmland.
**The total acres derived from ArcGIS field calculator without preserved open space or farmland.

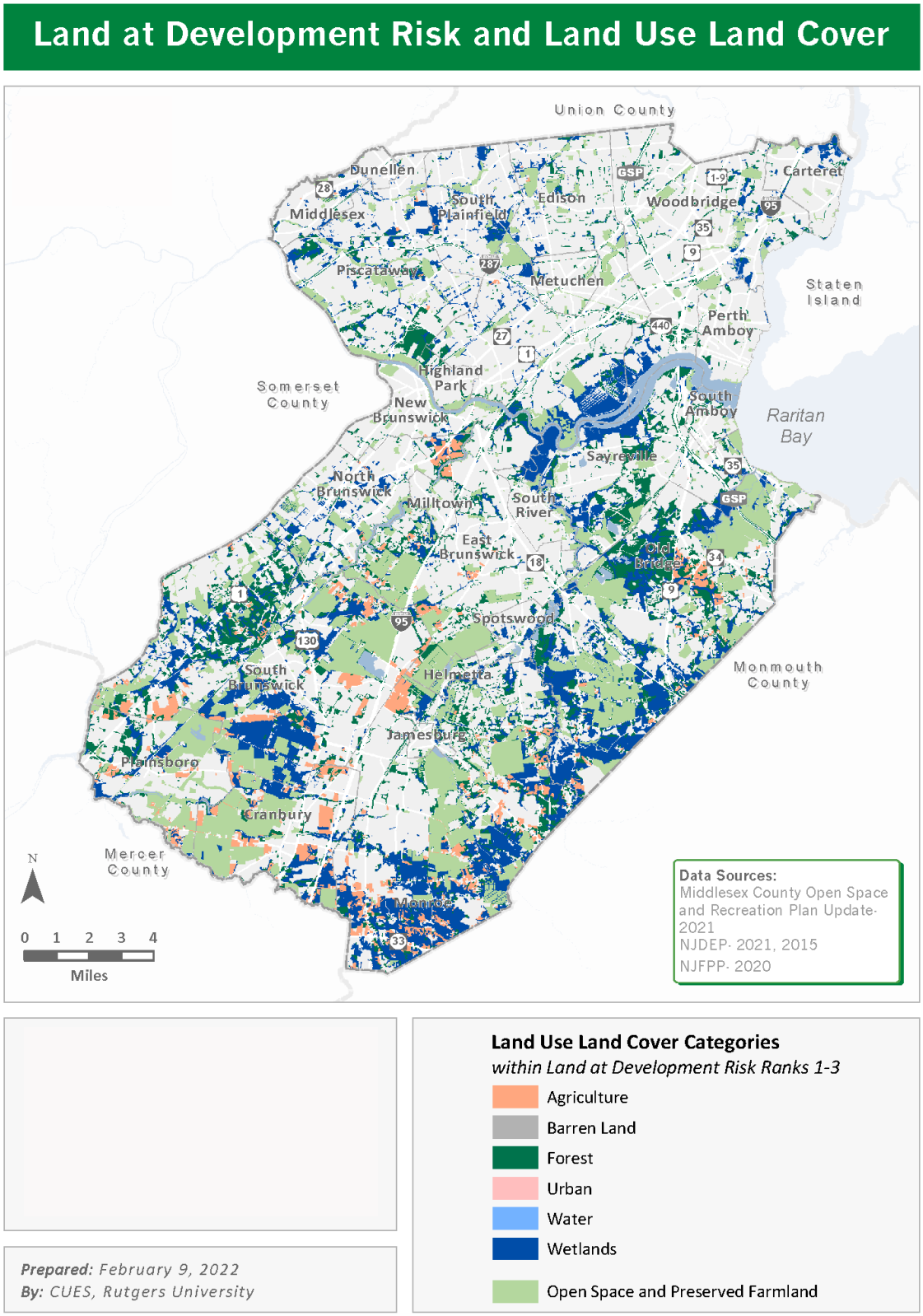
The research team identified over 22,000 acres of Middlesex County's landscape as the highest-ranking (3) land at development risk areas, ***Table 8***. *Rank* 2 areas occupy nearly 22,000 acres of the County's landscape not within a wastewater service area. *Rank* 1 areas occupy almost 6,000 acres and lack development zoning, making these areas ideal for preventative action before potential development designation approvals occur.

Table 9: Acreage of Land Use Land Cover, Land at Development Risk by Ranks

Land at Development Risk rank	Agriculture (acres)	Barren (acres)	Forest (acres)	Urban* (acres)	Water (acres)	Wetlands (acres)
3	3,818	20	11,356	467	23	6,860
2	2,116	8	4,457	133	68	14,986
1	6	2	1,685	46	31	4,031
Total	**5,940**	**30**	**17,498**	**646**	**122**	**25,877**

Source: Middlesex County Open Space and Recreation Plan Update, 2021. Pending Approval.; NJDEP, Land Use Land Cover 2015, ESRI GIS Field Calculator acres; PCS: NAD 1983 State Plane New Jersey FIPS 2900 Feet
*Urban land removed from the analysis, however, minor acreage remained in the overlap from the erase tool.

Figure 51: Land at Development Risk and Land Use Land Cover



The goal is to acquire land with high ecological and ecosystem service value (forests and wetlands) at development risk with open space preservation status to protect ecosystem service capabilities and ecological habitats. ***Table 9*** and ***Figure 50*** show that the forest and wetland land cover encompass the most acreage of land at development risk in *Rank* 2 and 3 areas. However, open space acquisition is not always appropriate in a growing community. Suppose non-desired open space acquisition for a particular parcel or area takes place. In that case, it is essential to consider conservation and best land management practices in unison with development and redevelopment efforts to deter people from living in environmental risk areas. Best land management strategies will preserve and conserve viable ecological habitats and corridors.

The ranking exercise clarifies that there are still undeveloped natural lands in Middlesex County worth protecting. Natural land cover is subject to degradation without additional protection, especially upland forest habitats. Environmentally conscious land use planning at a regional scale can support economic growth and land conservation efforts to protect the County's natural land and incorporate open space and reforestation efforts into new and existing development.

Figure 52: Disturbance Near Wetlands and Forested Area, Edison

Source: CUES, Rutgers University. Photograph. 2021.

Land at Development Risk Summary

Natural land in Middlesex County consists of various land use covers, including vacant land, wetlands, agriculture, and forests. The natural land outside of preserved open space and farmland holds a potential development risk. Land at development risk encompasses natural and vacant land in Middlesex County identified and scored through a Geographic Information Systems (GIS) ranking process (ranks 3-0), ***Figure 48, Table 7***.

Undeveloped land exists across the County's landscape, with the highest-ranked parcels (3) at development risk. Undeveloped land exists in clusters along U.S. Route 1, in the south, along Route 287 in Piscataway, and Old Bridge Township (not limited to these areas). The Raritan River spanning from Sayreville and South River (south) and Edison and Woodbridge (north), ***Figure 48,*** occupies a contiguous *Rank* 2 area. *Rank 1* areas not zoned for development have the least severe development threat and may benefit from municipal conservation zoning (discussed in the *Actions* chapter). The northwest has less land area of higher-ranking land at development risk as it is highly urbanized. However, smaller undeveloped land parcels can play an integral role in high flood-prone areas similar to the northeast. Overall, the County's southern half has more undeveloped land at risk of development than the north. More natural land is still intact in wetlands, forested areas, and even rural landscapes.

Between *Ranks* 1-3, there are roughly 50,000 acres of land at development risk. The research team identified over 22,000 acres of Middlesex County's landscape as the highest-ranking (3) land at development risk in ***Table 8***, followed closely by *Rank* 2 areas with roughly 22,000 acres. *Rank* 1 areas occupy almost 6,000 acres without development zoning, establishing these areas as ideal locations for preventative action before potential development approvals occur. Wetlands, protected by NJDEP, comprise over 25,000 acres (half) of the land at development risk, ***Table 9***. In contrast, upland forests occupy roughly 17,500 acres with minimal-zero protection, followed by unprotected agricultural land occupying nearly 6,000 acres. The research team's assumption concludes that a completely built-out scenario will occupy Middlesex County in the near future for unprotected natural lands.

Land acquisition is the ideal method for protecting undeveloped natural land. Landscape management strategies and conservation easements are also beneficial for protecting ecological habitats and cultural landscapes. The landscape varies in types and uses, leading to various appropriate methods for landscape preservation. The following section outlines multiple landscape types. The landscape types provide a unique framework for action interventions outlined in the *Action* chapter. Each landscape type has distinct methods to preserve and manage natural landscapes to decrease the landscape threat of development to the County's precious natural landscapes.

LANDSCAPE TYPES

Land use and physical characteristics of the landscape lead to landscape types which range from industrial landscapes to natural areas. Landscape type categories provide an organizational structure for Middlesex County's varied landscapes. Landscape types fall under various land use categories subdivided into cultural landscape types; a term developed through this plan. Cultural landscape types portray the understood use and structure of the landscape associated with each land use category identifiable through the cultural use of each space. The landscape type approach provides a structural framework to organize action implementation, further detailed in the *Actions* chapter, enhancing landscape performance and cultural value.

Land Use Types

The Land Use types are broad categories that utilize the New Jersey Tax Assessors' tax-parcel classifications and NJDEP's land use zoning categories, ***Figure 53***. These categories include residential, mixed-use, commercial, industrial, barren land, agriculture, and open space. ***Table 10*** lists the land use types with definitions and total acreage calculated in GIS. Land Use types are based on current, broad, base zoning that does not always represent the true nature of the ground plane falling within each category.

Table 10: Land Use Types, Definitions, and Acres

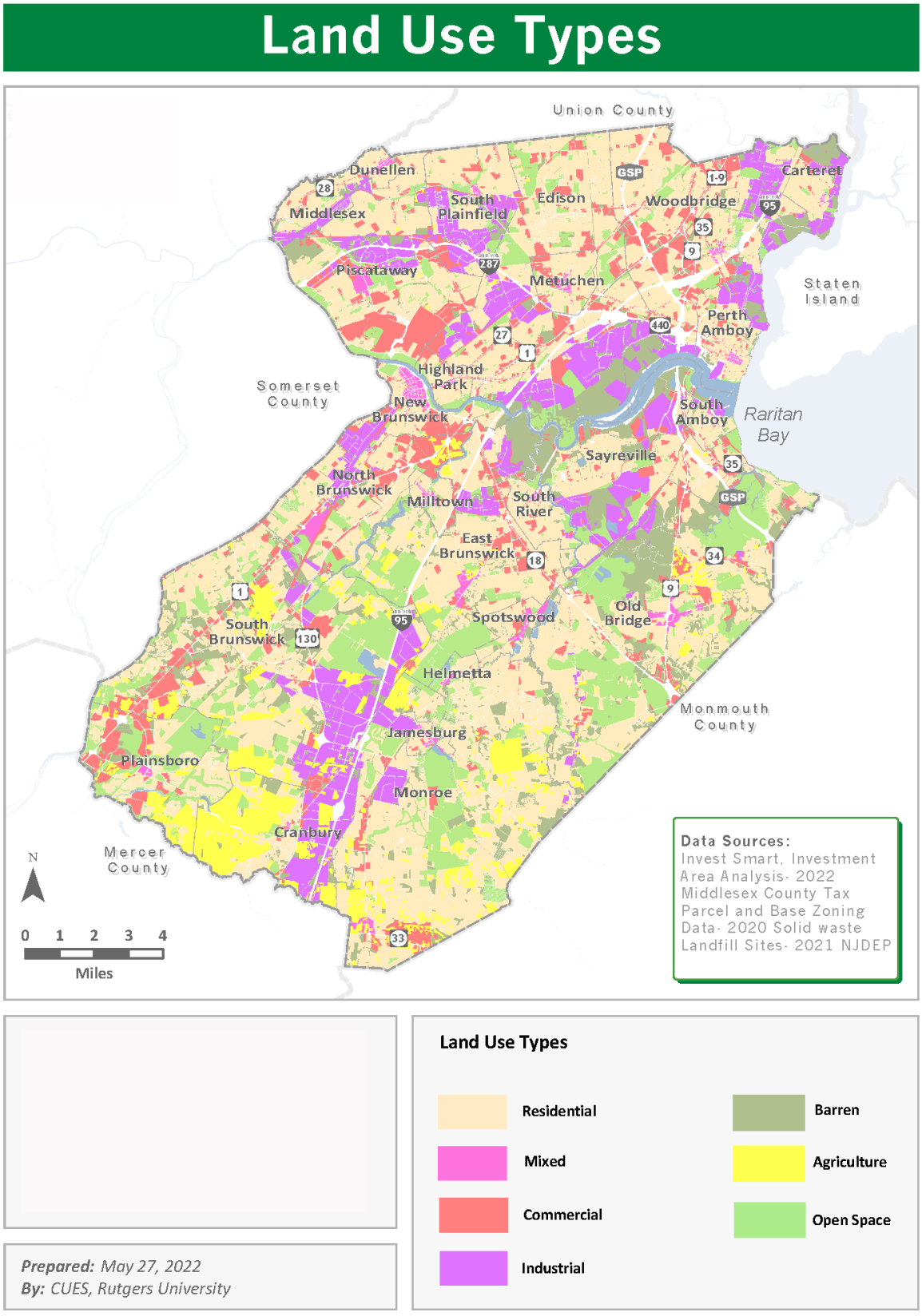
ID #	Land Use Category	Definition	Acres	Percent of Total
1	**Residential**	Single-family and multiple dwelling housing units classified by density and acreage size	86,407	44%
2	**Mixed-Use**	Areas with mixed commercial and residential land use typically with commercial on the first floor and residential above. Middlesex County's mixed-use area groupings categorize different downtown types.	2,028	1%
3	**Commercial**	Areas and buildings that primarily provide goods and services for the community, such as shopping, schools, and other service-related activities.	20,669	10%
4	**Industrial**	Industrial areas include heavy, and light industries and are production, manufacturing, and processing places. The heavy industry involves processing raw materials such as petroleum or coal, whereas "clean" production and storage involve light industrial practices such as warehouses and storage yards.	20,527	10%
5	**Barren**	Barren land contains thin soil, sand, or rocks in a natural setting and a lack of vegetative cover. In Middlesex County, barren land is the product of human activity. Extraction mining operations, landfills, and other disposal sites compose the majority of human-altered barren lands. This category groups in vacant land.	25,750	13%
6	**Agriculture**	Agricultural purposes such as crop production, animal husbandry, pasturelands, etc., occur on agricultural lands. The scale ranges from urban agricultural plots to large-scale rural agricultural landscapes. This includes community gardens, orchards, and large farming plots.	12,139	6%
7	**Open Space**	Open spaces are lands that are accessible to the public and designed for recreation, habitat preservation, or both. Open space includes parks, nature preserves, greenways, and other intentional land preservation efforts. These lands are usually, but not always, owned by a government or non-profit conservation organization.	31,112	16%
Total			**198,632***	**100%**

*All acres calculated in ArcGIS. NJDEP Land Use Data, Open Space, and Middlesex County Base Zoning data were utilized to generate overall acreage.

1. Definitions 1-6 adapted from NJDEP Land Use Land Cover Classification Systems, https://www.state.nj.us/dep/gis/digidownload/metadata/lulc02/anderson2002.html

2. Open Space definition (7) from Middlesex County Open Space and Recreation Plan Update, 2021. Pending Approval.

Figure 53: Land Use Types



Cultural Landscape Types

The *Ecosystem Services and Cultural Landscape Analysis* identified various landscape types throughout the County within the broad land use categories branded, in this plan, as cultural landscape types. These types are multilevel NJDEP land use data and the research team's definitions based on the cultural understanding of Middlesex County's spaces and associated landscapes. Cultural landscape type mapping utilized parcel data, building footprints, aerial imagery, and land uses to identify existing characteristics of the County. The analysis revealed 29 different cultural landscape types within the seven land use type categories. ***Figure 54*** illustrates cultural landscape type locations and ***Table 9*** lists all 29 types with acres calculated from the GIS analysis. The landscape type description sheets beginning on page 123 provide County-specific photograph examples, graphic representation, and descriptions for every type. The cultural landscape types utilize the land use, building type, and associated built features to support landscape related actions in the *Actions* chapter.

Figure 54: Cultural Landscape Types

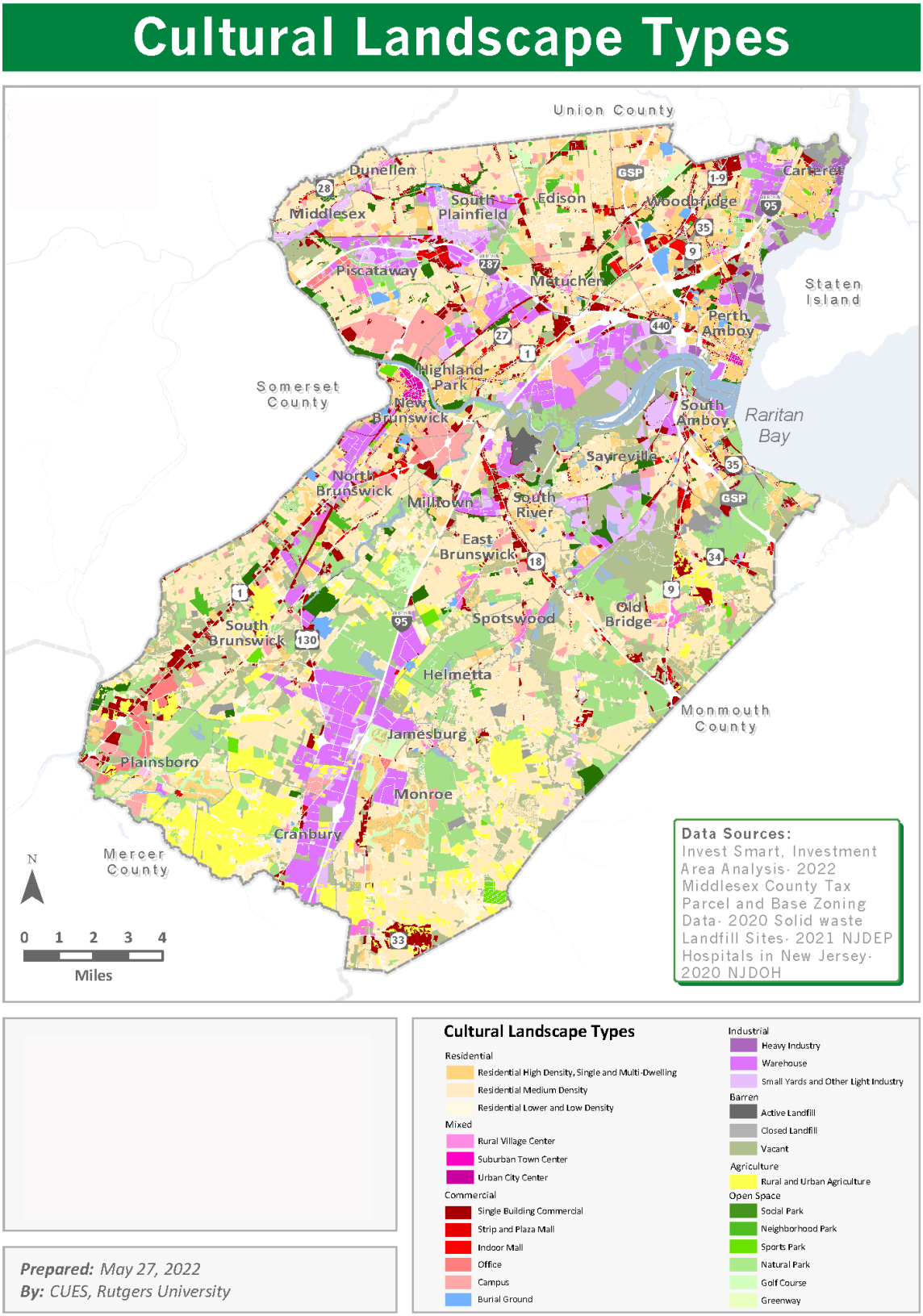


Table 11: Cultural Landscape Types with Acreage

ID #	Cultural Landscape Type	Acres
1.1	Single, Low Density Rural	6,189**
1.2	Single, Lower-Density Suburban	
1.3	Single, Medium-Density Suburban	64,774
1.4	Single, High-Density Suburban	15,445**
1.5	Multi-Dwelling, High-Density Suburban	
2.1	Rural Village Center	94
2.2	Suburban Town Center	1,623
2.3	Urban City Center	312
3.1	Single Neighborhood Building	8,722
3.2	Strip Mall	1,390**
3.3	Plaza Shopping Center	
3.4	Indoor Mall	214
3.5	Office Park	1,474
3.6	Campus	7,537
3.7	Burial Ground	1,332
4.1	Heavy Industry	994
4.2	Warehouse	12,843
4.3	Small Yard and Other Light Industry	6,690
5.1	Active Landfill	251
5.2	Closed Landfill	1,531
5.3	Vacant	23,968
6.1	Rural Farmland	12,139**
6.2	Urban Agriculture	
7.1	Social Parks	4,238
7.2	Neighborhood Parks	3,017
7.3	Sports Parks	945
7.4	Nature Parks	21,279
7.5	Golf Courses	1,588
7.6	Greenways	45
	Total	**198,632***

*All acres calculated in ArcGIS. NJDEP Land Use Data, Open Space, and Middlesex County Base Zoning data were utilized to generate overall acreage.

**Categories grouped for mapping purposes

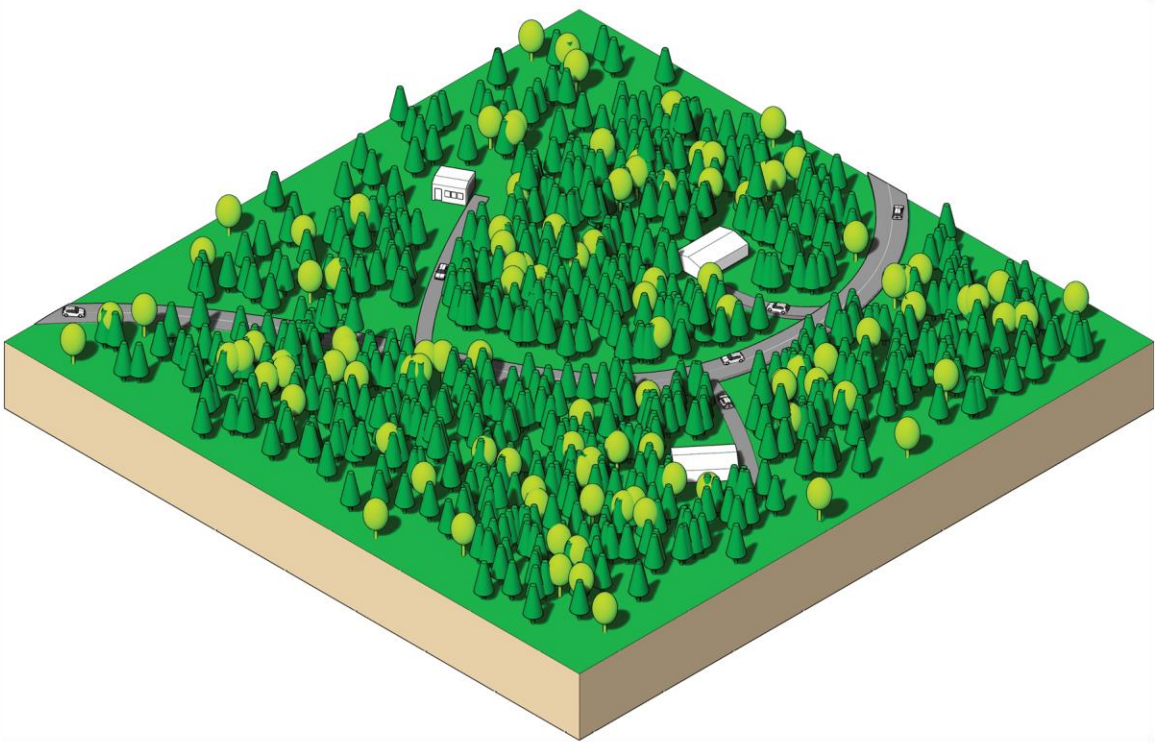
1.1 Single, Low-Density Rural

Residential

Description: Single-unit residential neighborhoods in rural or formerly rural areas with greater than one-acre lot sizes surrounded by agricultural or natural lands. Parcels contain 15-20 percent or less impervious surfaces. Lower population densities accompany these properties, requiring vehicular travel to access commercial areas.

Landscape Threats: Subject to new development and sub-division leading to habitat loss or viewshed disturbance

Piscataway, NJ. Single family home on 5-acre property.



Opportunities: Conservation, open space acquisition, agricultural viewsheds, permeable asphalt, sidewalk connections to open space and commercial areas, biodiverse plantings, shade tree protection, conservation zoning to protect natural habitats

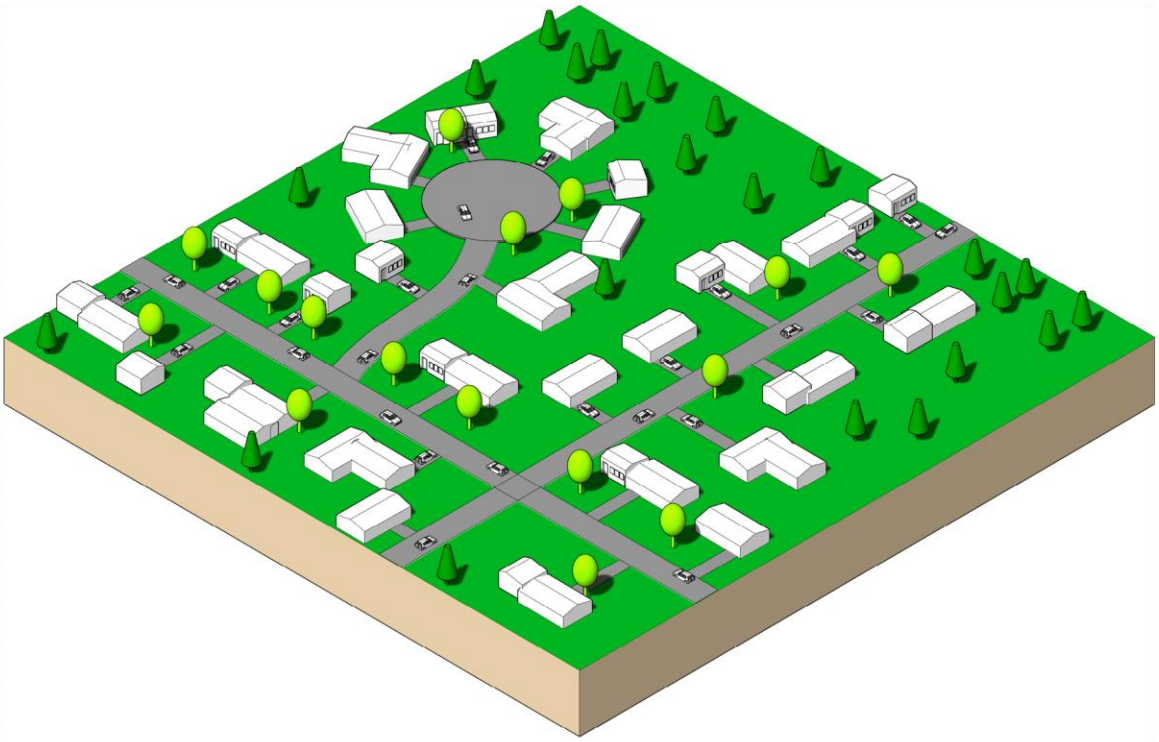
1.2 Single, Lower-Density Suburban

Residential

Description: Single-unit residential neighborhoods with lots greater than half-acre up to and including one-acre. These parcels generally contain roughly 20-25 percent impervious surface cover surrounded by lower population densities. Occupants often rely on vehicular travel.

Landscape Threats: Replaces rural and natural landscapes, lawn cover occupies most of the landscape with limited biodiversity

Monroe Township, NJ. Single family development.



Opportunities: Lawn alternatives, green infrastructure such as rain gardens, permeable asphalt, connect sidewalks to open space and commercial areas, biodiverse plantings, dry wells, shade tree protection, street trees, conservation zoning to protect natural habitats

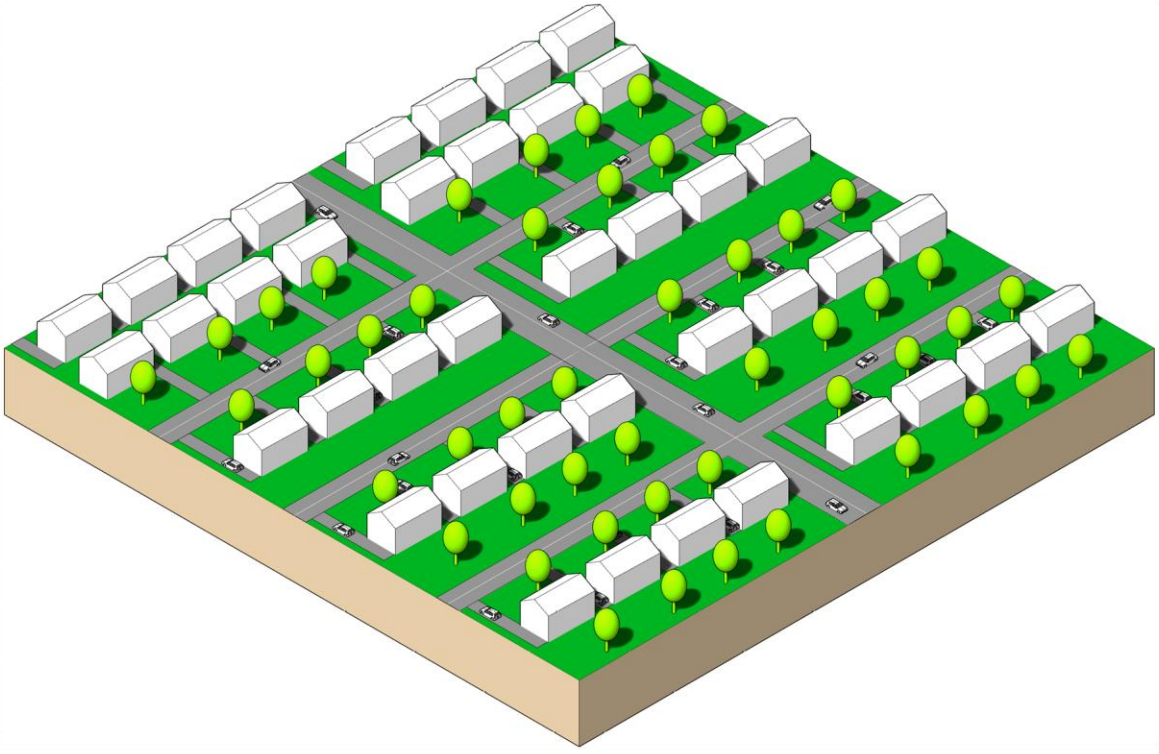
1.3 Single, Medium-Density Suburban

Residential

Description: Residential urban or suburban neighborhoods greater than an eighth-acre and up to and including half-acre lots. These areas often contain roughly 30-35 percent impervious surface cover. Moderate population densities surround these areas.

Landscape Threats: Subject to older home replacement with larger footprints, mostly lawn covered landscape, higher impervious surface cover to the total area, lower biodiversity, fragmented sidewalks in older neighborhoods

Woodbridge Township, NJ. Single family Cape Cod.



Opportunities: Reduce impervious surfaces, green infrastructure such as rain gardens, permeable asphalt, connect sidewalks to open space and commercial areas, biodiverse plantings, dry wells, shade tree protection, street trees

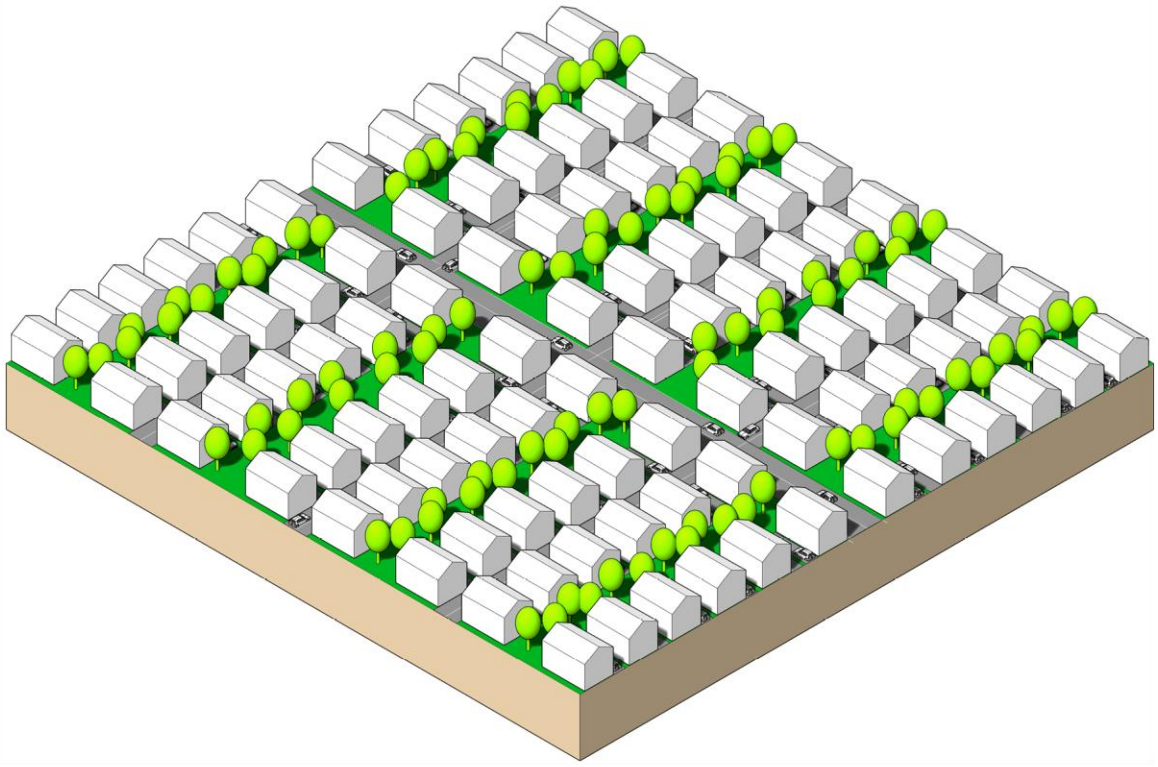
1.4 Single, High-Density Suburban

Residential

Description: Residential urban and suburban homes with multiple single-family dwellings near one another. Often five-plus units are on one acre of land. These lots generally contain impervious surface areas greater than 65 percent. Moderate to higher population densities surround these dwellings, especially in the adjacent cities.

Landscape Threats: Minimal landscaped space, if any landscaping, structures occupy most of the parcel, lower biodiversity

Perth Amboy City, NJ. Single family high-density.



Opportunities: Reduce impervious surfaces, green infrastructure such as bioswales, permeable asphalt, connect sidewalks to open space and commercial areas, biodiverse plantings, dry wells, shade tree protection, street trees

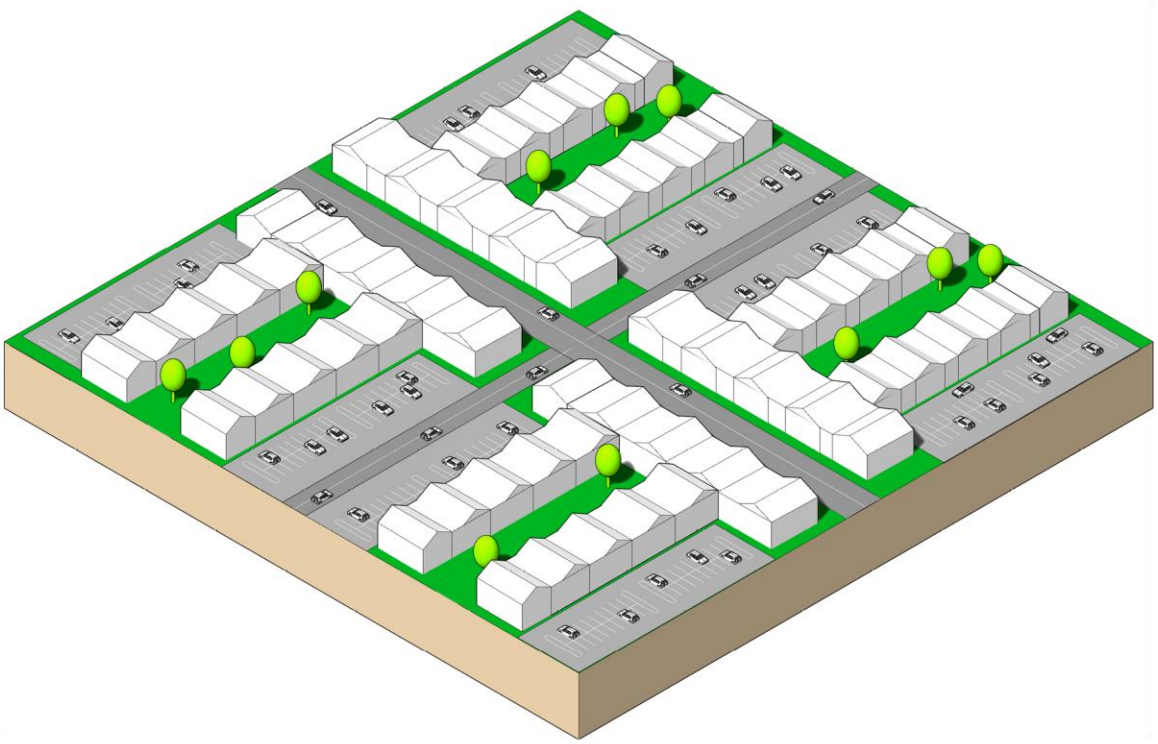
1.5 Multi-Dwelling, High-Density Suburban

Residential

Description: Suburban apartment complexes and town homes or row houses. Apartments are often two-plus stories high with parking lots or garages. In Middlesex County, isolation from commercial areas often occurs, with few exceptions. Town homes and apartment complexes create isolated communities, sometimes with central open space.

Landscape Threats: High impervious surfaces to the total area, lower biodiversity, larger parking areas throughout the neighborhood, community construction occurs at one time disturbing a large tract of land

Highland Park Borough, NJ. Town homes.



Opportunities: Reduce impervious surfaces, green infrastructure such as rain gardens, permeable asphalt, connect sidewalks to open space and commercial areas, biodiverse plantings, electric vehicle charging stations in parking lots, parking lot trees, street trees

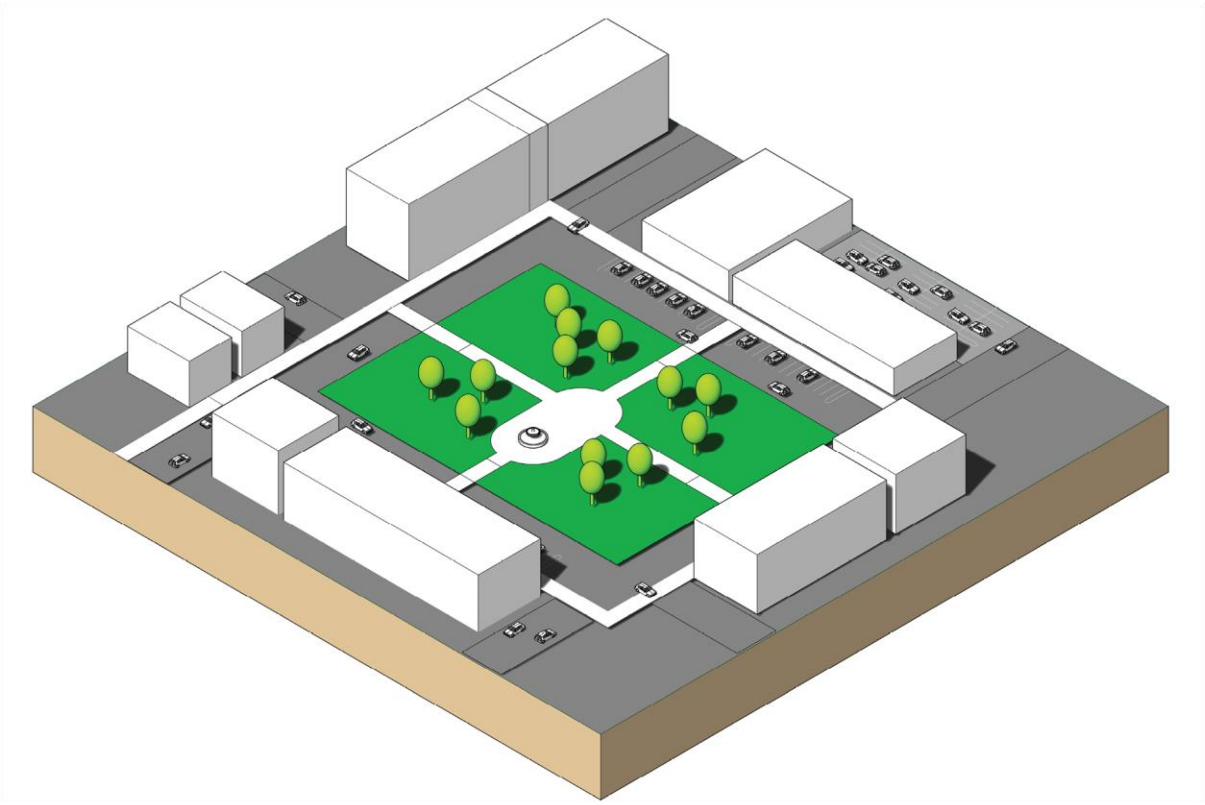
2.1 Rural Village Center

Mixed-Use

Description: The Rural Village Center is a commercial area located within a rural setting. This is a smaller commercial district encompassing private and public establishments. Residential dwellings occur in smaller, but higher-density clusters. The surrounding area's population density is much lower than suburban and urban mixed-use downtown areas. The area beyond the village center is car-centric.

Landscape Threats: Expansion may occur in surrounding natural areas and unprotected farmland

Plainsboro Township, NJ. Plainsboro Village Center.



Opportunities: Connecting sidewalks to neighborhood trails and parks, wayfinding, temporary pedestrian street and parking lot use, pedestrian plaza, green roofs, white roofs, solar panels, rain gardens, street trees, bioswales, streetscape amenity enhancements, local character

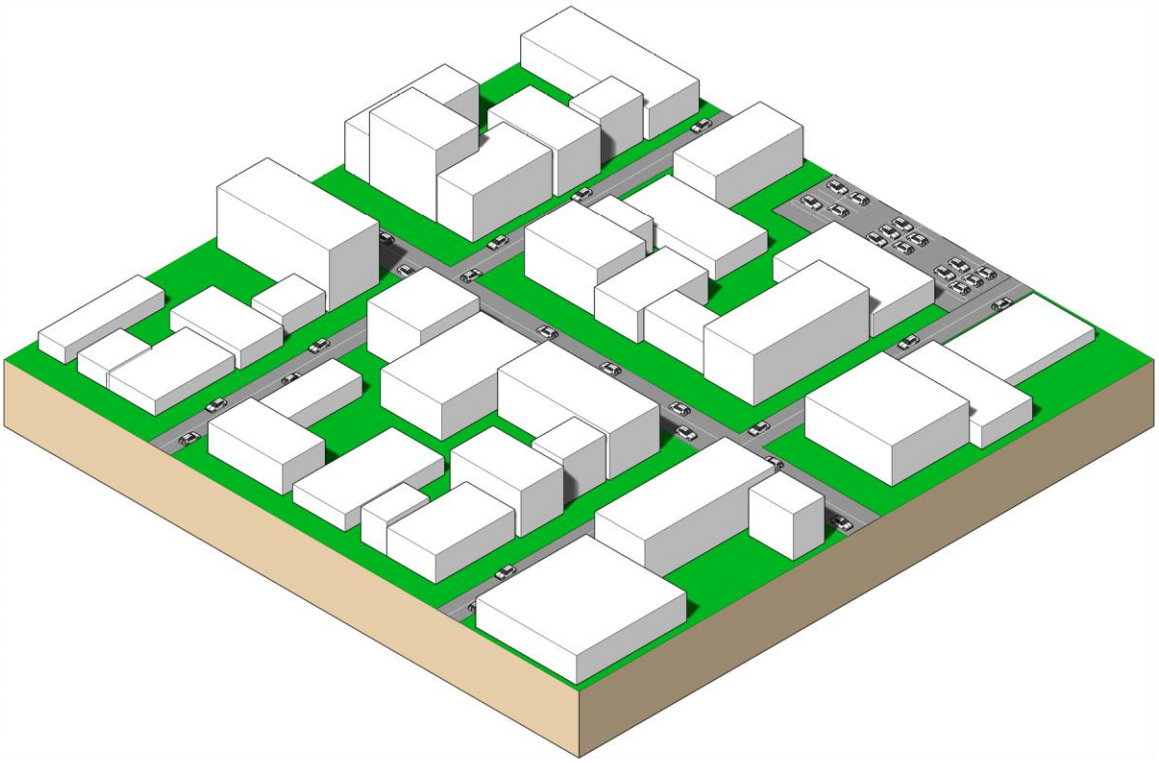
2.2 Suburban Town Center

Mixed-Use

Description: The Suburban Town Center includes the suburban central business district with a distinct character and is smaller than the Urban City Center. New development and older buildings are mixed on the suburban main street often 2-4 stories in height with residential and commercial uses. Often, this area serves the local community and surrounding residents.

Landscape Threats: High impervious surfaces, subject to replacement with larger structures and more impervious surfaces

Metuchen Borough, NJ.
Downtown Metuchen Main Street.



Opportunities: Connecting sidewalks to neighborhood trails and parks, wayfinding, temporary pedestrian street and parking lot use, pedestrian plaza, green roofs, white roofs, solar panels, rain gardens, street trees, bioswales, streetscape amenity enhancements, local character

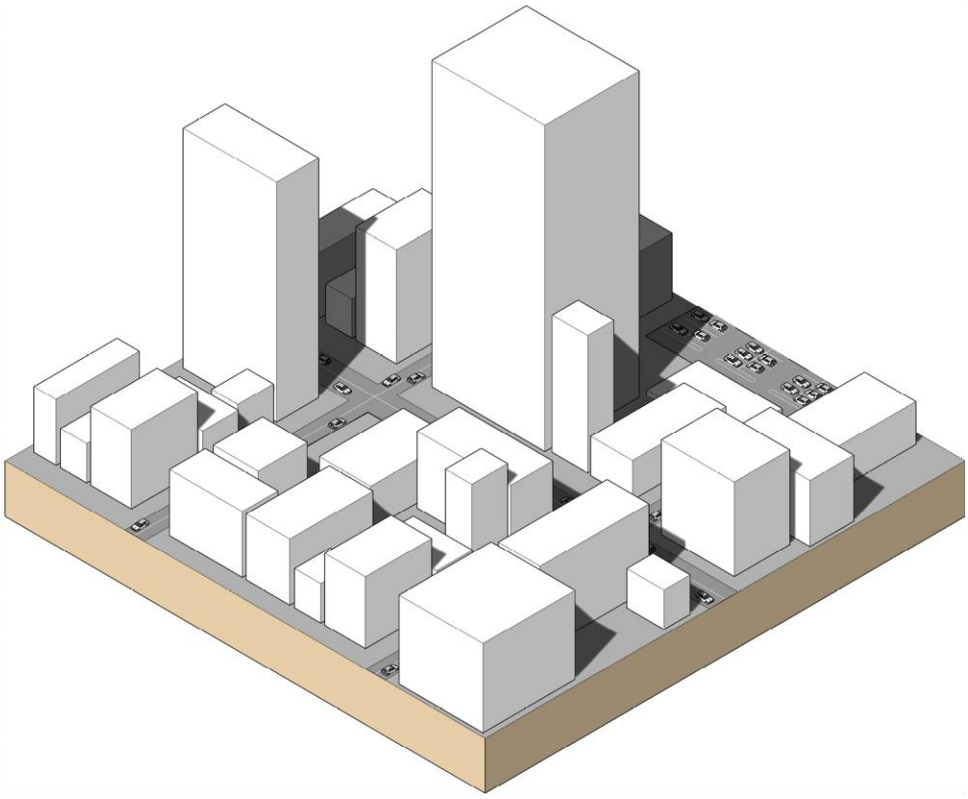
2.3 Urban City Center

Mixed-Use

Description: The Urban City Center is the city's central business district, with a mix of commercial and residential uses. Often with high-rise and 2-4 story buildings intertwined. The business district spans multiple streets with a higher surrounding population density. These areas serve as regional tourism locations and connect people to New York City and Philadelphia through the public transportation network.

Landscape Threats: High impervious surface cover, debris, and litter. Urban heat island effects and lower tree canopy cover

New Brunswick City, NJ.
Downtown area, George Street.



Opportunities: Connecting sidewalks to neighborhood trails and parks, wayfinding, temporary pedestrian street and parking lot use, pedestrian plaza, green roofs, white roofs, solar panels, rain gardens, street trees, bioswales, streetscape amenity enhancements, local character

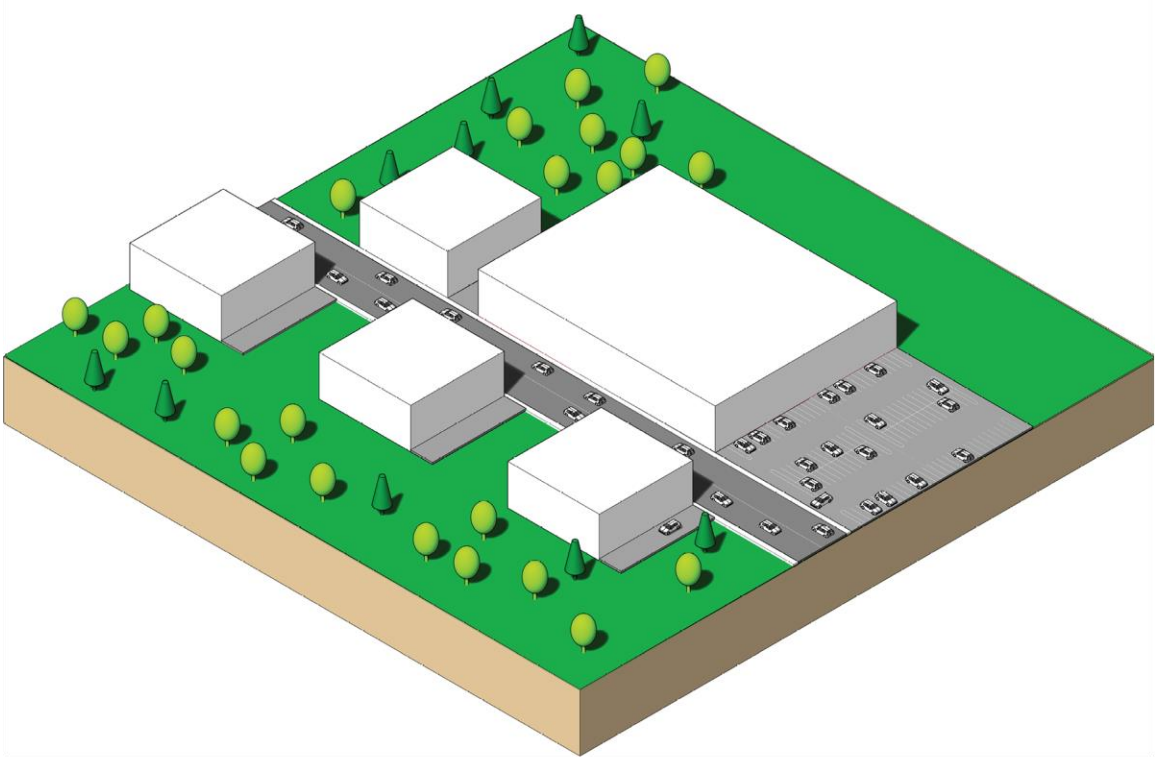
3.1 Single Neighborhood Building

Commercial

Description: Isolated single commercial buildings often in suburban or rural areas. The occupants of these buildings provide goods and services for the surrounding community. The lots landscape contains minimal landscaping, lawn, and parking lot cover. The area may contain surrounding natural space.

Landscape Threats: Higher impervious surface cover to the total parcel area, lower biodiversity, higher lawn cover

Dunellen, NJ. Stand alone commercial building.



Opportunities: Pedestrian pathway connections to neighborhood trails, lawn alternatives such as meadows and shrub plantings, white roofs, solar panels, rain gardens, parking lot trees, permeable pavement

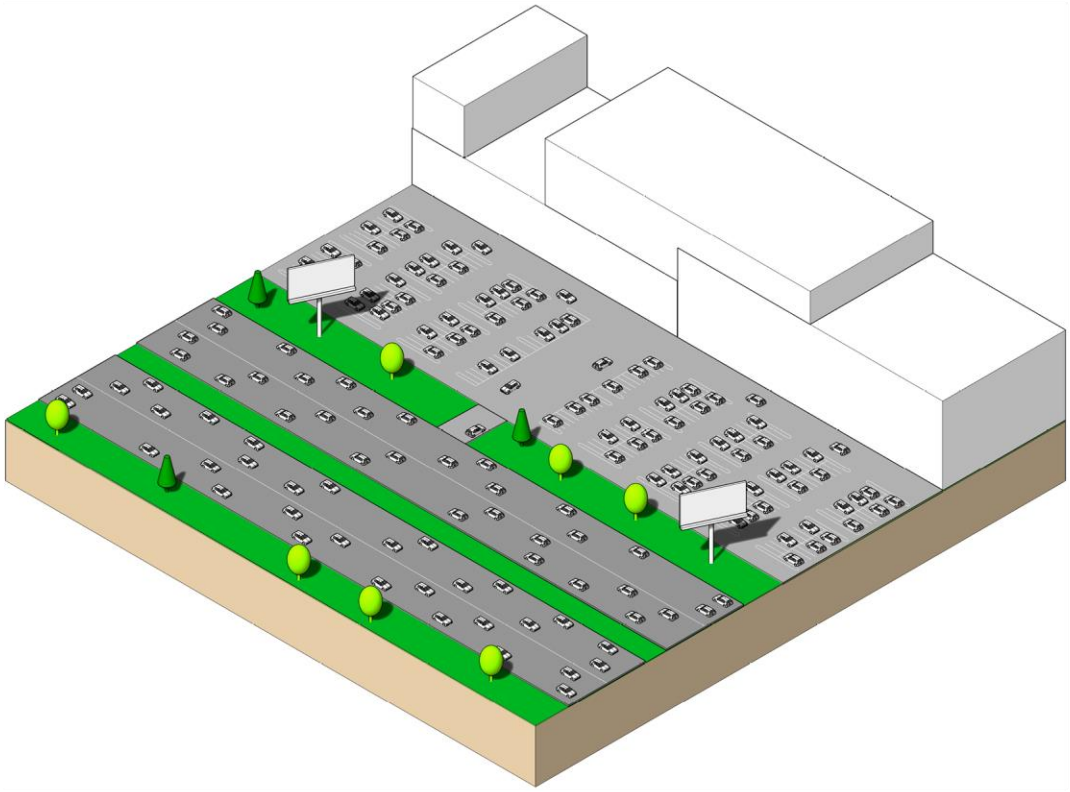
3.2 Strip Mall

Commercial

Description: A commercial building with attached stores in a row layout developed along major highways. These stores align along single strips with associated parking in front and delivery access behind.

Landscape Threats: Higher impervious surface cover to the total area, low biodiversity if any plantings, limited pedestrian accessibility

Edison Township, NJ. Strip mall.



Opportunities: Pedestrian pathway connections to neighborhood trails, lawn alternatives such as meadow and reforestation, green roofs, white roofs, solar panels, rain gardens, vegetated bioretention basins, electric vehicle charging stations in parking lots, parking lot trees

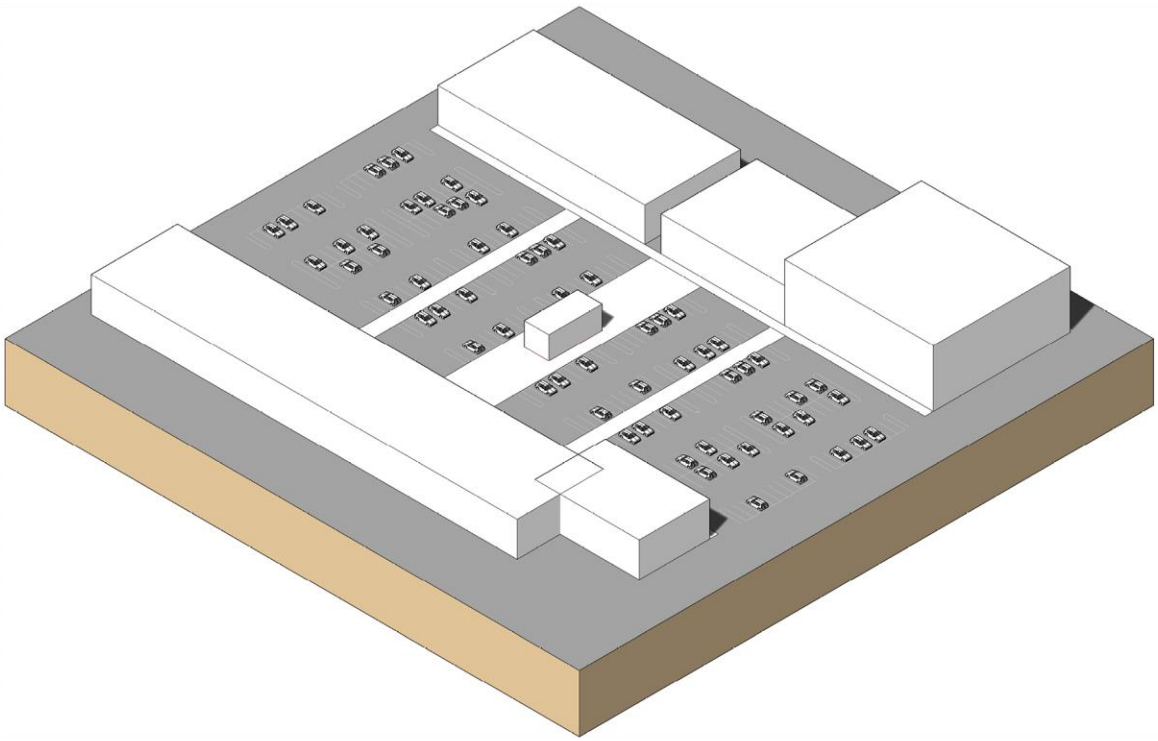
3.3 Plaza Shopping Center

Commercial

Description: A plaza-style shopping center is a commercial grouping with a central pedestrian area. The layout is an enclosed circle or facing rows. The attached buildings feature parking in front with delivery access in the back. The plaza aims for pedestrian centrality with designated pedestrian paths through the parking lot.

Landscape Threats: Higher impervious surface cover to the total area, low biodiversity if any plantings, may lack pedestrian connections to surrounding neighborhoods

North Brunswick Township, NJ. Shopping plaza.



Opportunities: Pedestrian pathway connections to neighborhood trails, outdoor gathering space, green roofs, white roofs, solar panels, rain gardens, vegetated bioretention basins, electric vehicle charging stations in parking lots, parking lot trees

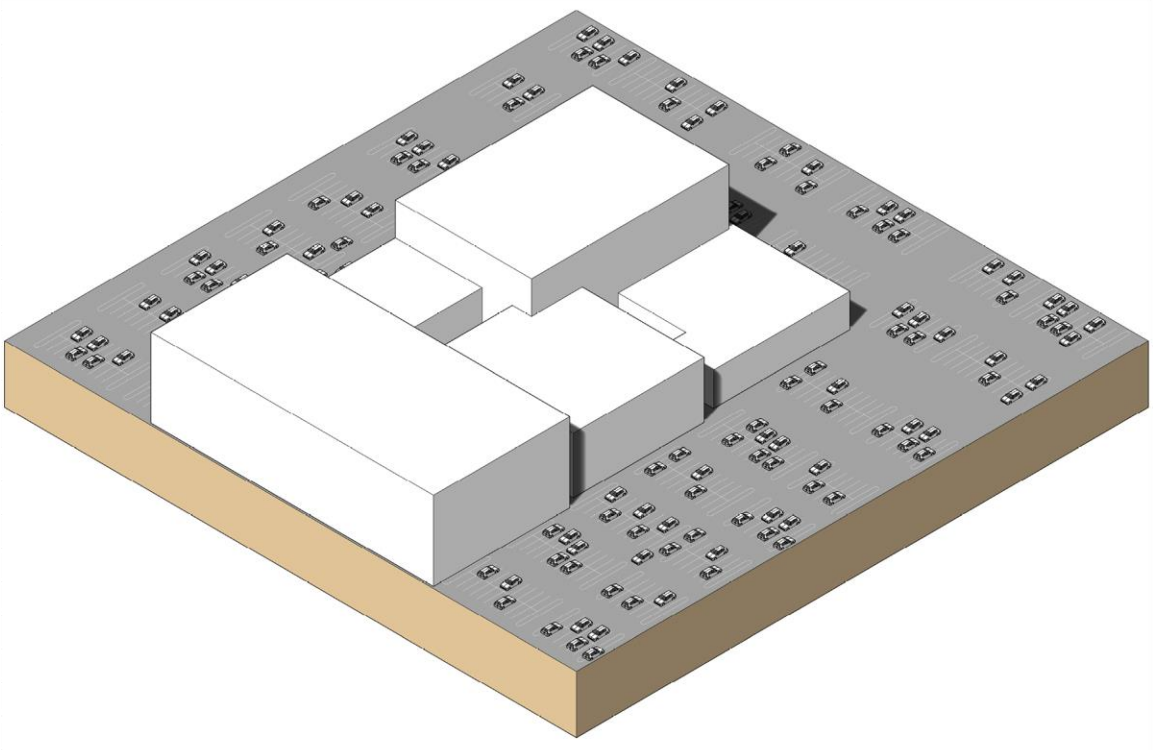
3.4 Indoor Mall

Commercial

Description: Large commercial building or grouping of large buildings with indoor shopping and dining. Contiguous parking lots often surround the mall, with limited pedestrian accessibility outside the mall complex. Activities sometimes occur in parking lots, but indoor activity and commerce are the main focus.

Landscape Threats: Higher impervious surface cover to the total area, low biodiversity if any plantings, lawn covered or parking lot landscape, new development often replaces natural areas

Woodbridge Township, NJ. Woodbridge Mall.



Opportunities: Pedestrian pathway connections to neighborhood trails, pedestrian gathering space, green roofs, white roofs, or solar panels, rain gardens and vegetated bioretention basins, electric vehicle charging stations in parking lots, permeable pavement, parking lot trees

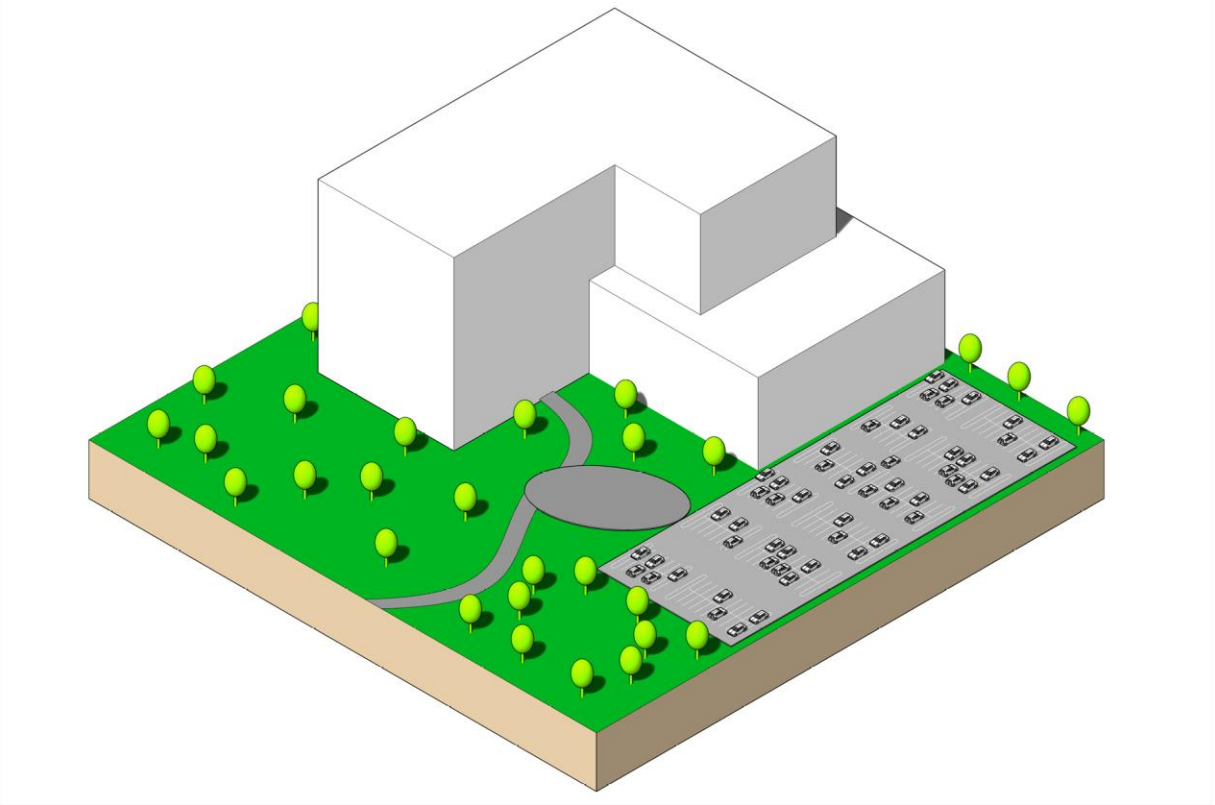
3.5 Office Park

Residential

Description: Isolated office buildings clustered on their own campus. Expansive lawn cover, maintained landscapes, and parking lots often surround these areas. Walking paths sometimes occupy the office park landscape with outdoor seating for employees.

Landscape Threats: Low biodiversity in landscaped areas, largely lawn covered landscape, new development often occurs in natural areas

Piscataway Township, NJ. Office complex.



Opportunities: Pedestrian pathway connections to neighborhood trails, outdoor gathering space, green roofs, white roofs, solar panels, rain gardens, vegetated bioretention basins, electric vehicle charging stations in parking lots, permeable pavement, parking lot trees, urban agriculture on underutilized lawn

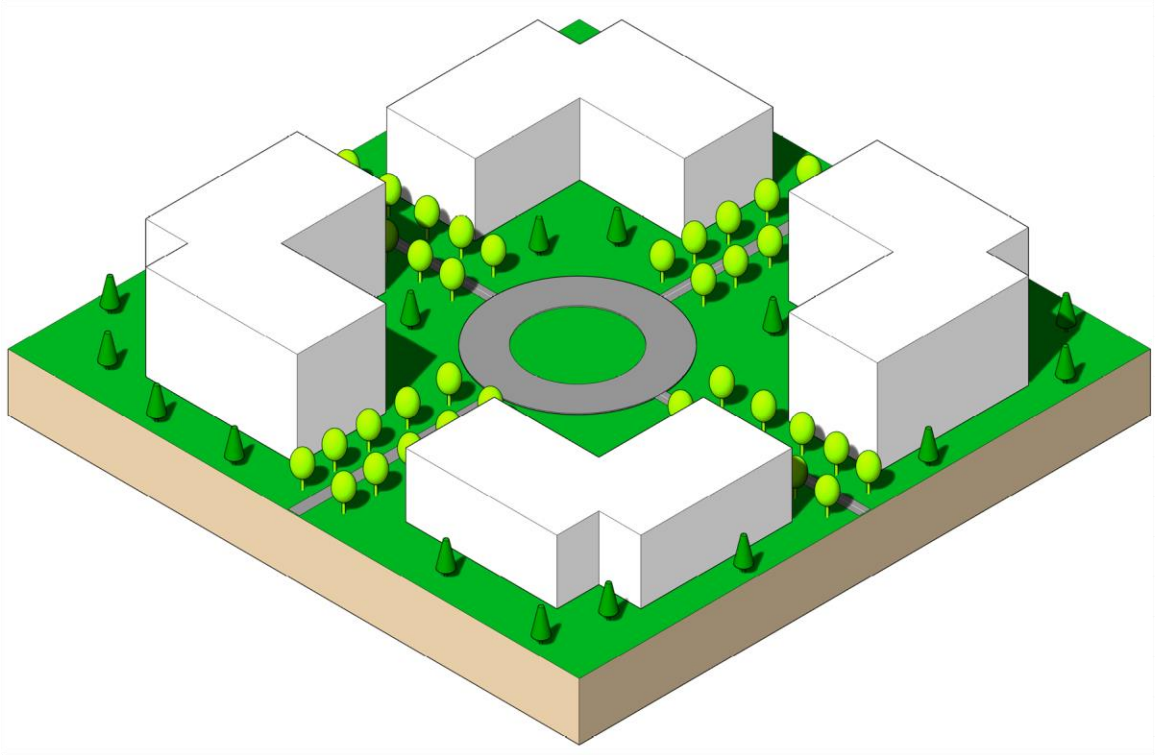
3.6 Campus

Commercial

Description: All levels of public and private schools, colleges, universities, and training centers. The campus includes all buildings, private campus open spaces, dormitories, and parking areas. The campus serves the local community and holds high cultural significance.

Landscape Threats: Expansive lawn cover, stormwater runoff in high impervious surface areas, land management may be disconnected from surrounding natural landscapes

New Brunswick City, NJ. Cook Campus.



Opportunities: Lawn alternatives such as reforestation and meadows, pedestrian gathering space, green roofs, white roofs, solar panels, rain gardens, electric vehicle charging stations in parking lots, permeable pavement, parking lot trees, green facades, street trees

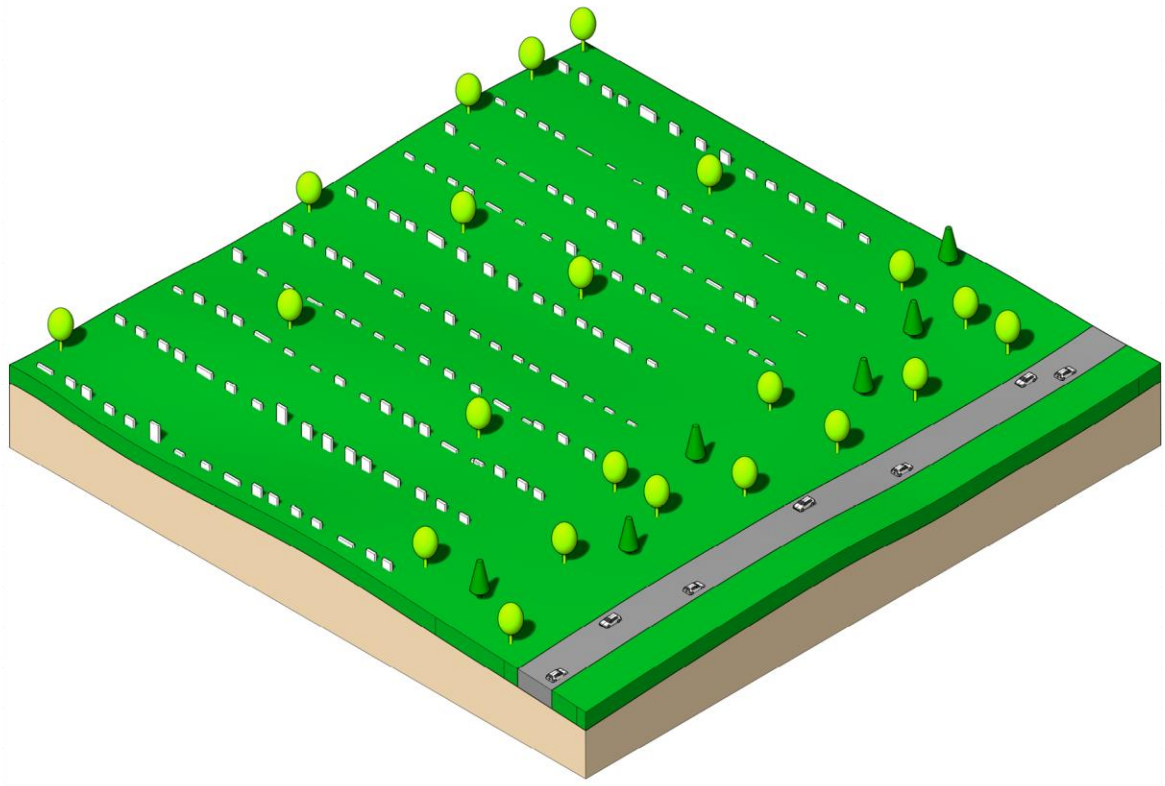
3.7 Burial Ground

Commercial

Description: Cemetery, graveyard, or burial ground is the sole purpose. The property cannot succumb to development and is often a maintained lawn surrounded by fencing with landscaping interspersed throughout the burial plots or surrounding the property.

Landscape Threats: Expansive lawn cover, potentially hazardous chemicals, fertilizer for lawn and regular lawn maintenance, limited biodiversity

South Plainfield Borough, NJ. Cemetery.



Opportunities: Biodiverse plantings, plant trees and shrubs around property edges, permanently preserved space for cultural experiences, greenway connections where appropriate

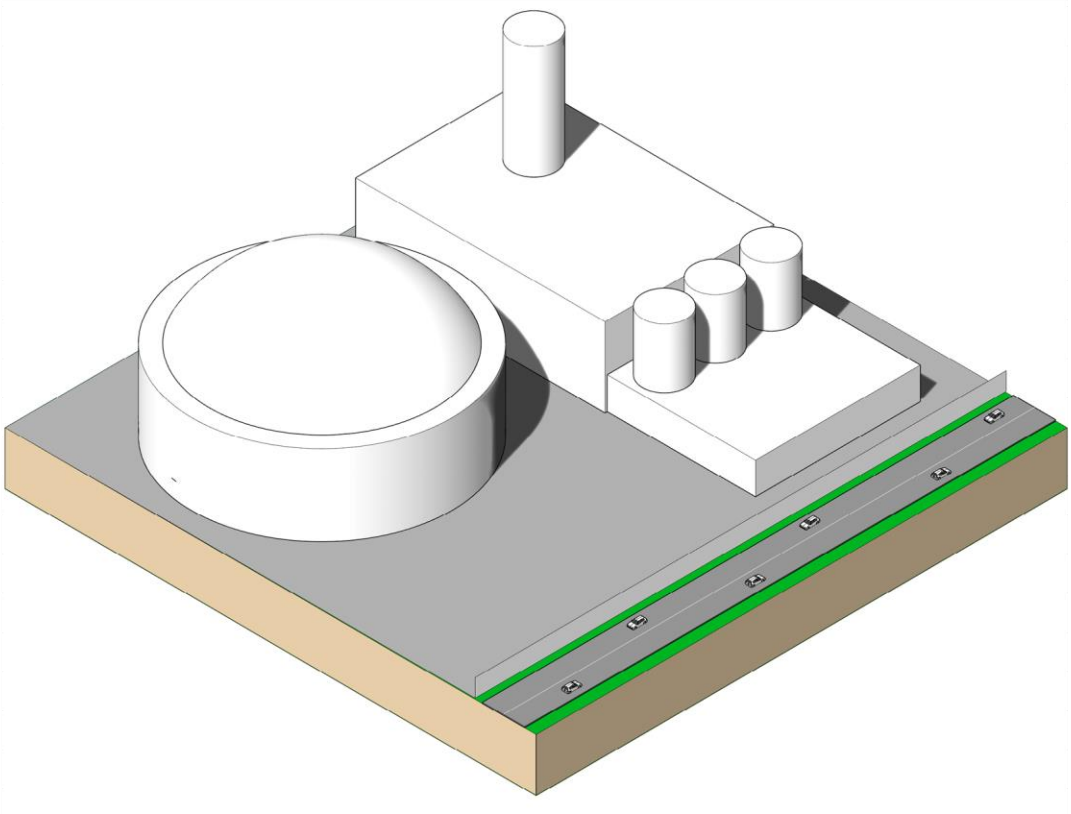
4.1 Heavy Industry

Industrial

Description: Heavy industrial landscapes in Middlesex County are dominated by oil and gas tanks. The landscape is often completely impervious. The property is fenced in with maximum security.

Landscape Threats: Completely impervious, hazardous materials, often limiting access to the waterfront, and fragmented trails and natural aquatic habitats

Woodbridge Township, NJ. Storage tank.



Opportunities: Wetland and forest habitat improvement at property edges and grass strips between roads and fencing, capture stormwater runoff in bioretention basins

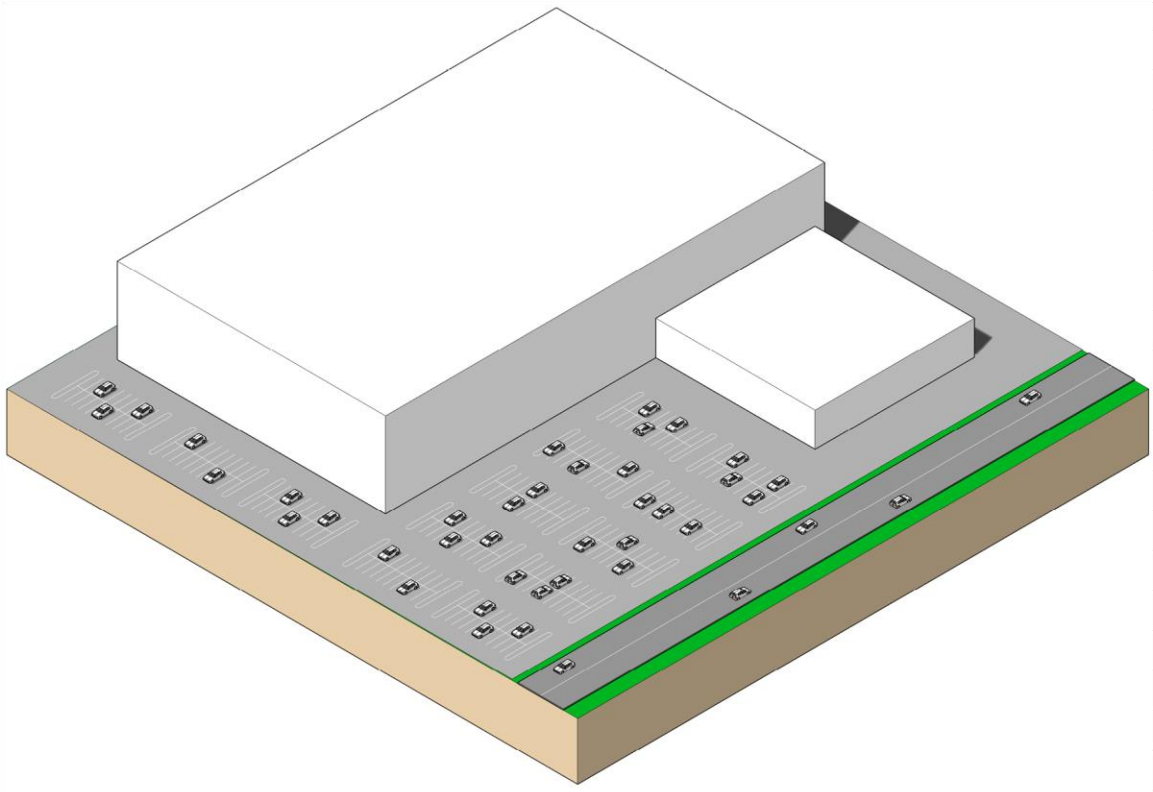
4.2 Warehouse

Industrial

Description: Light industrial warehouses are used for the design, assembly, finishing, packaging, and storing of products or materials. The building footprint is a large one-story rectangle with surrounding parking lots for employees and truck accessibility for shipping and receiving.

Landscape Threats: Large contiguous impervious surfaces from the building footprint and parking lot, often developed in natural, wetland, and former agricultural areas

Piscataway Township, NJ. Furniture warehouse.



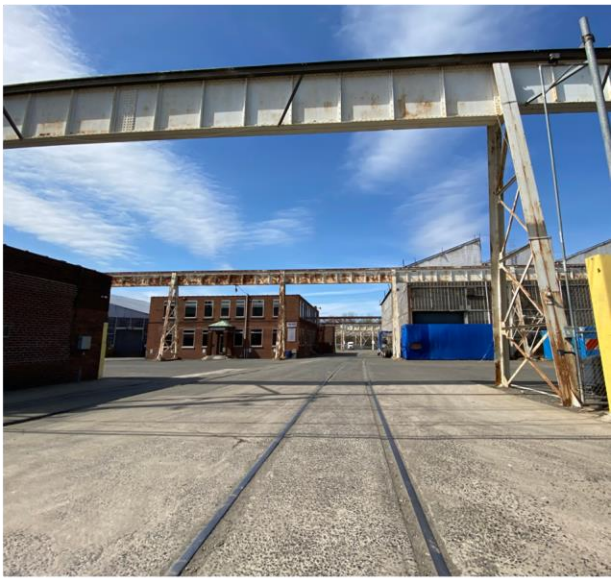
Opportunities: Pedestrian pathway connections to neighborhood trails, green roofs, white roofs, solar panels, rain gardens, vegetated bioretention basins, electric vehicle charging stations in parking lots, permeable pavement, parking lot trees, green facades

4.3 Small Yard and Other Light Industry

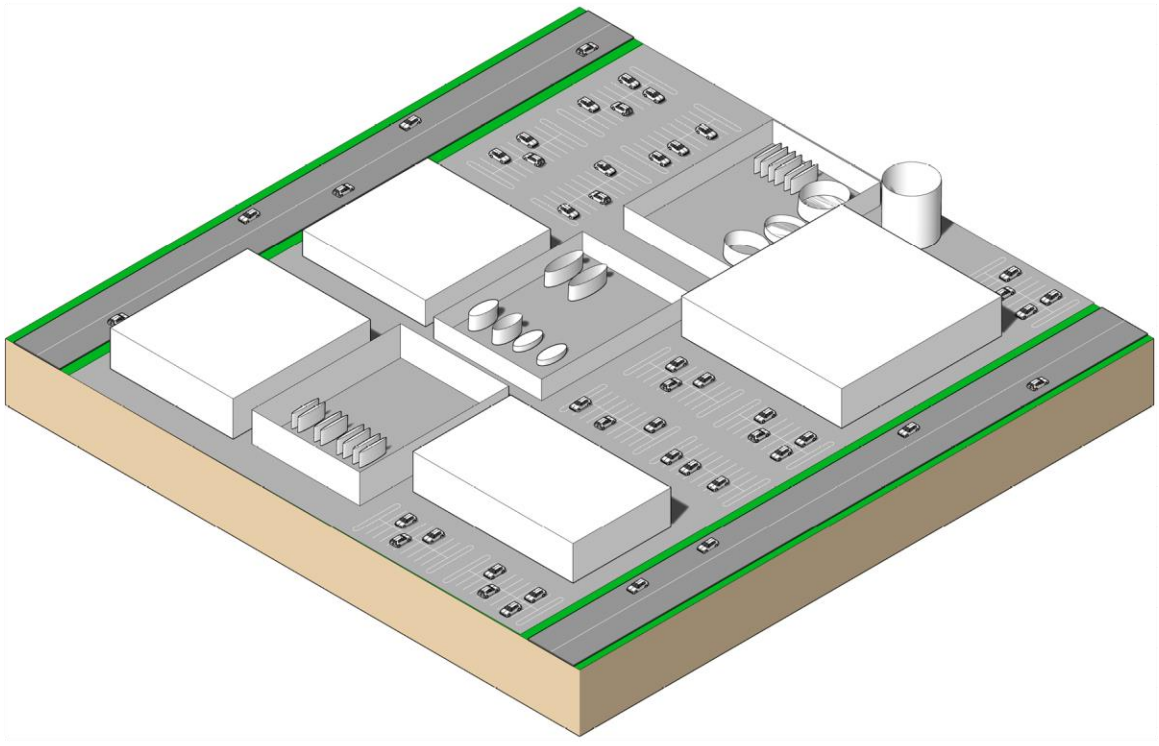
Industrial

Description: The main use of small-scale light industrial yards is the design, assembly, finishing, packaging, and storing of products or materials. Material piles for storage occupy the landscape, and rail lines may run through the property. This category encompasses all other light industrial yards outside of heavy industry and warehouses.

Landscape Threats: Potentially hazardous chemicals, debris, limited biodiversity, fragmented natural habitats, potential groundwater contamination



South Plainfield Township, NJ. Trucking yard.



Opportunities: white roofs, solar panels, electric vehicle charging stations in parking lots, parking lot trees, vegetated bioretention basins, rain gardens, bioswales, green facades

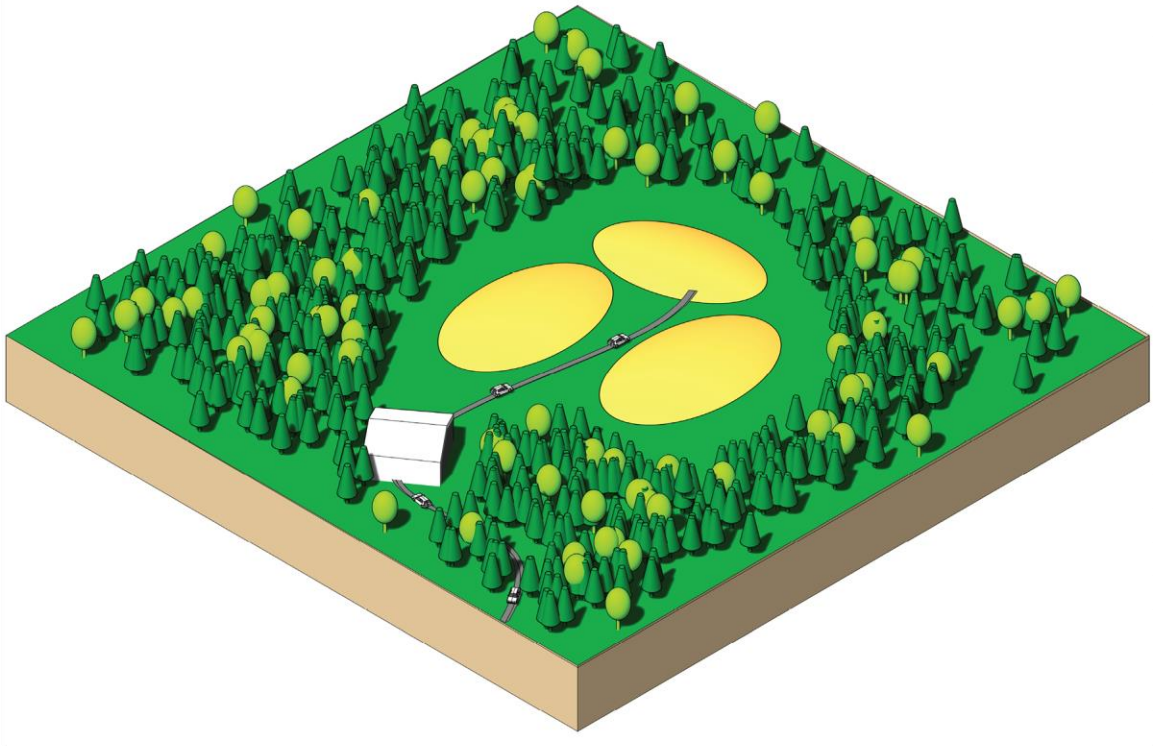
5.1 Active Landfill

Barren

Description: An area actively used for garbage deposit and storage.

Landscape Threats: Hazardous materials, methane gases, leaching, often located near water resources

East Brunswick Township, NJ. Active County landfill. Image Source: Google Maps, 2021.



Opportunities: Habitat improvements and protection in surrounding natural areas, solar panels in parking lots, parking lot trees

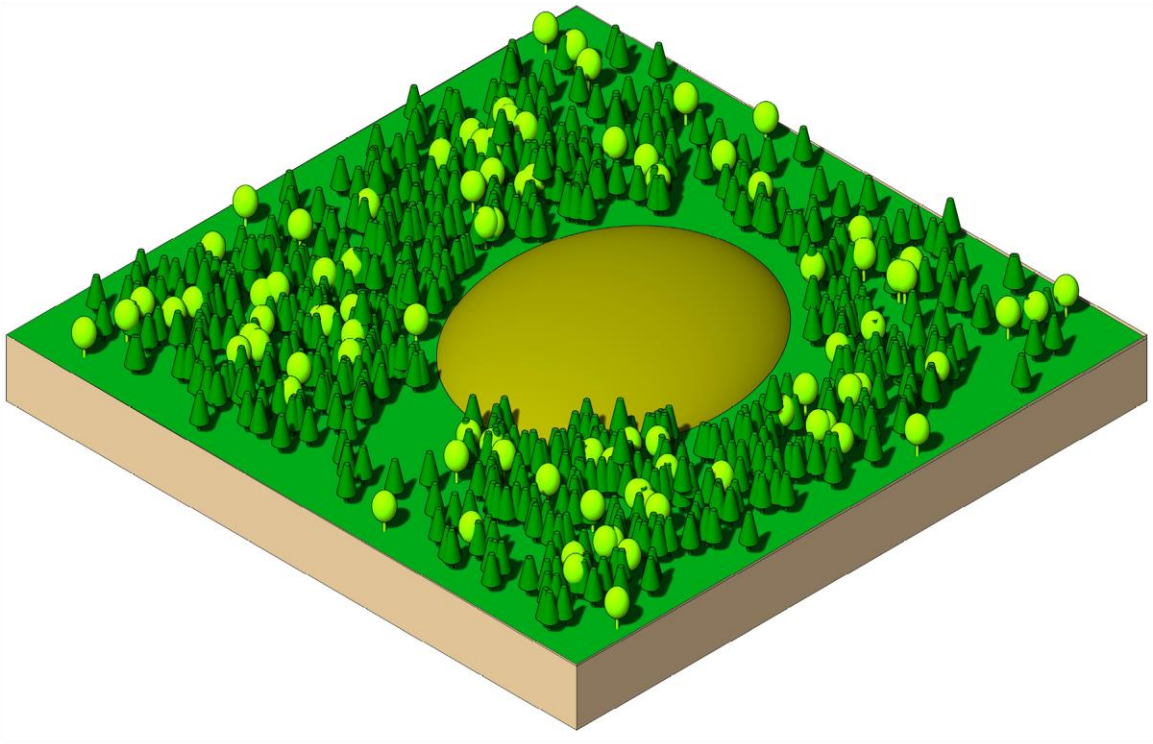
5.2 Closed Landfill

Barren

Description: A capped area formerly used for garbage deposit buried under the earth. Often contains large mounds.

Landscape Threats: Hazardous material leaching, deep-rooted vegetation poses a structural risk

Middlesex Borough, NJ. Closed landfill.



Opportunities: Meadow planting, passive recreation, solar fields

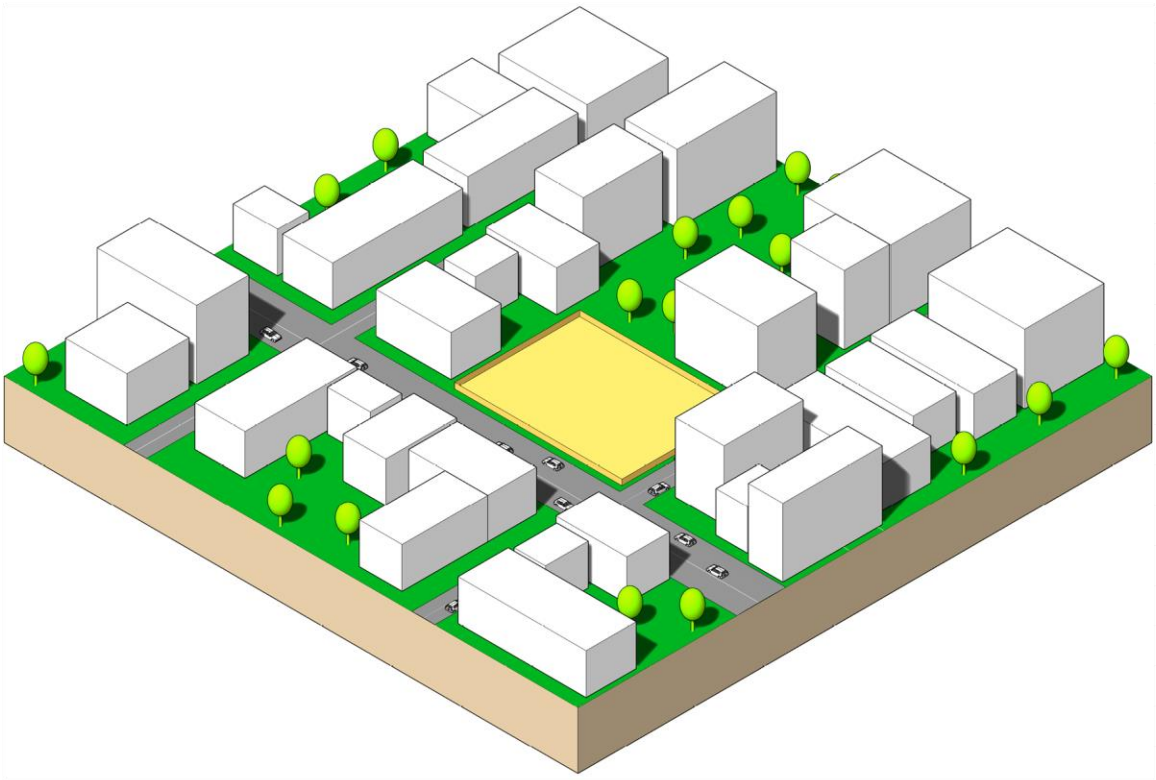
5.3 Vacant

Barren

Description: Parcels classified as vacant are adaptive reuse lots. This category includes all other barren or vacant lands, not active or closed landfills. These lots often occur in urban areas where former structures once stood or are remnant natural lands in urban areas. Vacant lands may contain Brownfield designations.

Landscape Threats: May contain degraded soils, physical debris, contamination, invasive and non-native plant species. Pristine ecological habitats may be subject to development

Dunellen Borough, NJ. Vacant property for sale.



Opportunities: Flexible space use for temporary activities, reforestation, urban meadow, urban agriculture, housing, stormwater management, open space, impervious surface removal if applicable, solar field

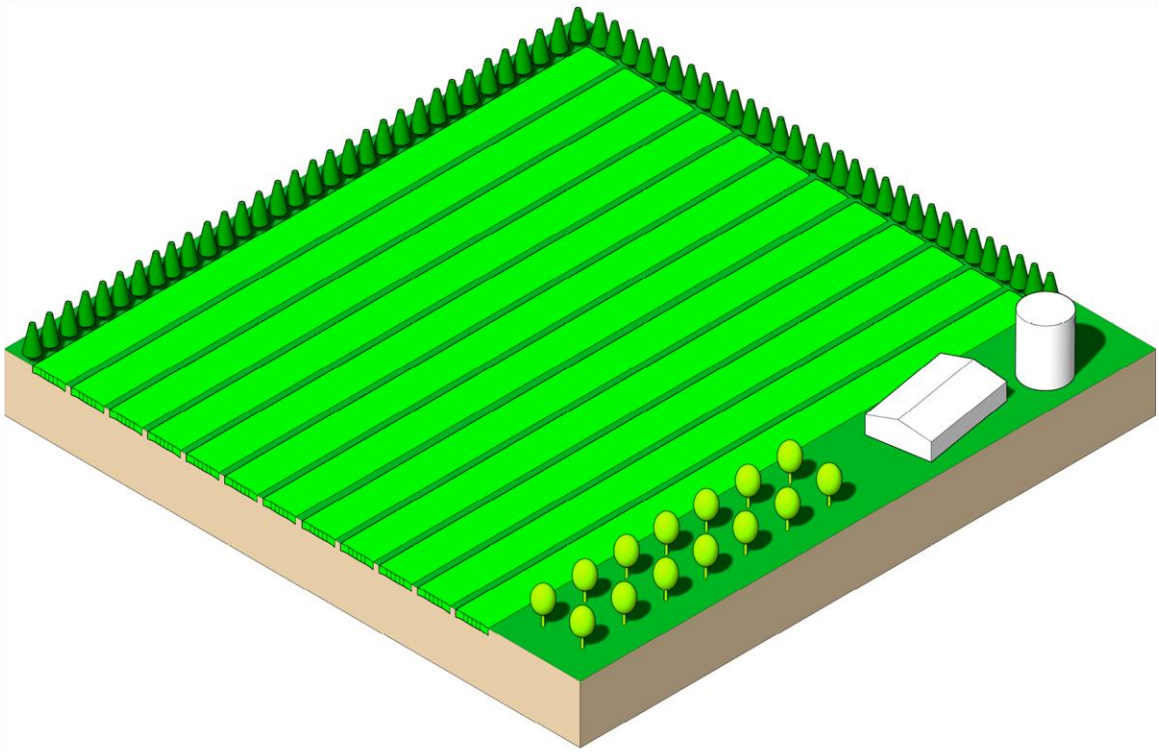
6.1 Rural Farmland

Agriculture

Description: Farms occur in the County's southern rural landscapes. They are large-scale plots often used for crop production fields or pasture lands.

Landscape Threats: Loss to residential, commercial, or industrial development. Harmful farming chemicals and animal waste in local waterways, viewshed disturbance

Old Bridge Township, NJ. Rural farm field.



Opportunities: Vegetated edges serve as wildlife habitats and cultural markers, viewshed protection and access, farmland preservation, culturally significant landscapes

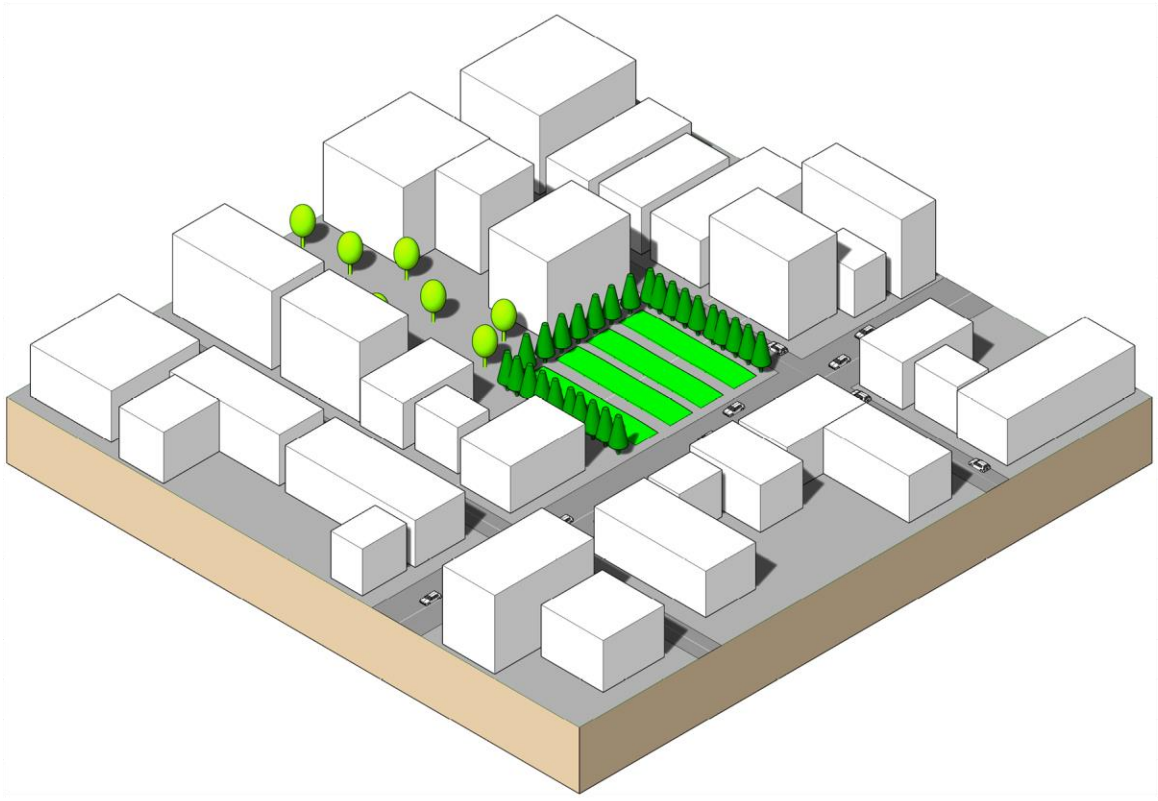
6.2 Urban Agriculture

Agriculture

Description: Small-scale urban farming plots in urban and suburban settings. This includes community gardens and small urban agricultural sites.

Landscape Threats: Economic sustainability, requires management group

New Brunswick City, NJ. Community garden.



Opportunities: Programming through community groups and non-profit organizations, capture stormwater for crops, biodiverse plants, community engagement and education

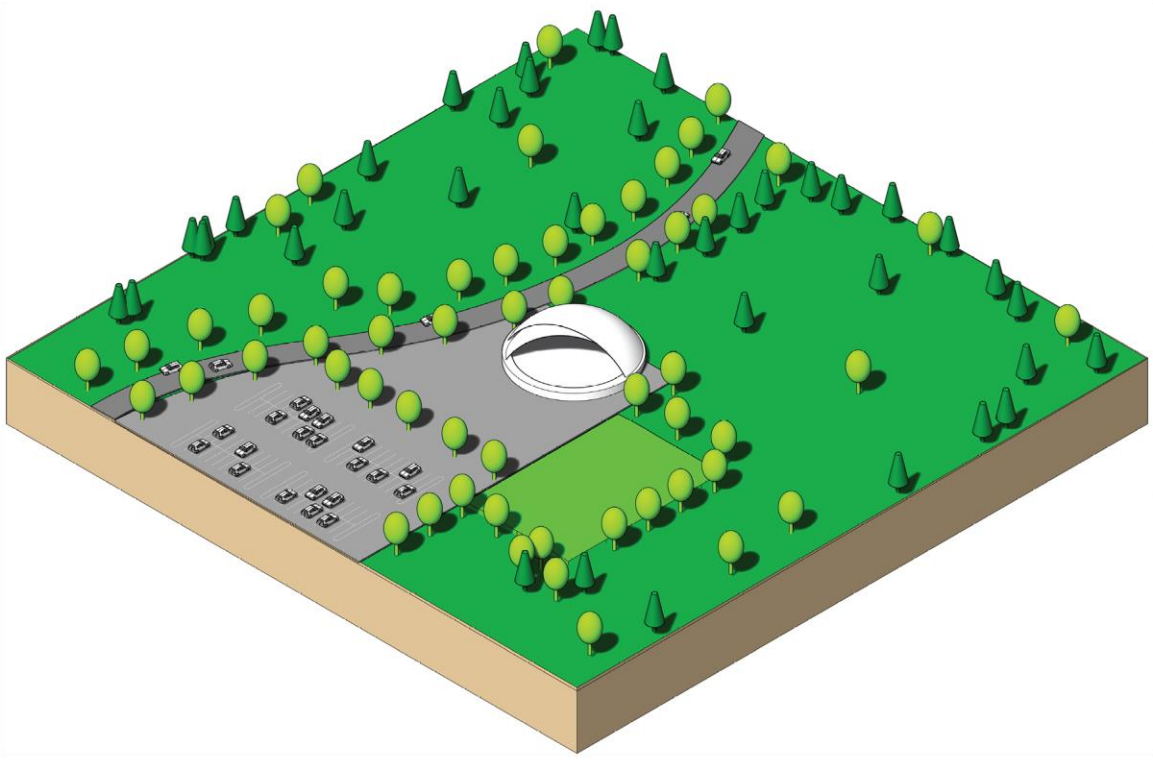
7.1 Social Parks

Open Space

Description: Social parks are critical facilities throughout the County. These parks offer a wide array of passive and active recreational opportunities and usually have structures that support social activities, such as outdoor stages, theaters, gazebos, and picnic areas.

Landscape Threats: Larger lawn areas, regular mowing, high traffic areas degrade landscape quality

South Amboy City, NJ.
Raritan Bay Waterfront Park gazebos.



Opportunities: Biodiverse plantings and lawn alternatives in underutilized areas, green infrastructure such as rain gardens, flood resilient infrastructure, amenity enhancements, greenway trails, activity programming, permeable parking

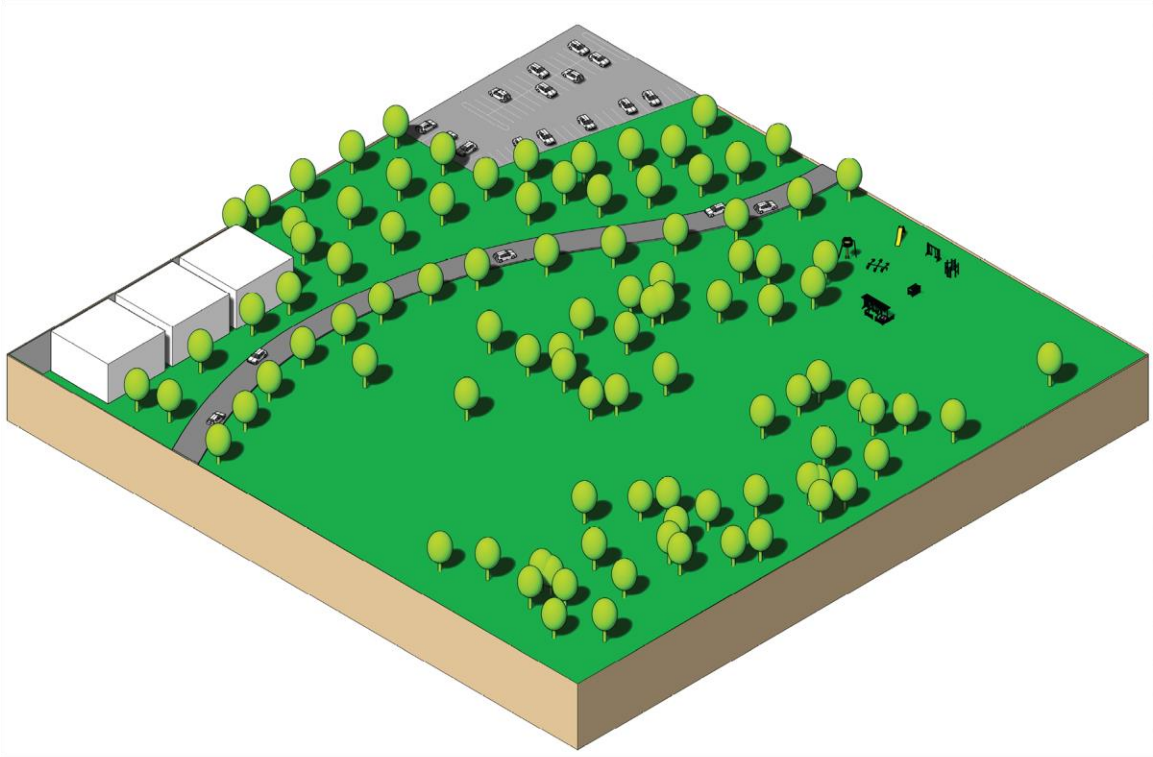
7.2 Neighborhood Parks

Open Space

Description: Neighborhood parks primarily serve the residents directly surrounding the park. They may have playgrounds or small sports fields needing little maintenance. Parking lots are smaller with limited roadways.

Landscape Threats: Low biodiversity, often lawn covered, limited maintenance complexity due to scale

Dunellen Borough, NJ. Gavornik Park.



Opportunities: Biodiverse plantings and lawn alternatives in underutilized areas, green infrastructure such as rain gardens, flood resilient infrastructure, amenity enhancements, greenway trails, permeable parking

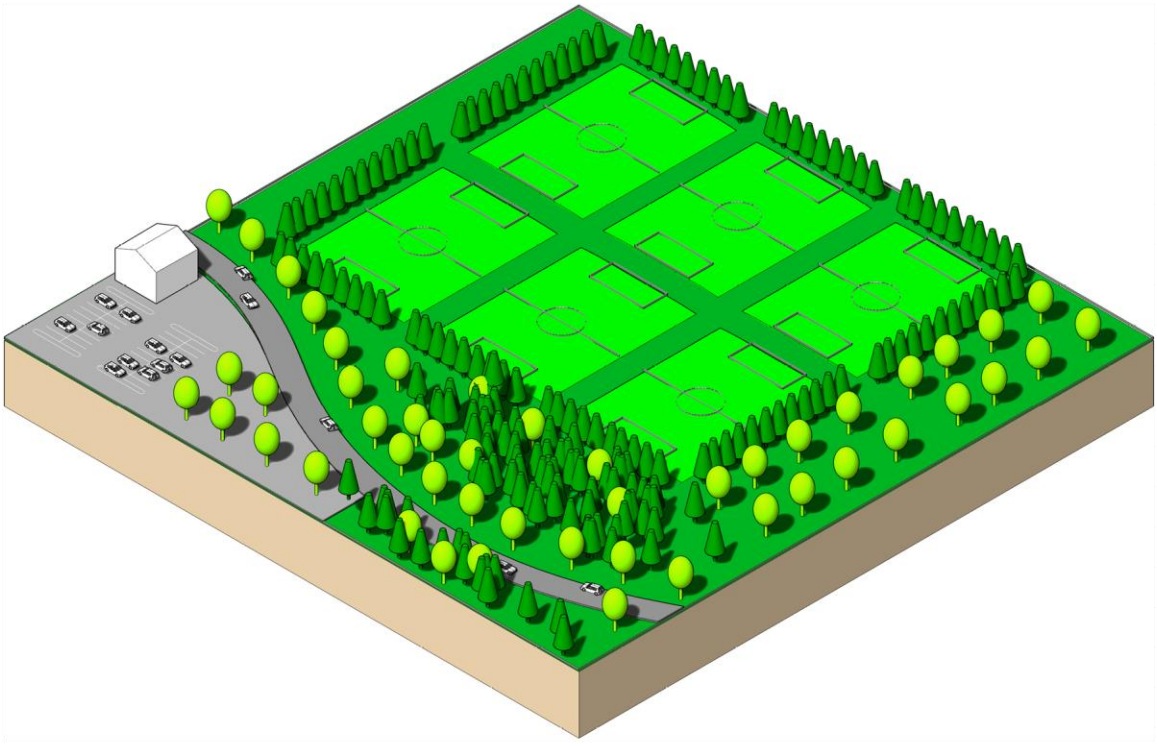
7.3 Sports Parks

Open Space

Description: Sports Parks contain fields and courts dedicated to specific sporting activities. These parks may be associated with schools and regularly programmed, or stand alone parks.

Landscape Threats: Low biodiversity, maintenance regimes may impact any surrounding natural landscapes, such as fertilizers and water use

Perth Amboy, NJ.
Thomas Mundy Peterson Park field view.



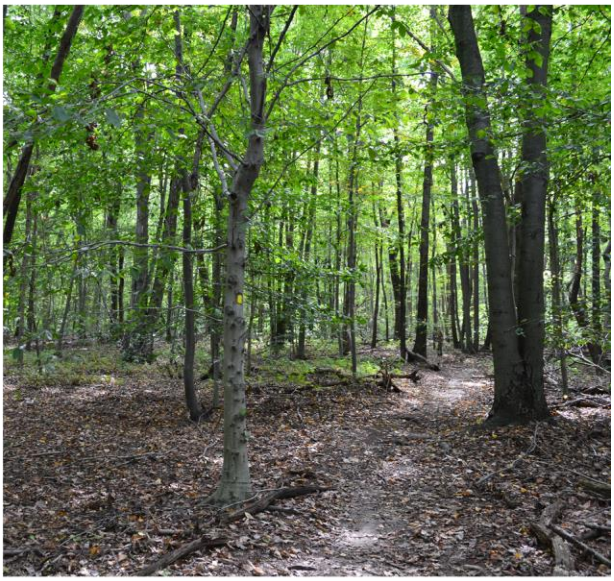
Opportunities: Biodiverse plantings and lawn alternatives in underutilized areas, green infrastructure such as rain gardens and bioswales, flood resilient infrastructure, amenity enhancements, greenway trails, permeable parking

7.4 Nature Parks

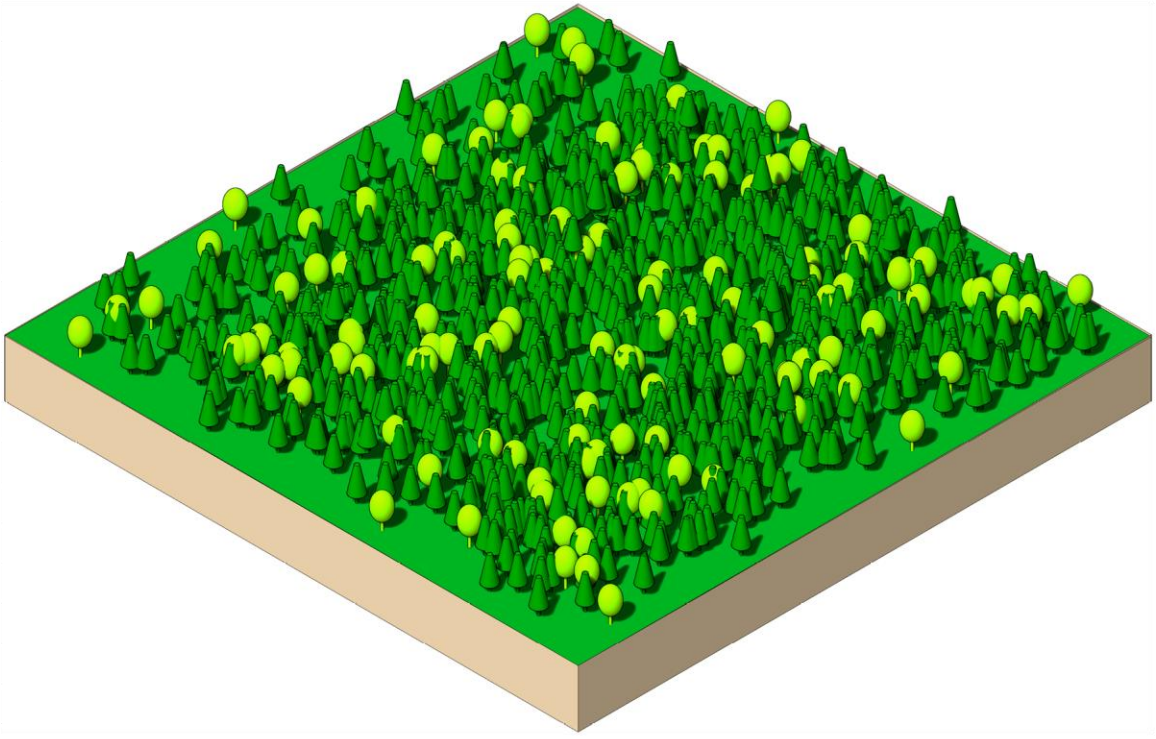
Open Space

Description: Nature parks are conservation areas or predominantly vegetated parks with high ecological value. Passive park use includes hiking, bird watching, photography, and nature study. Natural areas may or may not be accessible to the public but offer ecosystem services.

Landscape Threats: Surrounding area development pressure, invasive plant species, deer damage, public access can disturb ecological habitats



North Brunswick Township, NJ.
Ireland Brook Conservation Area.



Opportunities: Deer management through hunting and fencing, invasive species removal, restoration planting projects with biodiverse native plants, greenway trails and connections to existing paths, permeable parking, amenities such as bird blinds

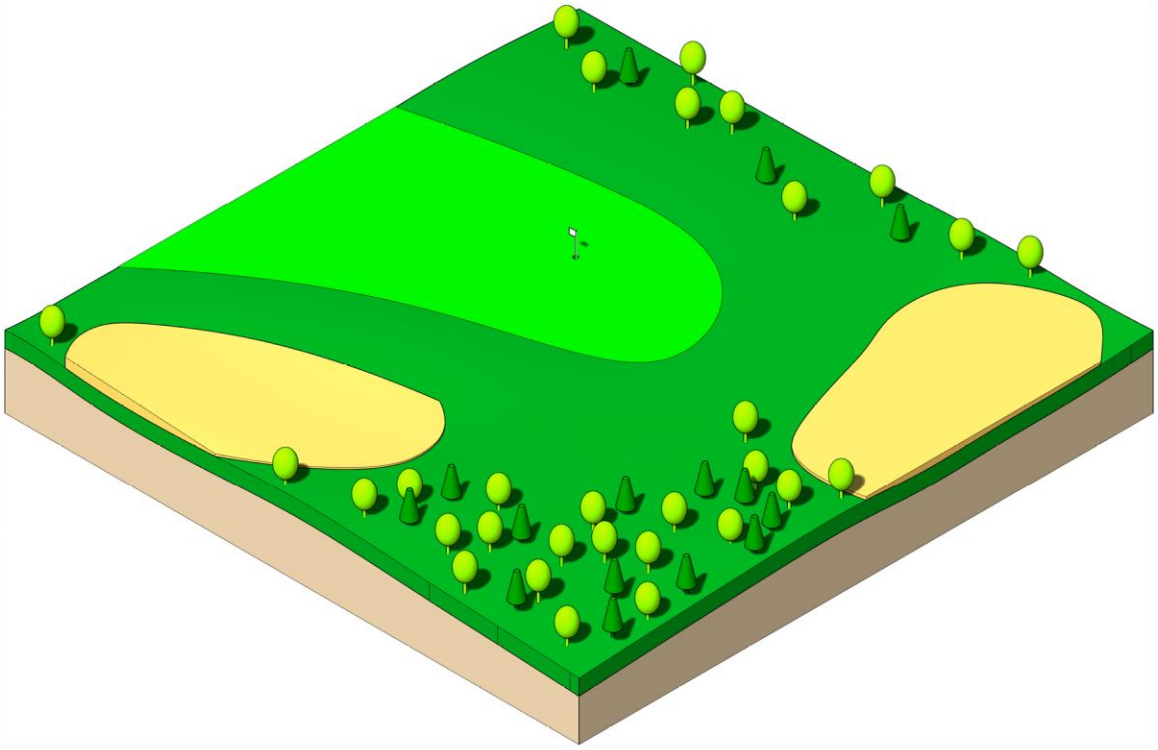
7.5 Golf Courses

Open Space

Description: A golf course is a recreational facility utilized for golfing. Heavy lawn maintenance and landscaping occur often. The landscape may contain water features and surrounding vegetated areas. Public and private golf courses exist throughout the County.

Landscape Threats: Regular fertilizer use and watering, limited plant biodiversity, often replace wetland and natural landscapes

Piscataway Township, NJ. Rutgers Golf Course.



Opportunities: Biodiverse plantings and lawn alternatives in underutilized areas, green infrastructure such as rain gardens, flood resilient infrastructure, amenity enhancements, permeable parking, trail connections to surrounding neighborhoods

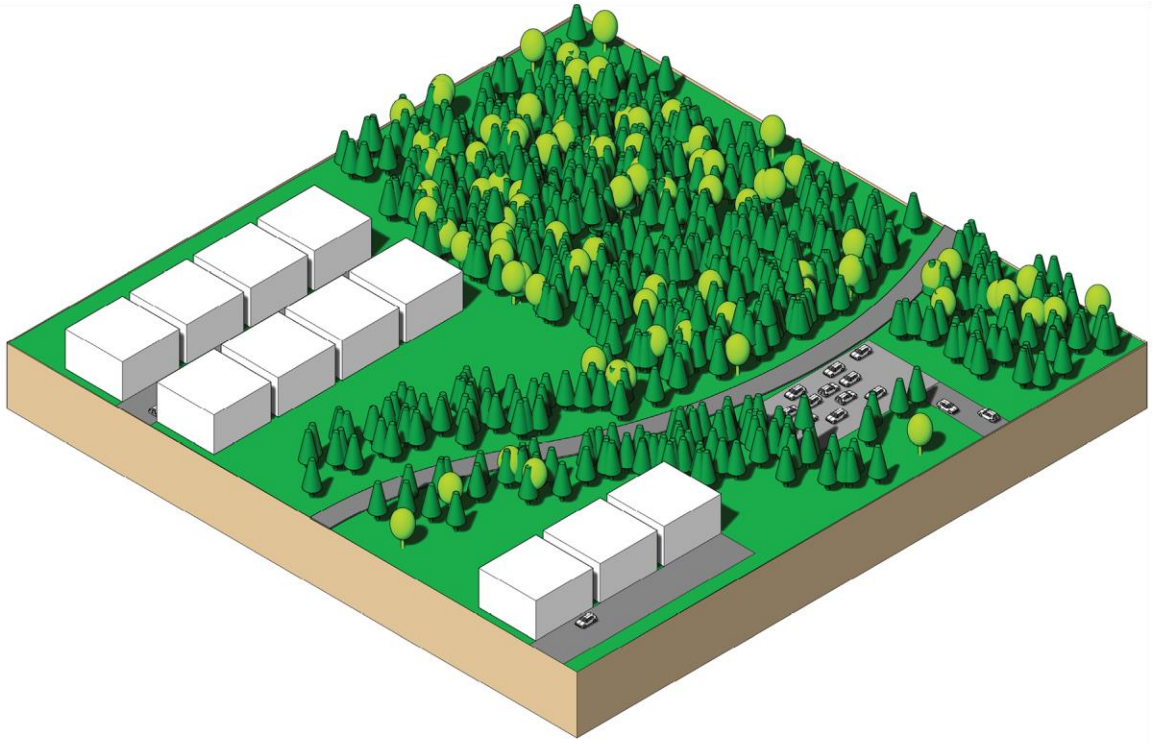
7.6 Greenways

Open Space

Description: A greenway is a linear natural or human-made corridor used for recreation, active transportation (bike trails), or habitat conservation.

Landscape Threats: Land ownership, incorporating maintenance access especially in natural and undisturbed areas

Metuchen Borough, NJ. The Middlesex Greenway.



Opportunities: Natural habitat corridors, safe pedestrian connections between open spaces and commercial areas, identifiable marker for pedestrian wayfinding, permeable parking

LANDSCAPE INFLUENCERS

Landscape influencers are the people and groups directly impacting the landscape. People affect decisions, ordinances, laws, and maintenance and define acceptable landscape standards or expectations that impact the landscape's visual and functional quality. Landscape influencers range from the private homeowner or resident to federal regulatory agencies. ***Table 12*** lists various landscape influencers and their potential impact on the landscape. Municipal, County, State, Federal, private landowners, and non-profit organizations are the leading landscape influencers with decision-making potential that directly impacts the landscape.

Table 12: Landscape Influencers

Influencer	Impacts
Municipality	Incorporate landscape enhancements into ordinances, enforcement through municipal permits, landowners, and managers
County	Provide tools for design standards, require specific landscape enhancements in land use planning, and collaborate among municipalities, landowners, and managers
State	Enforce and regulate environmental impacts of development, landowners, and managers
Federal	Enforce and regulate environmental impacts of development, landowners, and managers
Private Land Owners	Implement landscape actions on privately owned properties, and define expectations from their communities; individual scale impacts contribute to the neighborhood
Non-Profit Organizations	Provide resources and act as advocates for landscape enhancements

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CONCLUSION

The inventory of Middlesex County's environmental conditions informed the essential components to study Middlesex County's natural resources through an *Ecosystem Services Analysis* and people and space through the *Cultural Landscape Analysis*. The Destination 2040 Strategic Initiatives informed the *Inventory* chapter carried into the *Analysis* chapter, establishing priority intervention locations and guiding landscape enhancement needs and opportunities discussed in further detail in the *Actions* chapter.

The *Ecosystem Services* inventory established reasoning to compare the County's rich and diverse natural conditions with development (roughly 60 percent urban) and land preservation. Ecological habitat ranks overlayed with protected open space determined that nearly ***73% of ecological habitats occupy unprotected and non-preserved land.*** Further expansion of buildings, roads, and parking lots will significantly reduce environmental and ecological resources and increase existing flooding and urban heat island effects.

Wetlands and their buffers, priority flood mitigation zones, tree canopy cover, and urban heat islands compared with impervious surfaces revealed priority intervention target areas for green infrastructure, impervious surface removal, and a need for wetland protection. ***Impervious surfaces directly exacerbate flooding and urban heat island effects while degrading wetland quality.*** Replacing impervious surfaces with impermeable materials will help limit the accompanying negative impacts of flooding, urban heat islands, and habitat loss while increasing habitat quality and function to support the ecosystem service function of the natural resources.

Middlesex County's natural resources historically provided outlets for the County's rich cultural heritage formation. The National Park Service's definition of the cultural landscape as historical and natural places informed the inventory and analysis components for the cultural landscape conditions such as arts and culture centers tied to historic districts and sites, expanded to downtown streets, viewsheds, and place character. The *Cultural Landscape Features and Assets Analysis* concluded that the cultural landscape is much more than historical places. Current culture imprints itself in everyday locations such as parks, downtown areas, and even our own homes and is worth celebrating through modern intervention.

The ***Nature & Place.*** Photo Survey established cultural connections to outdoor spaces through memory, identity, and spiritual connections supporting the landscape's many cultural services. This revealed that outdoor experiences exist in viewsheds and landscapes experienced daily, such as commuting to work, at work, at school, or elsewhere, not limited to formal parks.

Placemaking opportunities such as space activation, wayfinding, and amenity enhancements will help create desirable places where people can shop, dine, and experience the outdoors at the heart of the County's cultural centers. A comprehensive greenway network can connect outdoor spaces with downtown areas and is a way to preserve more land by establishing ecological and pedestrian corridors throughout the County. Greenway opportunities exist throughout industrial, commercial, and residential zoned locations and already naturalized corridors.

Understanding nature's connection to place solidifies the necessity for humans to value landscapes to establish a broadened awareness of conservation. In Middlesex County, there are over 50,000 acres of land at development risk. These natural or vacant lands can serve the community through more open space, ecosystem services, and habitat for wildlife. Incorporating an environmentally conscious decision-making framework can ensure quality open space and recreational land, protect habitat corridors, maintain ground providing ecosystem services, and sustain the cultural value present throughout the County. Without a cultural value applied to the landscape, high-quality habitat conservation remains a battle amongst development pressures.

Middlesex County's Ecosystem Services and Cultural Landscape analyses revealed many improvement and protection opportunities throughout the County's landscapes and a regional scale organizational framework through a *Landscape Type* analysis. Enhancement opportunities include habitat preservation and conservation, urban environmental resource improvements, historical and cultural asset improvements, viewshed management opportunities, downtown area and streetscape enhancement potential, open space quality protection and enhancement needs, and the potential for County-wide greenway opportunities. The *Actions* chapter, informed by this analysis, categorizes actions into the above topics and then applies implementation strategies to landscape type-specific or across all landscape types actions supporting the Vision for Middlesex County's *Integrated Cultural Landscape and Ecosystem Services Action Plan*.

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DATA DICTIONARY

Map Title	Layer	Citation
Ecological Habitats of Concern	OSRP Ecological Habitats of Concern Ranks	CUES Rutgers University. (2021). *Middlesex County Open Space and Recreation Plan Update, Ecological Habitat Ranks*. [Pending Approval]. [Data set]. Rutgers University.
	Open Space	NJ Dept. of Environmental Protection Bureau of GIS NJDEP Bureau of GIS. (2020). *New Jersey Green Acres Program State, Local, and Nonprofit Open Space in New Jersey.* [Data set]. New Jersey Department of Environmental Protection. https://njogis-newjersey.opendata.arcgis.com/datasets/njdep::state-local-and-nonprofit-open-space-of-new-jersey?geometry=-78.862%2C38.661%2C-70.622%2C41.600
	Preserved Farmland	New Jersey Department of Agriculture (NJDA). State Agriculture Development Committee (SADC). (2020). NJFPP_Preserved_Farms. [Data set]. The New Jersey Farmland Preservations Program.
Wetlands, Buffers, and Watershed delineation	Wetlands	U.S. Fish and Wildlife Service; National Wetlands Inventory; National Standards and Support Team., U. S. F. & W. S. (2021). *Wetlands Mapper*. [Data set] National Wetlands Inventory. https://www.fws.gov/wetlands/data/Mapper.html
	C1 Streams	New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). (2010). *National Hydrography Dataset (NHD) Streams in New Jersey 2002*. (Edition 20101101). [Data set]. New Jersey Department of Environmental Protection. https://njogis-newjersey.opendata.arcgis.com/documents/njdep::national-hydrography-dataset-nhd-streams-2002-for-new-jersey-download/about
	HUC 14 Watershed Units	New Jersey Department of Environmental Protection. (2016). *14 Digit Hydrologic Unit Code Delineations for New Jersey* (Edition 20160309). [Data set]. New Jersey Department of Environmental Protection. https://www.nj.gov/dep/gis/digidownload/zips/OpenData/Hydr_HUC14_bnd.zip
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Priority Flood Mitigation	Priority Flood Mitigation	CUES Rutgers University. (2021). *Middlesex County Open Space and Recreation Plan Update, Flood Mitigation Ranks*. [Pending Approval]. [Data set]. Rutgers University.
Priority Flood Mitigation and Impervious Surfaces	Impervious Surfaces	New Jersey Department of Environmental Protection. (2018). *Impervious Surface (2015) of Middlesex County, New Jersey*. (Edition 20180930). NJ Department of Environmental Protection. https://www.nj.gov/dep/gis/digidownload/zips/OpenData/Land_is_2015_Middlesex.zip
Tree Canopy Cover and Impervious Surfaces	Tree Canopy Cover	U.S. Forest Service. (2016). *NLCD 2016 USFS Tree Canopy Cover (CONUS)*. [Data set]. Multi-Resolution Land Characteristics Consortium. Retrieved from, https://www.mrlc.gov/data/nlcd-2016-usfs-tree-canopy-cover-conus.
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Urban Heat Island and Impervious Surfaces	Urban Heat	U.S. Geological Survey. (2021). *LandSat (8 OLI/TIRS c2 L2) August 26, 2021. Band_10.* [Data set].
	Impervious Surfaces	New Jersey Department of Environmental Protection. (2018). *Impervious Surface (2015) of Middlesex County, New Jersey*. (Edition 20180930). NJ Department of Environmental Protection.

		https://www.nj.gov/dep/gis/digidownload/zips/OpenData/Land_is_2015_Middlesex.zip
Historical and Cultural Assets	Arts and Culture centers	Middlesex County Economic and Business Development. (2020). *Arts Cultural Historic Sites* [Data set].
	Downtown Streets	CUES Rutgers University. (2021). *Downtown Street Locations.* [Data Set].
	Historic Districts	New Jersey Department of Environmental Protection (NJDEP). (2020). *Historic Districts of New Jersey. (*Edition 20200401). [Data set]. New Jersey Department of Environmental Protection https://www.nj.gov/dep/gis/digidownload/zips/OpenData/Land_use_HPO_district.zip
	Historic Properties	New Jersey Department of Environmental Protection (NJDEP). (2020). *Historic Property Features of New Jersey*. [Data set]. New Jersey Department of Environmental Protection https://www.nj.gov/dep/gis/digidownload/zips/OpenData/Land_use_HPO_property_features.zip
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Land Use and Cultural Landscape Types	Middlesex County Base Zoning	Middlesex County Office of Planning, Middlesex County Office of Economic & Business Development. (2020). *Base Zoning*. [Data set].
	Invest Smart Strategic Investment Areas	***Invest Smart.*** Strategic Investment Areas Analysis (2022). Voorhees Transportation Center (VTC). *Rutgers University*. [Dataset].
	NJDEP Landfills	NJ Dept. of Environmental Protection Bureau of GIS, NJDEP. (2022). *Solid Waste Landfill Sites Extents in New Jersey.* [Dataset]. https://njogis-newjersey.opendata.arcgis.com/datasets/njdep::solid-waste-landfill-site-extents-in-new-jersey/explore?location=40.453738%2C-74.330500%2C11.31
Land at Development Risk	OSRP Land at Risk of Development	CUES Rutgers University. (2021). *Middlesex County Open Space and Recreation Plan Update, Land at Risk of Development*. [Pending Approval]. [Data set]. Rutgers University.
Land at Development Risk and Base Zoning	Middlesex County Base Zoning	Middlesex County Office of Planning, Middlesex County Office of Economic & Business Development. (2020). *Base Zoning*. [Data set].

APPENDIX

Appendix 1: Downtown Existing Quality Analysis Matrix Definitions

Topic	Term	Description
Downtown Character	Existing Downtown Area	Established downtown area
	Emerging Downtown Area	Developing or planned downtown area
Downtown Type	Urban City Center	City central business district, with a mix of commercial and residential uses; often has high-rise and 2-4 story buildings, multiple streets with a higher population density; larger scale with numerous areas/sections.
	Suburban Town Center	Distinct character, smaller in scale with a mix of 2-4 story buildings (generally) with residential and commercial; often serves the local community.
	Rural Village Center	This is a smaller-scale rural commercial district with small clusters of higher-density development.
Designations/Programs	Historic District/Properties	Historic properties or groups of properties recognized and protected by the state and National Registrar for their historical significance.
	Transit Village	The area around a transit facility that the municipality has demonstrated a commitment to revitalizing and redeveloping into a compact, mixed-use neighborhood with a vital residential component (72)
	Main Street Coalition	Designations awarded by the *Main Street New Jersey Program* which is the Certified State Coordinating Program of the National Trust's National Main Street Center. This initiative provides funding for NGO work (73)
	Special Improvement Districts (SID)	Generally, in the central business district of downtown or a mixed-use corridor, authorized by state law and created by a local government ordinance to collect a special assessment on the commercial properties and/or businesses in that area (74)
	Redevelopment Areas (RDA)	Parcels designated by the local government as an area in need of redevelopment
	Neighborhood Preservation (NPP)	Provides direct financial and technical assistance to municipalities based on strategic revitalization plans within those municipalities. (75)
	Shade Tree Commission	A commission developed through municipal ordinances to enlist a decision-making body with control over the shade trees in parks and in the public right-of-way (76)

Public Transportation	NJ Transit Train Station	The Coordinated Public Transit-Human Services Transportation Strategic Plan: Transit Services Map from September 16, 2021, supplied information for analysis of communities with public transportation. Sources on this map include ESRI, NJGIN, NJTPA, MCOP, NJ Transit, MCAT, Suburban Transit, Rutgers University, Princeton University, Mercer County, Somerset County, and Monroe Township.
	NJ Transit Bus Route	
	NJ Transit Bus Stop	
	Rutgers Bus Route	
	Rutgers Bus Stop	
	Greater Mercer MTA Route	
	Greater Mercer MTA Stop	
	MCAT Route	
	MCAT Stop	
	Suburban Transit (Coach USA) Route	
	Suburban Transit (Coach USA) Stop	
	Somerset County Shuttle Route	
	Somerset County Shuttle Stop	
	Tiger Bus Route	
	Tiger Bus Stop	
	Monroe Township Shuttle Route	
Amenities	Open space within a .5-mile buffer	Any ownership, designated open space parcel within a .5-mile radius of an identified downtown street
	Captivating and Active Storefronts	Storefronts with visible activity through windows, activity on the sidewalk, or visually stimulating decoration
	Wayfinding Signage	Directional signage in the downtown area
	Public Art	Art installations such as statues, murals, etc. within the public realm
	Street Trees	Trees along the right-of-way in tree pits or planters
	Sidewalk Amenities (benches, bicycle racks, garbage cans)	Amenities designed for human comfort
	Light Pole Flags	Small flags unique to the municipality adorning light fixtures
	Dedicated Pedestrian Space (plaza, etc.)	Permanent pedestrian space not within a designated open space parcel
	Marked bicycle lanes	Bicycle lanes painted on the roadway with signage
	Wide Sidewalks (greater than 5 feet)	Sidewalks house activities other than walking
	Arts and Cultural Opportunities	Art and cultural amenities are available in the downtown area, including theaters, museums, galleries, cultural centers, college cultural centers etc.

	New Apartment Development	Apartment complexes designed to accommodate the downtown area
	Farmer's Markets	An outdoor market selling local produce and goods
	Pedestrian Centric	Area with sidewalks and amenities for easy and safe walking; the area is easily accessible by bike or foot
	Car centric	A vehicle is needed to get to this area; located off of a major highway
Parking	On-Street Parking	Public parking along the main roadway
	Public Lot Parking	Public parking in a lot
	Park and Ride Lot	Parking lot with transportation to main area of transportation (identified through Google Maps).
	Parking Deck	Paid parking in a parking deck structure
Business Type	Large Franchise Stores	"Big box" stores are the main commercial feature
	Locally Owned Businesses	Smaller businesses owned by the local community offer the dominant commercial experience
Green Infrastructure	Rain Gardens	Landscaped, shallow depressions capture rainwater and allow it to percolate slowly into the ground
	Detention Basin	Temporarily stores and attenuates stormwater runoff

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