BIKE FAIRFAX CITY

Live Life Connected on Two Wheels

CITY OF FAIRFAX VIRGINIA 1805

ADOPTED JUNE 22, 2021

Acknowledgments

Thank you to the local residents, community leaders, and government staff that participated in the development of this plan through meetings, workshops, events, comment forms, and plan review. Special thanks to those who participated as steering committee members, listed below.

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Glossary of Terms

PREVIOUSLY PROPOSED PROJECT: A project that has already been proposed in a previous plan such as the *2017 Fairfax Multimodal Transportation Plan*.

PROGRAMMED PROJECT: A project that is currently in the design phase, under construction, or has some level of funding associated with it.

BIKEWAY: A general term that includes bike lanes, paths, and designated streets or routes that provide for bicycle travel.

BIKE LANES: Bike lanes provide a dedicated lane for bicycle travel on the roadway utilizing striping, pavement markings and signage.

BUFFERED BIKE LANE: A buffered bike lane is an on-street bike lane that has a painted buffer either between the bike lane and parked cars, between the bike lane and the standard motor vehicle lane, or both.

LOCAL ACTIVITY CENTER: A local Activity Center, as defined in the city's *Comprehensive Plan*, are locations in the City where pedestrian-oriented, mixed use development is strongly encouraged to accommodate future growth. These Activity Centers include Old Town Fairfax, Northfax, Fairfax Circle, Pickett and Main, and Kamp Washington.

LONG TERM IMPROVEMENT: Long term improvements identify higher volume / higher speed corridors that will likely require long planning horizons and major investments.

TRAFFIC STRESS: As one measurement of the user experience, "traffic stress" is the perceived sense of danger associated with riding in or adjacent to vehicular traffic. A low stress roadway or bicycle facility means that it feels comfortable and safe for users of the street, particularly bicyclists.

NEIGHBORWAYS: Neighborways are streets with low vehicle volumes and speeds that prioritize bicycle travel through signage, pavement markings, and/or traffic calming.

OFF-STREET PATH: Off-street paths, also referred to as trails, provide a bike facility completely separated from the roadway; often shared with pedestrians, may vary in design and location (e.g. park trails, sidepaths next to roads, short connector trails, etc.)

SEPARATED BIKE LANE: On-street bicycle facilities physically separated from motor vehicle traffic using bollards, curbs, or parking.

SPOT IMPROVEMENTS: Spot improvements are design features aimed to address challenging locations, usually at intersections and crossings.

SUPER SHARROWS: Super sharrows are enhanced large pavement markings centered in the travel lane used to reinforce that people bicycling share the road with motor vehicles.

TRIP GENERATOR: A trip generator is a key destination within the community that people frequently travel to. Trip generators were used in this plan to understand the demand for bicycling on specific corridors.

COMPLETE STREETS: Roadways designed and operated to enable safe access and travel for all users, including pedestrians, bicyclists, motorists, and public transportation users of all ages and abilities.

Executive Summary

Why Create a Bike Plan?

The City of Fairfax Bicycle Plan, *Bike Fairfax City,* outlines a comprehensive bike network as a key component of a sustainable multimodal transportation system. The recommendations in this plan support many of the goals in the *2035 Comprehensive Plan*.

A comprehensive bike network will benefit all transportation modes—biking, walking, driving, and public transit. Bicycle infrastructure has been shown to improve safety for all street users, can reduce congestion, provide more transportation options, and improve the economy, environment, health, and opportunity.

The Plan's Vision

Bike Fairfax City *Vision Statement:*

"In 2035, Fairfax is a city where residents of all ages and abilities can safely and efficiently travel within and between neighborhoods and destinations using a connected network of low stress bikeways. Biking is a convenient, safe, and desirable choice for transportation and recreation. Bicycle facilities, programs, and policies foster health, equity, and sustainability, and contribute to the unique and vibrant Fairfax community."

The Plan's Goals

The six goals below build upon the vision statement, relate directly to the values from the *2017 Fairfax Multimodal Transportation Plan*, and expand on lessons learned from national bicycle research. The goals have been adapted to promote bicycle travel within and between neighborhoods in the City of Fairfax.

CONNECTED

VIBRANT

SAFE + SECURE

ROBUST

INTERGENERATIONAL CITY

GREEN

What's in the Plan?

- Documentation of past and current bicycle planning processes in the City of Fairfax.
- Analysis of existing conditions for biking and how it relates to the larger transportation system in the city and region.
- Recommended policies, programs, and a comprehensive network of on-road bikeways and off-street paths.
- Strategies to implement the plan recommendations.

Existing Conditions

An existing conditions analysis was performed to better understand trends and issues related to biking in Fairfax City today. This work sets the stage for the development of the recommended network, proposed policies and programs and implementation strategies to advance bicycling in Fairfax City.

Type of Analysis Completed	Key Observations
Planning History	The *2017 City of Fairfax Multimodal Transportation Plan* sets a clear vision for transportation in the City of Fairfax and directly informed the goals of this plan.
Review of Existing + Planned Bike Network	The city's compact development and existing neighborhood streets and off-street trails provide opportunities for short distance trips ideal for biking. However, gaps in the trail network and barriers on major roadways limit connectivity across the city.
Safety Analysis	81% of bicycle crashes in the past decade occurred on major arterials such as Main St and Fairfax Blvd.
Traffic Stress	Major arterials create high stress bike experiences while local, neighborhood streets and off-street trails generally provide low stress experiences.
Bicycle Trip Generators + Existing Access	Activity Centers, such as Old Town and Northfax, are where most of the major destinations are located. These locations, however, are often along high volume, high speed corridors.

Public Input

Public input for the *Bike Fairfax City* plan included an online survey, online interactive map, steering committee meetings, a public workshop, and public comment periods on the draft plan.

While the public participation wasn't statistically representative, we generally heard that people preferred: more separated bicycle facilities, better connections to trails and other community destinations, and increased safety for bicyclists.

Recommended Bicycle Network

The recommended bicycle network was developed using the findings from existing conditions analysis, understanding public input, and applying professional judgment. The result is a connected network of low stress bikeways including neighborways, off-street paths, spot improvements, and long term improvements, such as separated bike lanes. Other improvements such as standard bike lanes and super sharrows complement the low stress network.

In addition to physical infrastructure, the plan includes policy and program recommendations such as updated design standards, traffic safety policies, evaluation strategies, and education and encouragement programs.

Basis of the Recommended Bicycle Network

EXISTING CONDITIONS

Previous Plans + Policies
Current Road Conditions
Safety Analysis
Level of Traffic Stress
Trip Generation
Circulation Patterns
Fieldwork

+

PUBLIC INPUT

Steering Committee
User Survey
Interactive Map
Public Workshop

PROFESSIONAL JUDGMENT

Best Practices
Engineering Judgment

Facility Types

Different types of bikeways are better suited for different roadways based on considerations such as how fast and how frequently vehicles use the road and the roadway width. The following bikeways and project types are part of the recommended network design “toolbox”.

RECOMMENDED: 43 Locations
Spot improvements are design features aimed to improve challenging locations, usually at intersections and crossings.

RECOMMENDED: 2.4 MILES
Bike lanes provide a dedicated lane for bicycle travel on the roadway utilizing striping, pavement markings and signage.

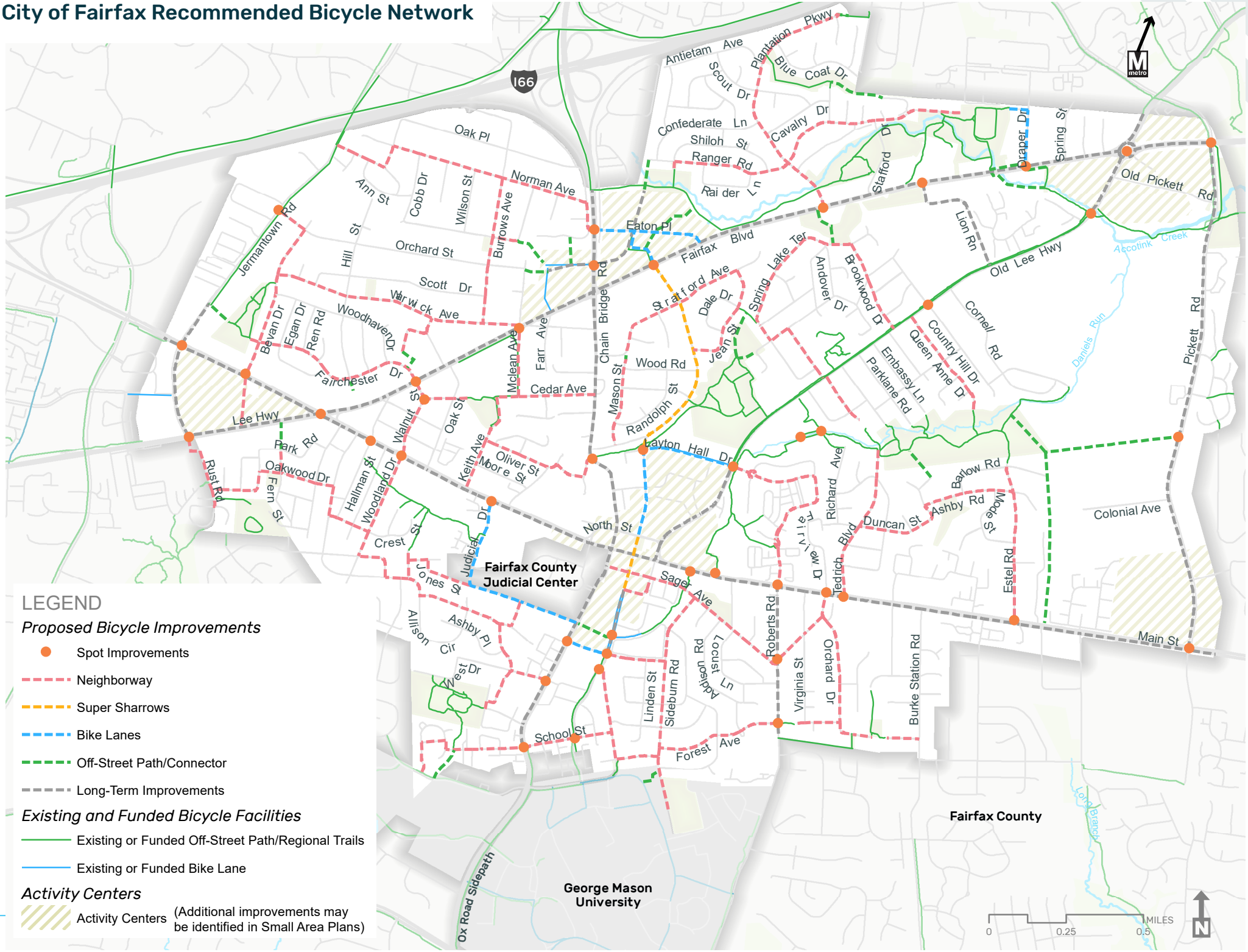
RECOMMENDED: 19.7 MILES
Neighborways are streets with low vehicle volumes and speeds that accommodate bicycle travel through signage, pavement markings, and/or traffic calming.

RECOMMENDED: 3.5 MILES
Off-street paths provide a bike facility completely separated from the roadway, are often shared with pedestrians and may vary in design and location (e.g. park trails, sidepaths next to roads, or short connector trails).

RECOMMENDED: 0.87 MILES
Super sharrows are enhanced large pavement markings centered in the travel lane used to reinforce that bikes share the road with motor vehicles.

RECOMMENDED: 13.6 MILES
Long term improvements identify higher volume / higher speed corridors that will likely require long planning horizons and major investments.

City of Fairfax Recommended Bicycle Network



Plan Implementation

The project team developed a strategy to guide implementation of the recommended infrastructure improvements, policies, and programs. The implementation strategy includes the following:

- prioritized short- and long-term projects;
- action items to implement the program and policy recommendations and the prioritized short-term and long-term projects;
- conceptual designs for three example projects to highlight the recommended design principles; and
- potential funding sources.

Network Prioritization

Given limited funding, the City of Fairfax must decide how to prioritize the implementation efforts recommended in this plan. In order to identify high priority initiatives, the project team developed prioritization criteria (connectivity, demand, feasibility, safety and high need) to guide short term and long term projects.

Action Items

Action items are proposed for implementation of several of the program and policy recommendations, such as updating city standards with current bicycle facility design best practices, incorporating bicycle recommendations into maintenance and operations programs, and developing an annual report card to measure progress on the bicycle plan goals.

In addition, the action items outlined on the right will help guide implementation of the prioritized infrastructure recommendations.

Short Term Projects

21.5 Miles and 22 Spot Improvements

Short term projects are projects that are recommended for completion within the next 5 years. The short term network includes the entire neighborway network as well as other projects that met most of the prioritization criteria. The City should engage stakeholders to develop wayfinding signage for the neighborway network, identify traffic calming elements, and determine a final design concept for the short-term spot improvements and bikeways.

ACTION ITEMS: SHORT TERM NETWORK

- Network Branding + Wayfinding
- Neighborway Concept Development
- Spot Improvement + Bikeway Implementation

Long Term Projects

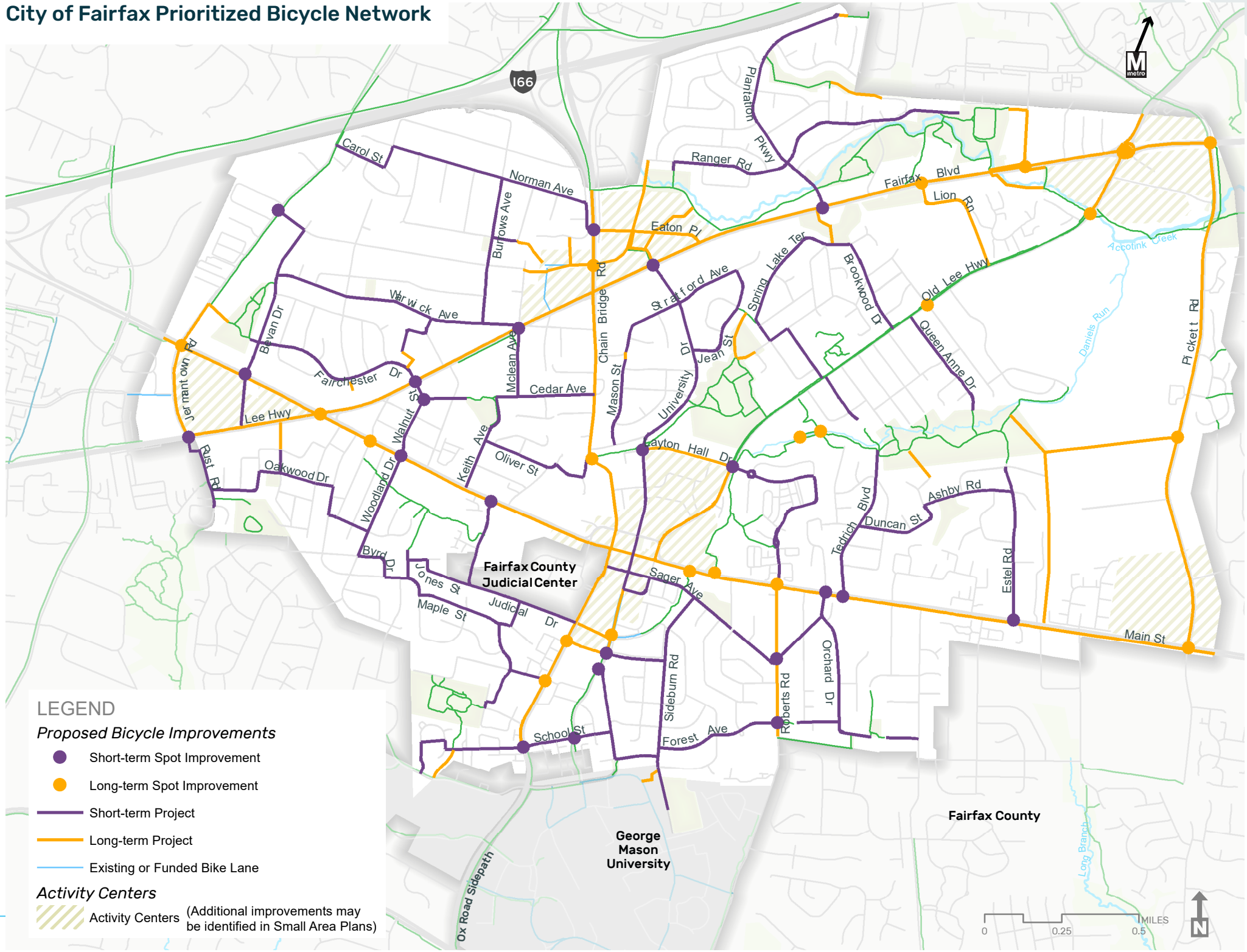
18.5 Miles and 21 Spot Improvements

Long term projects require additional traffic studies and a community design process to evaluate trade offs, and may require multi-agency coordination. Several of the projects identified in the long term network are more complicated and require more time to develop feasible concepts for the corridor and outline a strategic approach to implementation.

ACTION ITEMS: LONG TERM NETWORK

- Corridor Studies
- Focused Community Engagement
- Secure Funding

City of Fairfax Prioritized Bicycle Network



LEGEND

Proposed Bicycle Improvements

- Short-term Spot Improvement
- Long-term Spot Improvement
- Short-term Project
- Long-term Project
- Existing or Funded Bike Lane

Activity Centers

- Activity Centers (Additional improvements may be identified in Small Area Plans)

Chapter 1: The Vision

CHAPTER 1
The Vision

The City of Fairfax is well positioned to become a bikeable community. The city is a compact community of nearly 25,000 residents, adjacent to the Fairfax campus of George Mason University, and centrally located within Northern Virginia. Many prominent destinations both inside and outside the city are within easy biking distance. Mason, with a student population of approximately 36,000, is approximately one mile from Old Town Fairfax. The city is just over six square miles in area and contains a diverse range of shops, restaurants, services, and other amenities.

However, limited availability of a low stress bike network means that few community members can comfortably access these amenities without a car. The City of Fairfax Bicycle Plan, *Bike Fairfax City*, outlines a comprehensive bike network as a key component of a robust and sustainable multimodal transportation system. This will increase residents' travel options between neighborhoods and to Activity Centers and other commercial opportunities within the city. It will also improve connections to the surrounding region, such as to regional transit at the Vienna/Fairfax-GMU Metrorail station and to regional trails including the Cross County Trail and the planned I-66 trail.

A comprehensive bike network will benefit all transportation modes—biking, walking, driving, and public transit. Bicycle infrastructure has been shown to improve safety for all users of the street, improve the safety of sidewalks for people walking, increase the predictability of bicyclists and motor vehicles, and can reduce congestion by providing more viable transportation options.

Developing the Vision Statement

The *Bike Fairfax City* plan builds upon the vision outlined in the *City of Fairfax Multimodal Transportation Plan* (2017)—which emphasizes safe and efficient transportation options—to explicitly promote bicycling as an option for people of all ages and abilities. The vision was also developed through input from the City, stakeholders, and the public.

As envisioned in the City's *2035 Comprehensive Plan*, the *Bike Fairfax City* plan outlines a multipronged strategy of infrastructure improvements, policies, and programs to help improve bicycling safety and comfort, building on previous efforts and supporting the City's continued development as a vibrant and sustainable community.

Bike Fairfax City *Vision Statement:*

"In 2035, Fairfax is a city where residents of all ages and abilities can safely and efficiently travel within and between neighborhoods and destinations using a connected network of low stress bikeways. Biking is a convenient, safe, and desirable choice for transportation and recreation. Bicycle facilities, programs, and policies foster health, equity, and sustainability, and contribute to the unique and vibrant Fairfax community."

Planning Process

Project Background

The *Bike Fairfax City* plan outlines a comprehensive bicycling network and recommends projects, policies, and programs aimed at bolstering a safe biking community in the City of Fairfax.

The recommendations within the plan were developed by analyzing previous plans and existing conditions, and collecting public input on how the community wants to travel in the future. The plan prioritizes these recommendations and presents a set of recommendations for future implementation of high quality infrastructure, high impact programs, and supportive policies for bicycling.

The plan was initiated by the Transportation Division to meet several goals in the City's *2035 Comprehensive Plan*. It builds on the work of the *2017 Multimodal Transportation Plan* (adopted in the *Comprehensive Plan*). It also builds on and overlaps with a number of other planning efforts including (but not limited to) the *2014 Parks and Recreation Strategic Master Plan* and the *Old Town and Northfax Small Area Plans* adopted in 2020. The plan integrates projects under development and seeks to integrate with the surrounding region including the bicycling network in Fairfax County and on Mason's Fairfax campus.

FIGURE 1: PROJECT TIMELINE

Public Input

Overview

Public input for the *Bike Fairfax City* plan consisted of several phases. The first was an online survey to gauge respondents' bicycling habits and their ideas for improvement of bicycling within the City of Fairfax. The second was an online interactive map in which respondents identified destinations they would like to access by bike, bike routes that need improvement, specific barriers to bicycling, and existing preferred bike routes. Public input also consisted of three steering committee meetings and a public workshop to help guide the development of the plan and provide feedback on the results of the existing conditions analysis and draft recommendations. Other public input opportunities included public comment periods after the public workshop and the full draft of the plan.

While the participation wasn't statisitically representative, we generally heard that people preferred: more separated bicycle facilities, better connections to trails and other community destinations, and increased safety for bicyclist.

A summary of each portion of the public engagement can be found in Appendix A.

COVID-19 Impacts

This plan reflects an adjusted planning process in response to the COVID-19 pandemic. Due to Virginia Governor Ralph Northam's Executive Order 55, planned outreach activities and the associated schedule were modified to comply with public health guidelines. This includes shifting to virtual outreach activities and an extension of the overall plan timeline.

I bike with my kids (ages 9 and 11) and I would like to see more bike lanes and preferably separate bike lanes so they can feel comfortable biking around the city.

Plan Goals

The goals outlined below build upon the vision statement, relate directly to the values from the *2017 Fairfax Multimodal Transportation Plan*, and expand upon national best practices. These goals guide the strategies presented in this plan. The goals have been adapted to promote bicycle travel within and between neighborhoods in the City of Fairfax.

Connected

Create connected bikeable streets and trails that allow people to safely and conveniently travel within Fairfax and connect to regional facilities such as the I-66 trail and the Cross County Trail.

Safe + Secure

Address the safety of the transportation system for the most vulnerable users and aim for zero bicycle fatalities and serious injuries.

Vibrant

Recognize the placemaking benefits of bicycle friendly communities, capitalize on the potential for economic growth, and implement complete streets solutions to support active, healthy and livable communities.

Green

Reduce transportation related emissions, preserve green space, and add facilities that enhance the natural beauty and environmental quality of the city.

Robust

Ensure that biking is one of many viable and convenient mobility options for residents and visitors, and ensure they have a variety of route options to access their destinations by bike.

Intergenerational City

Create a bicycle network that attracts and encourages people of all ages and abilities to travel around the city by bike.

Benefits of Biking

Bicycling has many benefits to residents and communities such as improved transportation choice, traffic safety, economy, environment, health, and opportunity. Several benefits of biking are described in more detail on the following pages.

An active lifestyle through bicycling leads to myriad health benefits for all ages.

How we travel within our communities can greatly affect our physical, mental, and social health and well being. Creating opportunities for making healthy travel options the default choice has great potential to impact health outcomes in the community. When residents have access to connected and safe places to bicycle, it is easier to expand social connections, address mental health, and engage in more physical activity. In turn, increased physical activity – including even small shifts from sedentary behavior to lower levels of activity – can help reduce the risk of various diseases and health conditions.

Relation to Plan Goals

Relates most closely to the goals of a vibrant, green, and intergenerational city.

CITY OF FAIRFAX HEALTH INDICATORS

23.6% of adults over the age of 20 in the City of Fairfax **are overweight or obese** (Body Mass Index 25-29.9 or >30, respectively).[1]

16.7% of Adults over the age of 20 in the City of Fairfax are sedentary, meaning they did not participate in any physical leisure activities during the past month.[2]

One international study showed that, when adjusted for other types of physical activity, bicycling has been shown to reduce the overall rate of mortality by 10%.[3]

Nationally, those who bicycle report a better mood, higher self confidence, higher tolerance to stress, and healthier sleep patterns.[4]

A flexible multimodal network serves a larger share of the community and provides more choice and freedom.

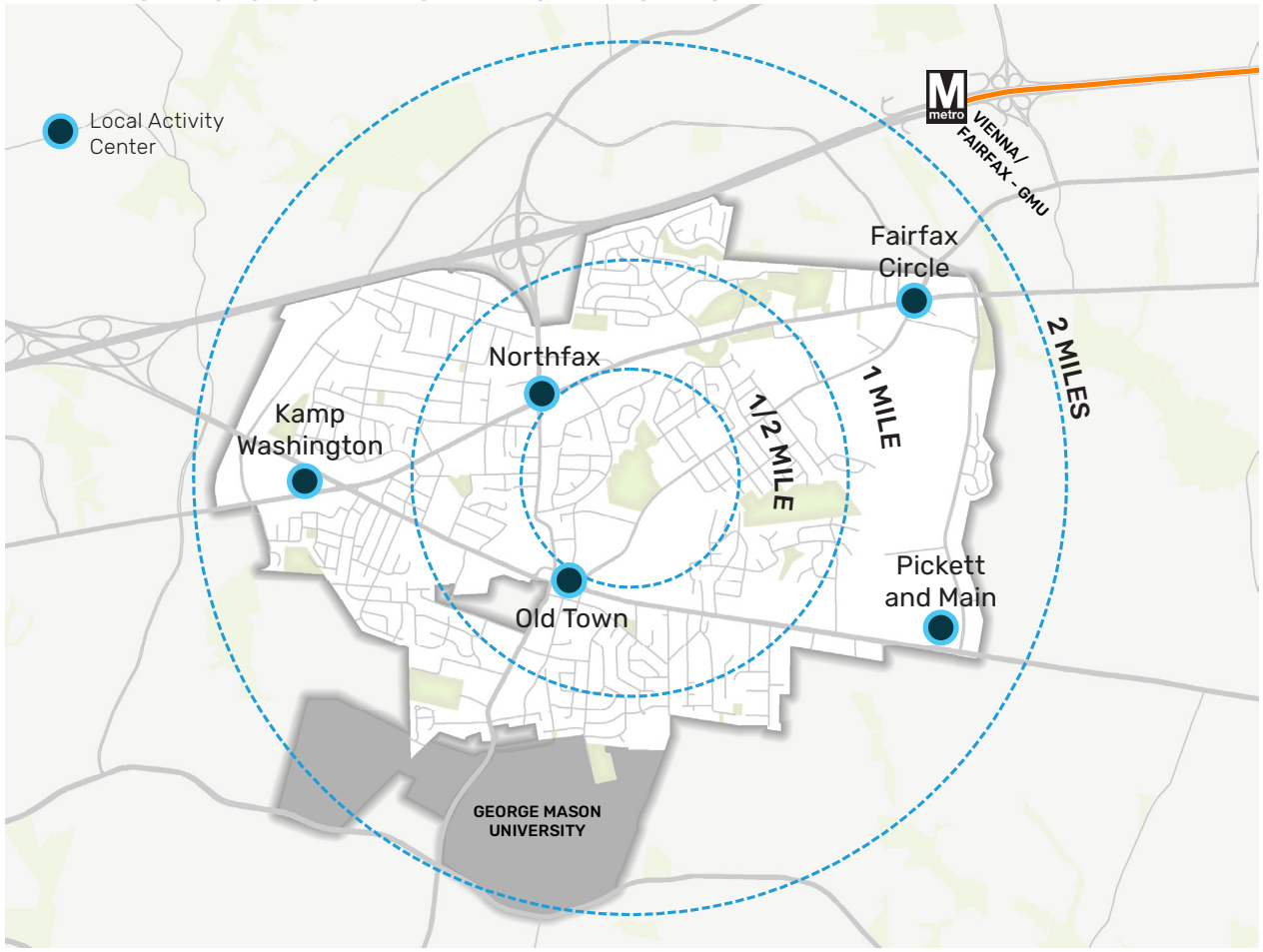
On average, 40% of all trips Americans make are two miles or less—a distance that can be covered by a 10 minute bike ride or a 30 minute walk.[5] In the metropolitan Washington region, the median of all non-commute trips made by inner suburban residents—such as Fairfax City residents—is 2.7 miles.[6]

Most destinations in the city are within a distance that most riders would consider comfortable. In fact, if every street in the network were comfortable for bicyclists, every resident would be within a 15-minute bike ride of at least one, and in many cases several, Local Activity Centers.

Relation to Plan Goals

Relates most closely to the goals of a connected, robust, and vibrant city.

MAP 1: DISTANCES FROM THE CENTER OF THE CITY OF FAIRFAX



Safe speeds are especially important to help protect the most vulnerable on the road.

People biking are disproportionately threatened by even small increases in traffic speed. Figure 2 shows that as vehicle speeds increase, the risk of death for pedestrians increases. While not to the same degree as pedestrians, increased vehicle speeds also increase the risk of death for people biking. Bicycle infrastructure also increases traffic safety for all modes, including pedestrians. Bike infrastructure, particularly physical barriers that separate bikes from speeding cars as opposed to shared or painted lanes, significantly lowered fatalities in cities that installed them.[8] Bicycle facilities, therefore, improve safety for all road users, not just people bicycling.

Between 2007 and 2019 there were **46 crashes involving people bicycling** in the City of Fairfax. **67%** of the total crashes occurred at **intersections,** while **74%** of the total crashes occurred along the three **primary corridors** in Fairfax:

- Main St
- Chain Bridge Rd
- Fairfax Blvd

This data is further reviewed in Chapter 2.

Relation to Plan Goals

Relates most closely to the goals of a safe + secure and intergenerational city.

FIGURE 2: SPEED + SURVIVABILITY IN CRASHES[7]

A pedestrian hit by a vehicle traveling at **25 MPH** has an **89% chance** of survival

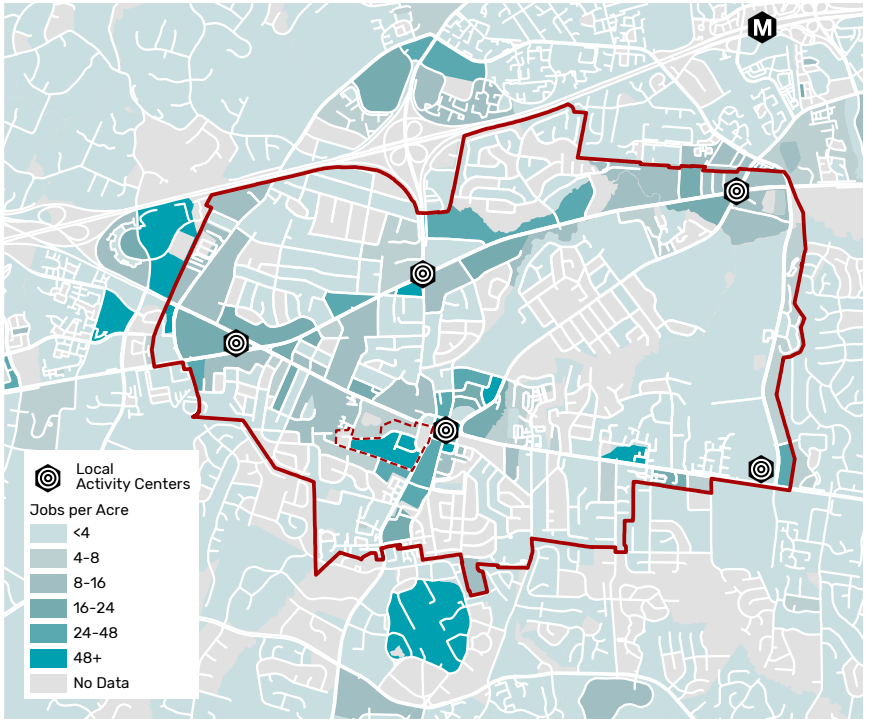
A pedestrian hit by a vehicle traveling at **35 MPH** has a **68% chance** of survival

A pedestrian hit by a vehicle traveling at **45 MPH** has a **35% chance** of survival

A more bikeable City of Fairfax is an economically stronger City of Fairfax.

Employment in the City of Fairfax generally follows the key corridors of Main St and Fairfax Blvd with nodes at the Local Activity Centers—Fairfax Circle, Northfax, Kamp Washington, Old Town, and Pickett and Main. Linking these destinations, essential services, and jobs via multimodal networks is critical to a vibrant and resilient community. Furthermore, a more unified multimodal link between Fairfax and George Mason University will benefit the local economy and spur more diverse development opportunities in Fairfax.

The Link+Place typology, introduced in the *Multimodal Transportation Plan*, guides the design of the City's streets based upon its context. This typology will be a powerful tool in creating a human- scale transportation network that helps develop places people want to be and the connections that make it safe and comfortable for people to reach them.



A national study showed that employment and sales increased, particularly for food service businesses, after bike lanes were installed along streets in various cities.[9]

Relation to Plan Goals

Relates most closely to the goals of a vibrant and connected city.

More biking trips in place of automobile trips means less air pollution.

Decreasing reliance on automobiles and reducing congestion by using bikeways and trails can help improve the environment. Replacing automobile trips with walking and bicycling trips can reduce particulate matter, nitrous oxide, sulfur oxide, volatile organic compounds and carbon dioxide that a typical motor vehicle emits.

By **2050**, if even just **7%** more of all American commute trips were made by bike and foot, we could avoid around **5 gigatons** of carbon emissions.[10]

In addition, trails and greenways, which can act as active transportation corridors, can serve a dual purpose by conserving open space, providing a filter for runoff, increasing resiliency in flooding situations and preserving sensitive sites like wetlands.

The City of Fairfax has committed to reducing greenhouse gas (GHG) emissions 80% below the 2005 baseline levels by 2050. As shown in Figure 3, overall GHG emissions within the City of Fairfax decreased 30% between 2005 and 2018, which included a reduction of over 35,000 MTCO2e (metric tons of carbon dioxide equivalent) from mobile transportation.[11] Increasing the share of trips made by bicycle can substantially reduce emissions in this sector and is critical to achieving the City's GHG emission reduction goals.

Relation to Plan Goals

Relates most closely to the goals of a green and vibrant city.

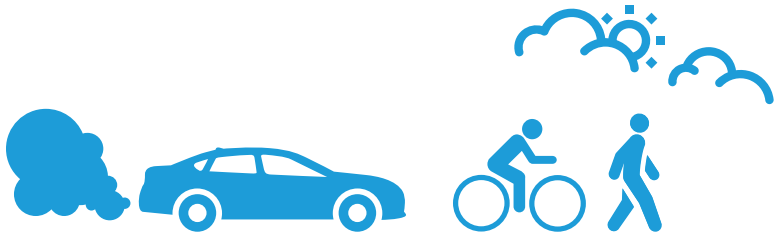
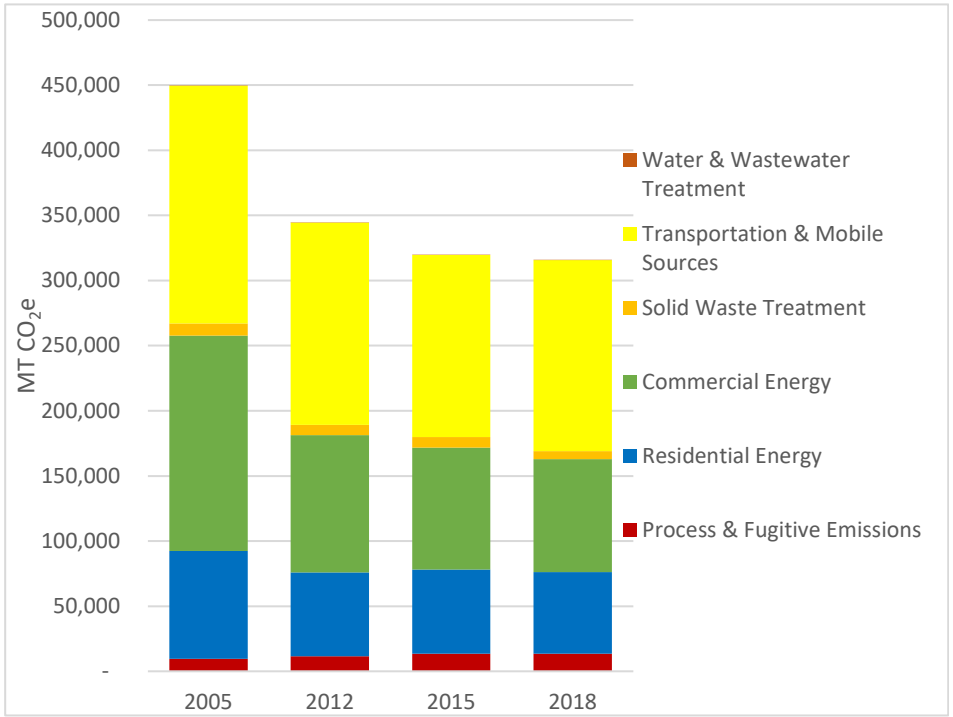


FIGURE 3: CITY OF FAIRFAX TOTAL GHG EMISSIONS BY ACTIVITY



Source: Greenhouse Gas Emissions Inventory for the Metropolitan Washington Region (2005-2018), Metropolitan Washington Council of Governments

Equitable access to transportation increases economic stability and community health.

Without access to transportation, getting to work, going to school, buying healthy foods, and visiting health clinics and government services can be difficult or impossible. Often, traditionally vulnerable populations, such as minority groups, youths, older adults, people living in poverty, adults with no high school education, residents with limited English proficiency, and households with no access to a motor vehicle, may rely heavily on bicycling, walking, and transit.

Building bicycling facilities and encouraging bicycling for transport can help provide multiple transportation options and decrease some of the economic and health burdens experienced by households without motor vehicles. Enhancing active transportation options can also reduce the economic burden of **car ownership, which can cost drivers as much as $11,000 per year.**[12]

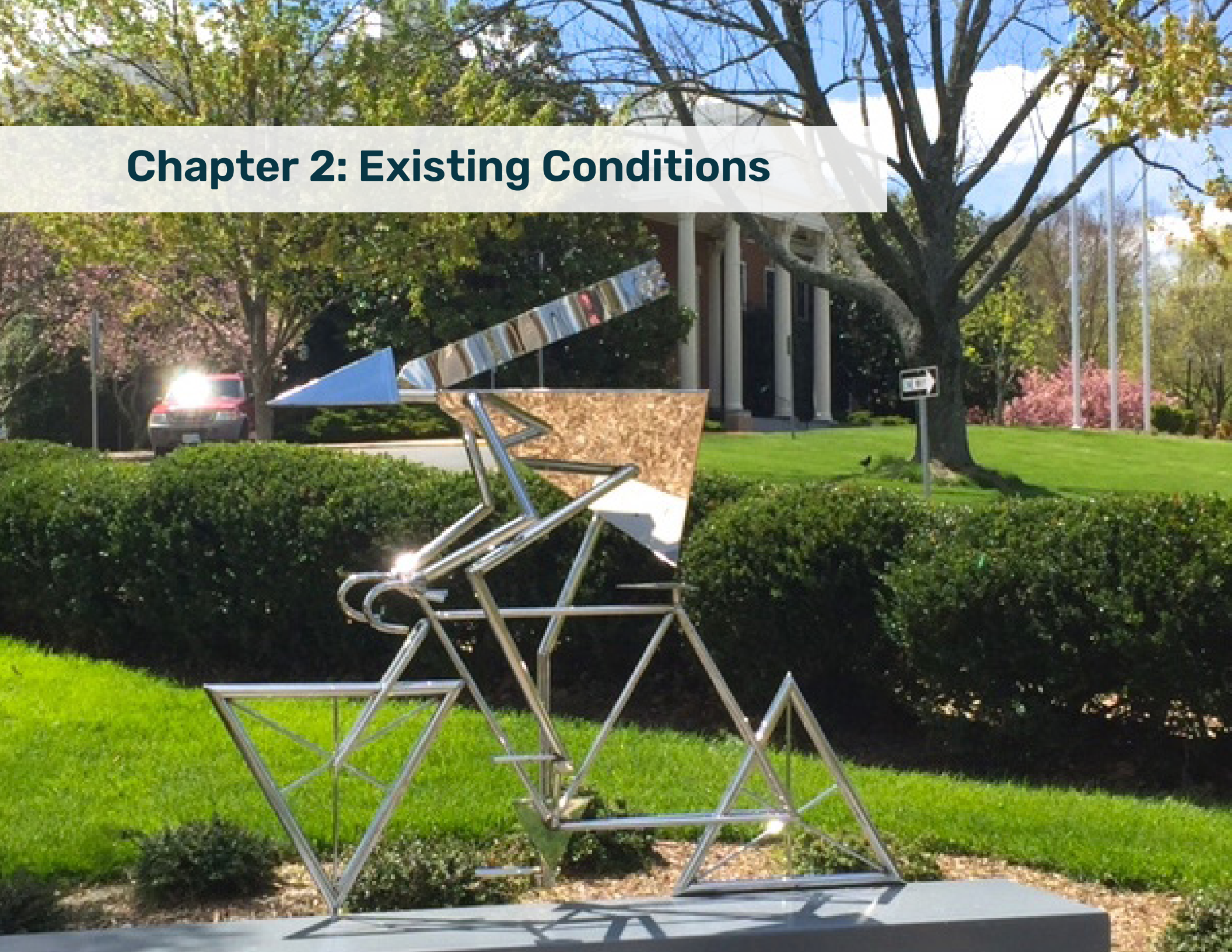
6.3% of households in the City of Fairfax lack a motor vehicle. Without investment in biking, walking, and public transit, people living in a household without a car have few options to access essential services and destinations such as jobs, groceries, and school.[13]

8.7% of residents in the City of Fairfax are living in poverty. Providing safe and convenient active transportation options can greatly reduce transportation costs.[14]

Relation to Plan Goals

Relates most closely to the goals of an intergenerational and robust city.

Chapter 2: Existing Conditions



CHAPTER 2

Existing Conditions

A primary focus of this plan is to develop a set of priority projects that are recommended for development. An existing conditions analysis was performed to better understand trends and issues related to biking in Fairfax today.

This work sets the stage for the development of the recommended network, proposed policies and programs and implementation strategies to ultimately advance bicycling mobility, safety and connectivity in Fairfax.

TABLE 1: EXISTING CONDITIONS REVIEW

Type of Analysis Completed	In order to understand...
Review of Existing + Planned Bike Network	What it is like to bike in Fairfax today and opportunities and barriers to bicyclist travel.
Planning History	Previous recommendations for improving biking.
Safety Analysis	Where bicycle crashes are occurring and if there are any trends/patterns related to where crashes occur.
Traffic Stress	The amount of discomfort that people feel when they bike on streets in Fairfax today.
Bicycle Trip Generators + Existing Access	Where we can expect bicyclist activity and what streets may need to be improved to connect destinations through a low stress network.

Existing + Planned Bike Network

As of 2020, there are few on-street bicycle facilities in the City of Fairfax. The existing bike lanes, such as those on University Dr and Breckinridge Ln, primarily serve as on-street connections between trail systems. The future off-street bicycle facility to be installed along Old Lee Highway will serve as a key connection between the Metro station and Old Town in Fairfax.

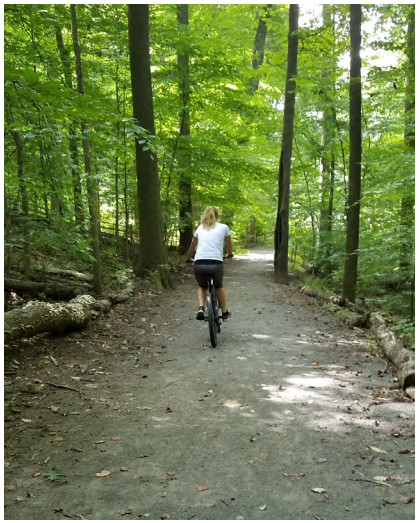
As seen in Map 2, the 10+ miles of off-street trails in Fairfax are predominately located in or near parks. Trails in Fairfax have a wide range of characteristics including width, surface material, accessibility, and general maintenance. This amount of variability can have a mixed effect on user types.

TABLE 2: EXISTING, PLANNED, AND PROPOSED FACILITY TYPES (AS OF FALL 2020)

Development Status	Bike Lane	Off-Street
EXISTING: Facility exists	**0.7 miles**	**10.6 miles**
PLANNED/PROGRAMMED: Facility is planned as a funded City project or part of an approved development	**0.6 miles**	**4.9 miles**
PROPOSED ROUTE (OFF-STREET OR ON-STREET): Facility is a proposed City project, proposed in a City plan, or proposed as part of a development under review	**12.5 miles**	**6.3 miles**

Bike Lane

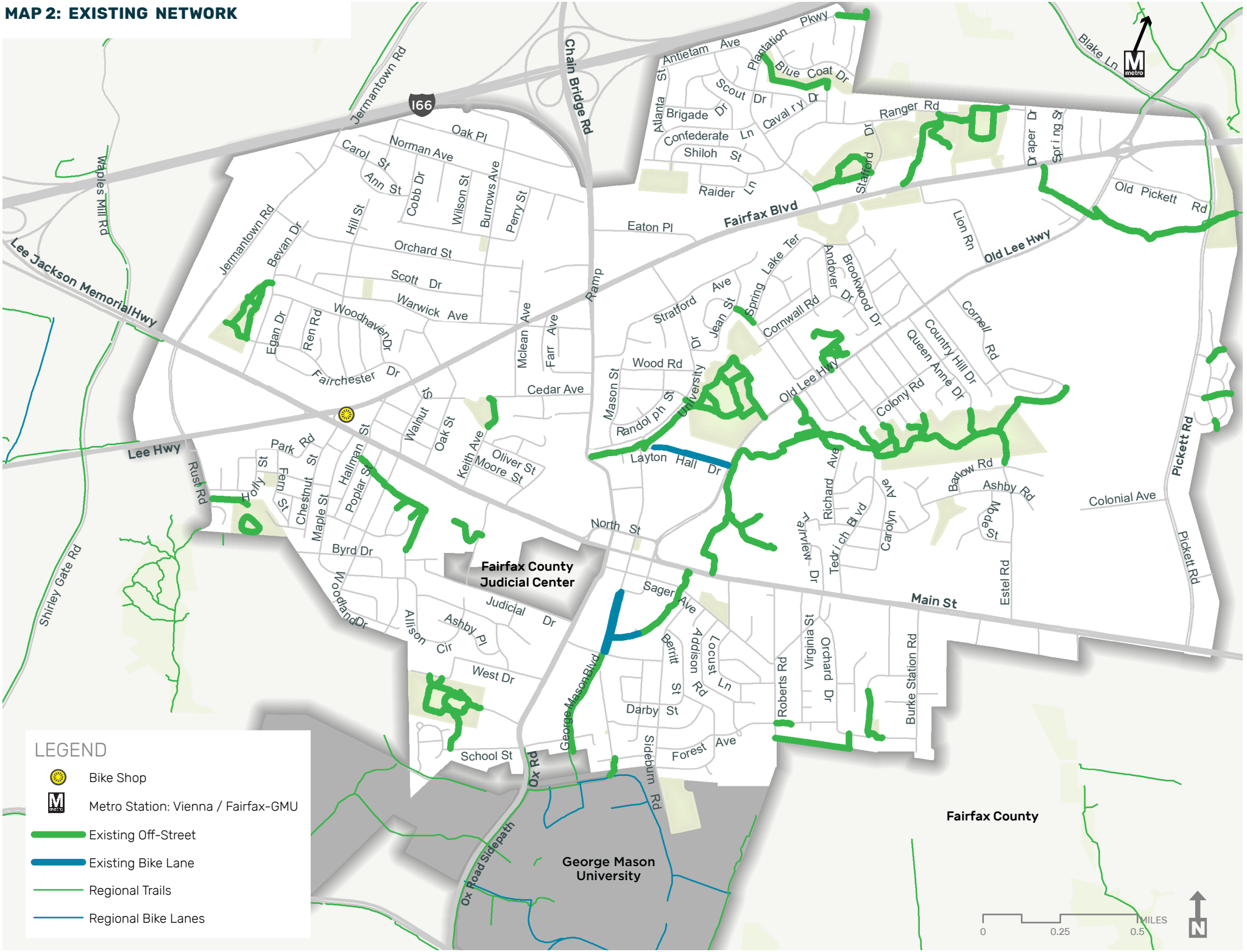
On-street bike lane (typically 5 feet)



Off-Street

Shared paths or bike trails physically separated from traffic (trails, sidepaths, etc.)

MAP 2: EXISTING NETWORK



Planning History

Integrating Previous Recommendations

There have been many bicycle recommendations in the City of Fairfax over the years. Some projects have been implemented, while others are still high level concepts or simply an identification of potential corridors for improvement. One of the first steps of this planning process has been to analyze what's existing today, what's in the process of being planned, and what has been proposed but not yet been studied in depth or taken forward into design and implementation.

CITY OF FAIRFAX *2035 COMPREHENSIVE PLAN*

The *Comprehensive Plan* is the City's official policy guide for future development related decisions. While the city's goals and policies support a more multimodal transportation system, existing development patterns tend to favor motor vehicle travel. For example:

- Major job centers in the region result in more people traveling farther to their jobs.
- The predominately low density development means that destinations are farther apart and thus trip lengths, on average, tend to be longer.

One key policy in the *Comprehensive Plan* is the identification of five Local Activity Centers, where higher density, mixed-use development is encouraged. The City of Fairfax has completed Small Area Plans for two of these Activity Centers (Northfax and Old Town). These plans lay out more detailed recommendations for these areas, including bicycle and pedestrian accommodations.

2019 FAIRFAX-MASON-VIENNA BIKESHARE FEASIBILITY STUDY

The City is working to implement recommendations from the *2019 Fairfax-Mason-Vienna Bikeshare Feasibility Study* for dockless shared bikes and e-scooters and station-based Capital Bikeshare within the study area.

2017 CITY OF FAIRFAX MULTIMODAL TRANSPORTATION PLAN

The *2017 Multimodal Transportation Plan*, adopted as part of the *Comprehensive Plan* and updated in June of 2020, set a clear vision for transportation in the City of Fairfax. The vision states: "In 2035, Fairfax is a city with options for residents to easily, safely, and efficiently move within and between neighborhoods either by walking, bicycling, taking public transportation, or driving."

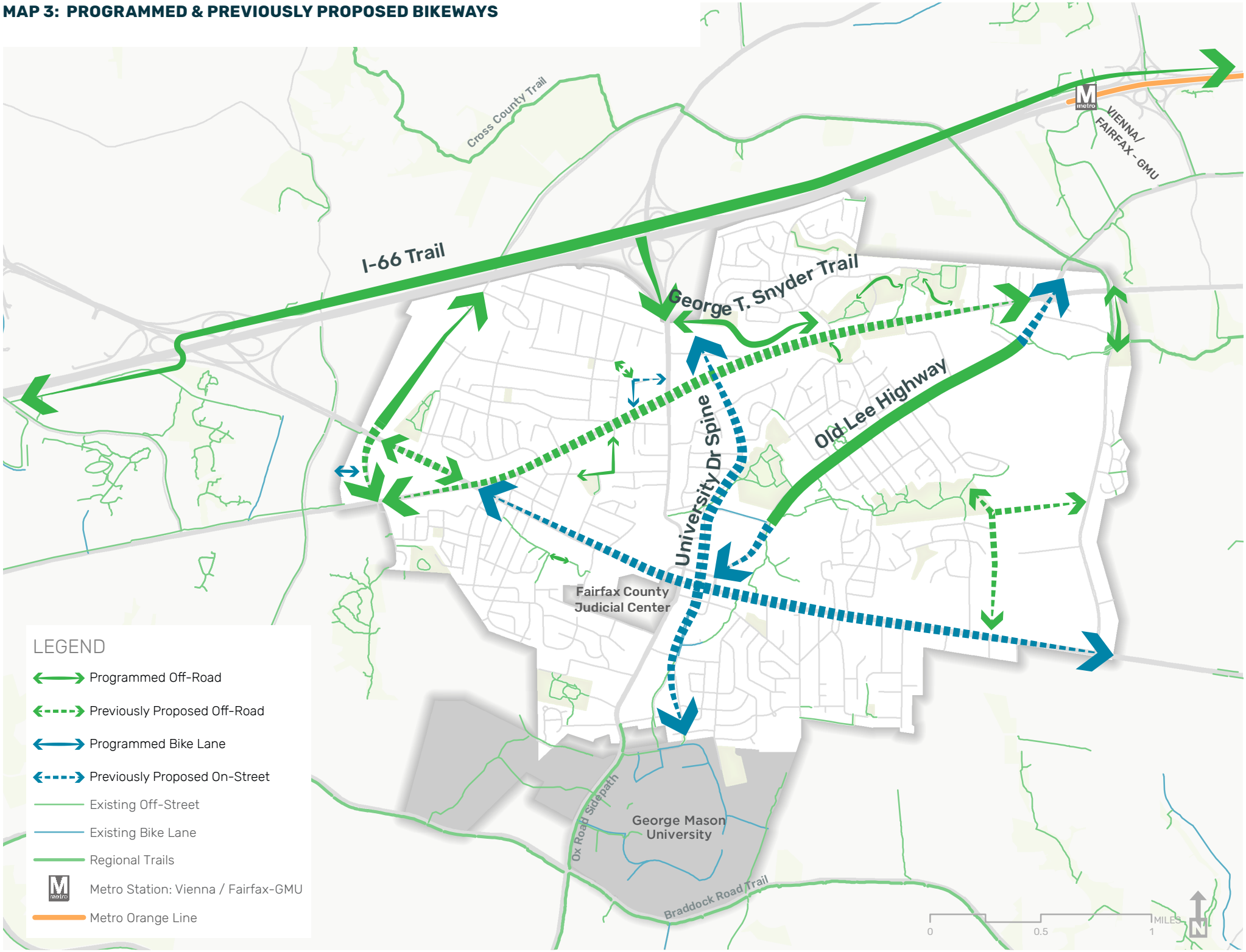
The plan identified general corridors for on-street and off-street bicycle facilities shown on Map 3. These routes identify major corridors that need improvement to provide bicycle connectivity, but have not yet been studied to identify a feasible concept or implementation strategy.

Stakeholders and residents identified a set of core values for the city, which are then reflected in the plan's vision, goals, and strategies. These core values reflect a City of Fairfax that is safe + secure, connected, intergenerational, vibrant, green, and robust.

2014 PARKS & REC STRATEGIC MASTER PLAN

This plan created a vision for the future of trails in Fairfax. Public comments received during the planning process demonstrated a strong desire to have safe, accessible trails that provide direct connections to parks, schools, neighborhoods, and retail areas. The plan prioritized the improvement and development of the trail system. Several potential trails were identified in the plan and those that provide opportunities for key bicycle connections are shown on Map 3.

MAP 3: PROGRAMMED & PREVIOUSLY PROPOSED BIKEWAYS



Challenges and Opportunities to Biking in Fairfax Today

The city's character and central location in Northern Virginia provides both opportunities and challenges for developing a comfortable bike network. The following key takeaways from an evaluation of existing conditions will inform what links in the bicycle network can be improved in the short term and what options may exist for longer term improvements with larger or more complex projects.

CHALLENGE: IMPROVEMENTS TO MAJOR ROADWAYS. Separated bike facilities on major roads are necessary to achieve a comfortable network, however, they typically require long term changes.

The challenge of improving major roadways provides a barrier to a safe + secure and intergenerational city.

CHALLENGE: HIGH VOLUME ROADWAYS. The central location in the region means that there is a significant amount of vehicle traffic on city streets. The city's roadway network is largely built out and many roadways are at capacity; there are few opportunities for roadway widening or reallocation of travel lanes. Furthermore, much of the city has suburban land use patterns that encourages driving and many of the off-street trails and quiet neighborhood streets lack connectivity to a broader network. This forces bicyclists to make difficult, uncomfortable, or unsafe connections on or across high volume and high speed roads.

The challenge of high volume roadways provides a barrier to a connected and green city.

CHALLENGE: STREET CONNECTIVITY. The cornerstone of a bicycle friendly circulation system is a well connected network of streets and trails. An interconnected network helps to disperse traffic and allows for narrower, human scaled streets. An ideal street grid includes a high ratio of nodes (intersections) to links (roadways). Closely spaced intersections provide more direct and convenient routes to destinations, reducing travel distance.

In Fairfax today, many short trips that could be made by bike are made by car simply because of poor connectivity within the existing street grid. The hierarchical street system creates congestion by overloading the limited number of intersections and roadways. The lack of connectivity in Fairfax means even a short trip to school or to the grocery store requires using a major arterial.

A comparison of the entire City of Fairfax street grid (above right) to a functional grid (below right) paints a stark picture. The east side of the city consists almost entirely of neighborhoods isolated by physical barriers.

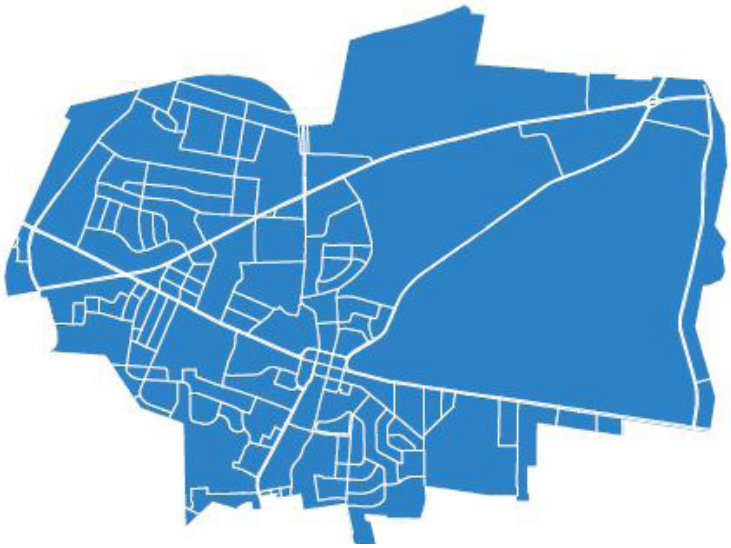
The functional grid (below right) is made up of roads that can be used to travel by vehicle to another neighborhood or part of the city. The west side of the city is far more integrated with the city center and areas immediately northwest, southwest, and south of city boundaries.

OPPORTUNITY: STREET CONNECTIVITY. While the lack of street connectivity can be a challenge, as described above, there is also an opportunity to improve the connectivity through off-street paths. Off-street paths can provide direct connections to destinations for people walking and biking without adding to the roadway network.

Disconnected streets provide both a challenge to and an opportunity for a more connected, robust, and vibrant city.

TOTAL VEHICULAR STREET GRID

FUNCTIONAL VEHICULAR STREET GRID



OPPORTUNITY: NEIGHBORHOOD STREETS

Many neighborhood streets, roughly 60% of the roadway network in Fairfax, could be comfortable for biking with minimal improvements.

Comfortable neighborhood streets for biking provides an opportunity for a more green and intergenerational city.

OPPORTUNITY: PLANNED BIKE PROJECTS. Fairfax has several bike infrastructure projects planned or underway such as the planned multimodal improvements to Old Lee Highway, the George Snyder Trail, and the Jermantown Road shared use path.

Already planned bike projects provides an opportunity for a more vibrant and robust city.

OPPORTUNITY: DISTANCE TO DESTINATIONS. The city is relatively compact, providing opportunities for short distance trips (ideal for bicycling) to destinations in and near the city. Some of the older roads are narrow with low traffic volumes, particularly on unconnected streets. There are some off-street trails and small trail connections that provide more comfortable routes for bicyclists and pedestrians.

A close distance to destinations provides an opportunity for a more connected and robust city.

OPPORTUNITY: INCREASED DEMAND. Currently the city is undergoing redevelopment in many areas, often resulting in increased density and mixed land uses. While this increased density puts additional pressure on the roadway network for vehicular traffic, it also increases interest in and support for multimodal transportation options including transit, bicycle, and pedestrian networks.

Increased demand for bike projects provides an opportunity for a more vibrant and robust city.

OPPORTUNITY: OFF-STREET PATHS AND RECREATION. While critical gaps limit its usefulness, several existing trail networks do connect parts of the city to key destinations while also providing a low stress experience. In addition, a robust network of regional trails provide critical links to destinations like the Vienna Metro station.

Opportunities to enhance the off-street path network and increase recreation promotes a green and connected city.

Safety Analysis

There were 46 collisions involving a bicyclist reported in Fairfax between 2008 and 2019. 67% of those crashes occurred at intersections. Corridors that had multiple crashes include Chain Bridge Rd, Fairfax Blvd, Main St, and University Dr. This is not surprising as these four major arterials link residential areas to transit, Activity Centers, shopping districts, recreational facilities, and public facilities.

The total number of bicycle crashes is likely higher than the number of crashes captured by police reports. Bicycle crashes may go unreported if there were no major injuries, no property damage occurred, or if the parties were not aware of the need to report the crash. The City should consider exploring other data sources, such as the near-miss data proposed by Fairfax Families for Safe Streets or injury data from Emergency Medical Services and the Fire Department.

With the limited crash data available, it's difficult to fully understand safety trends and impacts in Fairfax. The high crash corridors, shown on Map 4, however, clearly show a need to improve the safety for all users on major arterials as well as provide safe low stress alternative routes for people bicycling.

FIGURE 4: CRASHES BY YEAR

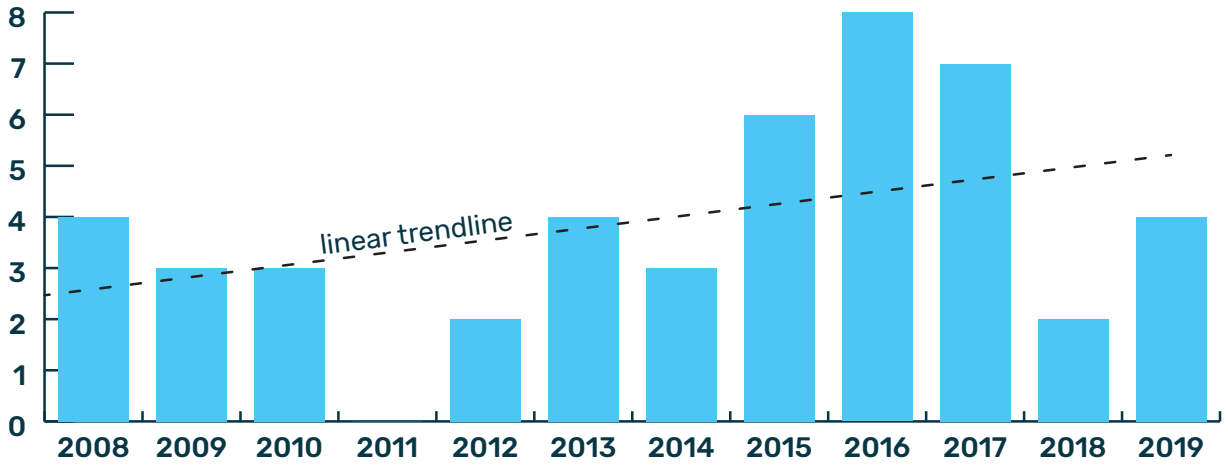
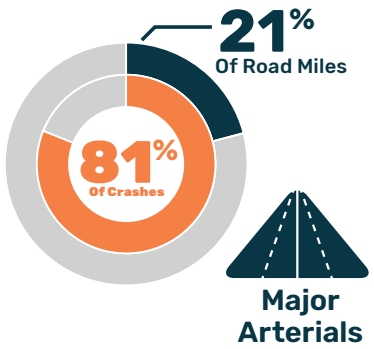
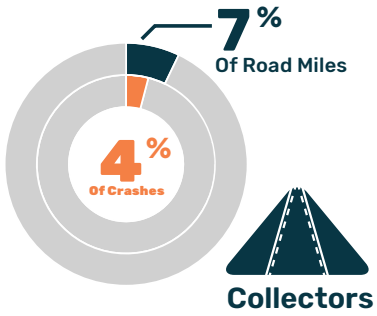
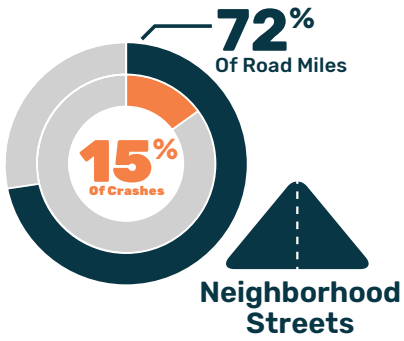


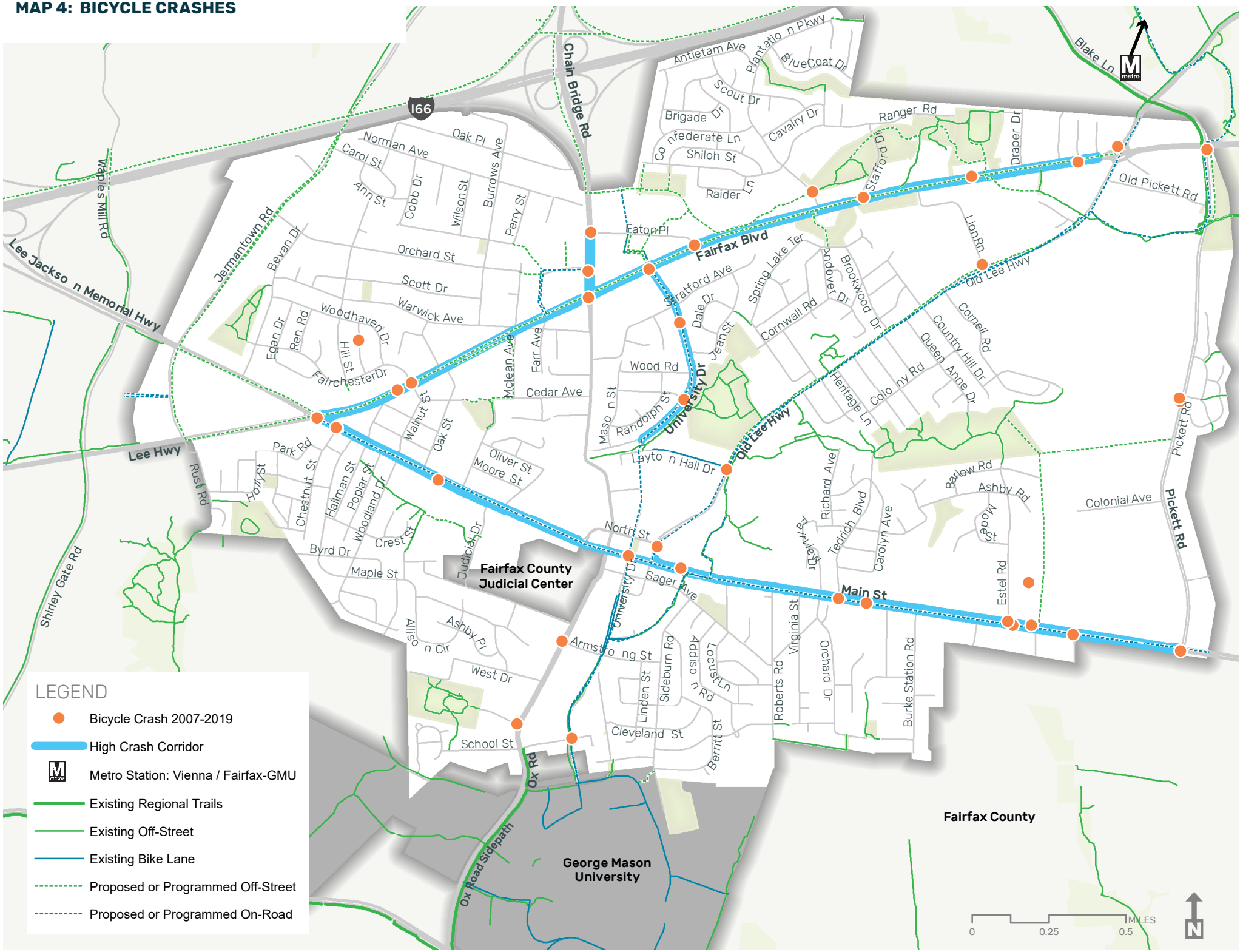
FIGURE 5: CRASHES BY STREET CLASSIFICATION







MAP 4: BICYCLE CRASHES



Level of Traffic Stress

As one measurement of the user experience, "traffic stress" is the perceived sense of danger associated with riding in or adjacent to vehicular traffic. The less stressful – and therefore more comfortable – a biking facility is, the wider its appeal to a broader segment of the population.

A bicycle network is likely to attract a large portion of the population if it is designed to reduce stress associated with potential motor vehicle conflicts and connect people bicycling to where they want to go. High comfort facilities, such as separated bike lanes and bicycle boulevards, appeal to a more diverse cross section of the public than traditional facilities like bike lanes, wide outside lanes, and sharrows. While not included in the level of traffic stress analysis, shared use paths also provide comfortable bicycle facilities for a wide range of users.

The results of the traffic stress analysis shown in Map 5 indicate:

- Major arterials, like Main St and Fairfax Blvd, create high stress bike experiences while local, neighborhood streets provide, in general, low stress experiences.
- By taking a roundabout route, it is possible to access key destinations like GMU, Old Town or any of the Activity Centers following only low stress links. Indirect routes, however, might deter some bicyclists.
- Off-street trails provide low stress experiences and, in some cases, provide parallel routes to the high stress corridors.
- Improving intersection crossings at key locations along the high stress corridors will greatly enhance the connectivity of the low stress network.

Types of Bicyclists

The Four Types of Cyclists, shown below, consider one's interest and comfort bicycling.[15] The majority of the population in the United States—those who are interested but concerned—are most likely to be comfortable biking only on low stress roadways. A level of traffic stress (LTS) analysis helps to identify a low stress network that supports people bicycling who are interested in riding but are concerned for their safety.[16] This group typically represents up to 60% of the population.

1-3%

STRONG & FEARLESS

Very comfortable and willing to ride on streets with no designated bike facilities.

5-10%

ENTHUSIASTIC & CONFIDENT

Very comfortable riding but prefer streets with designated bike lanes.

50-60%

INTERESTED BUT CONCERNED

Comfortable on trails and streets with buffered or separated bikeways; interested in biking more.

30%

NOT CURRENTLY INTERESTED

Physically unable or very uncomfortable biking, even on streets with separated bikeways.

Level of Traffic Stress Results

The LTS mileage, described below, shows how many existing roadway centerline miles within the city are LTS 1 - LTS 4. Map 5 on the following page shows the LTS results for each street within the city.

LTS 1

63.3 Miles (60% of network)

Represents little traffic stress and requires less attention, so is suitable for all bicyclists. This includes children that are trained to safely cross intersections (around 10 yrs. old/5th grade) alone and supervising riding parents of younger children. Traffic speeds are low and there is no more than one lane in each direction.

LTS 2

10.4 Miles (10% of network)

Represents little traffic stress but requires more attention than young children can handle, so is suitable for teen and adult bicyclists with adequate bike handling skills. Traffic speeds are slightly higher but speed differentials are still low and roadways can be up to three lanes wide in total for both directions.

LTS 3

7.7 Miles (7% of network)

Represents moderate stress and suitable for most observant adult bicyclists. Traffic speeds are moderate but can be on roadways up to five lanes wide in both directions. Typical locations include low speed arterials with bike lanes or moderate speed non multilane roadways.

LTS 4

24.2 Miles (23% of network)

Represents high stress and suitable for experienced and skilled bicyclists. Traffic speeds are moderate to high and can be on roadways from two to over five lanes wide in both directions. Intersections can be complex, wide, and or high volume/speed that can be perceived as unsafe by adults and are difficult to cross.

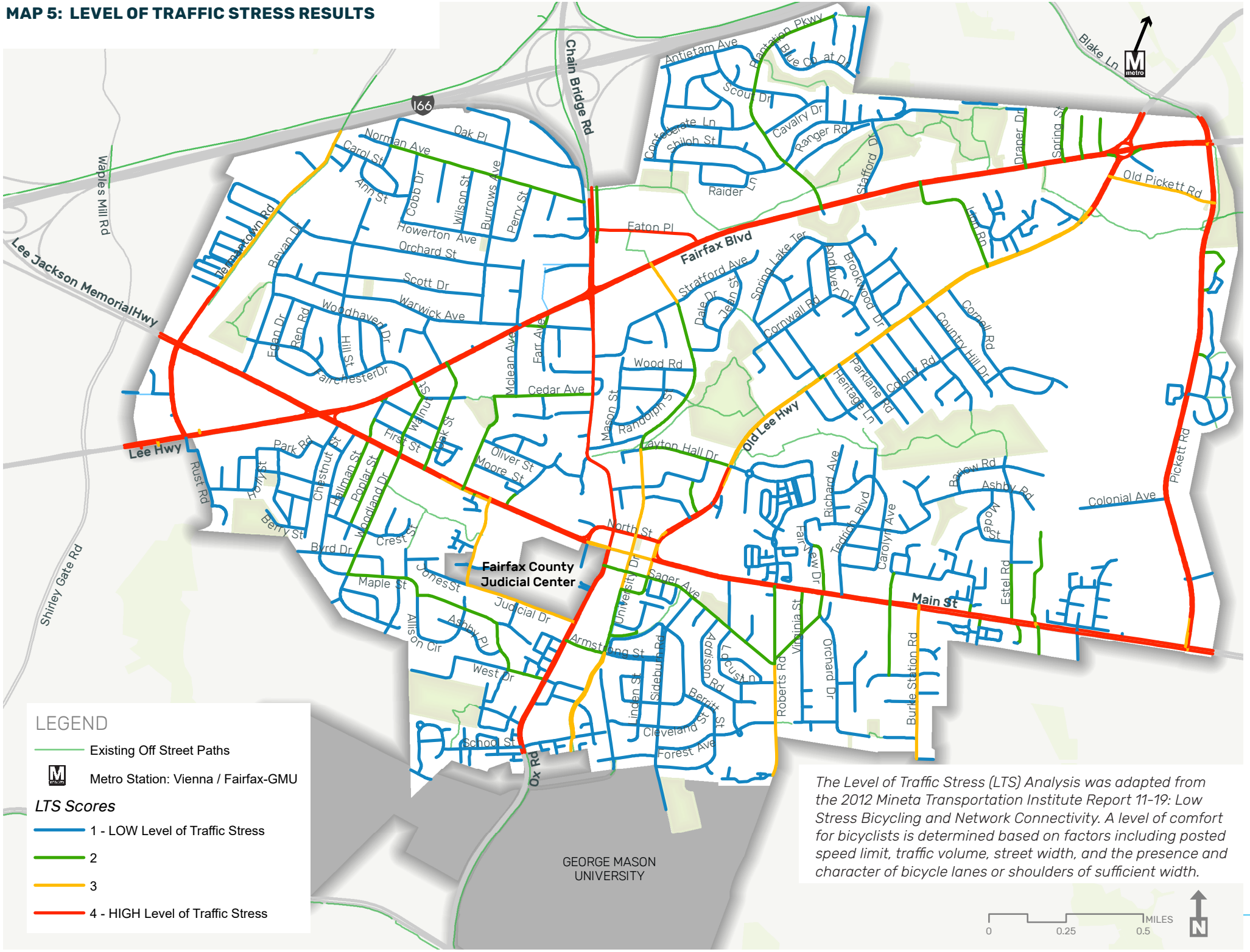
LTS 1

LTS 2

LTS 3

LTS 4

MAP 5: LEVEL OF TRAFFIC STRESS RESULTS



The Level of Traffic Stress (LTS) Analysis was adapted from the 2012 Mineta Transportation Institute Report 11-19: Low Stress Bicycling and Network Connectivity. A level of comfort for bicyclists is determined based on factors including posted speed limit, traffic volume, street width, and the presence and character of bicycle lanes or shoulders of sufficient width.

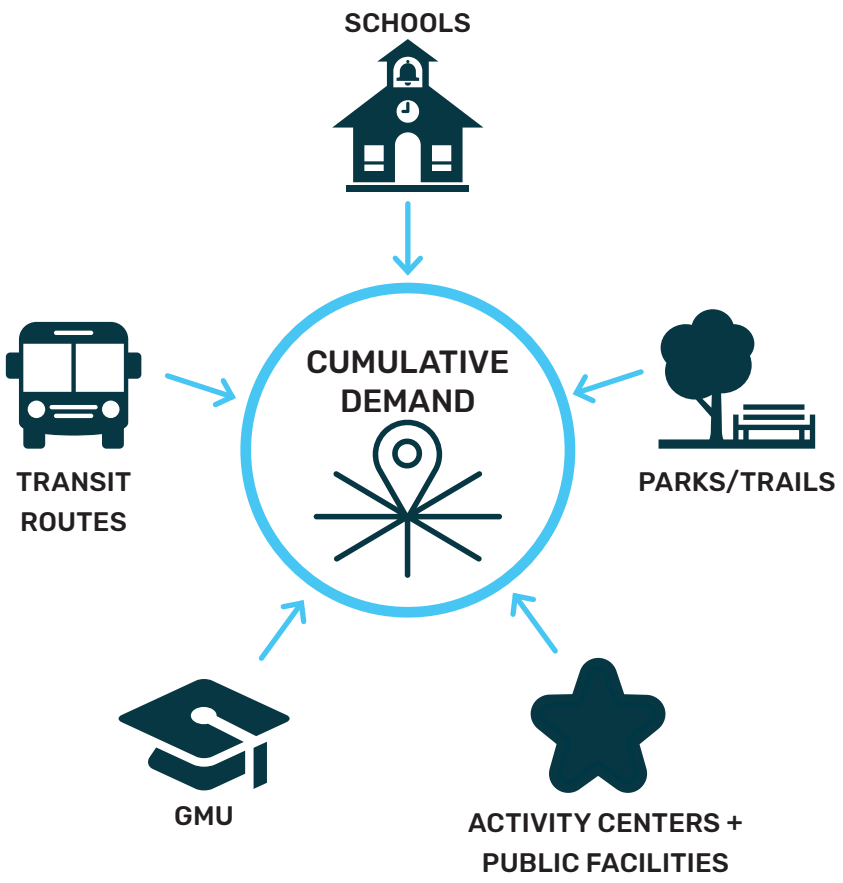
Bicycle Trip Generators

To understand potential bicycle demand on specific corridors in the City of Fairfax, the following trip generators were identified and evaluated: transit routes, schools, parks/trails, George Mason University, shopping centers, Activity Centers, and public facilities such as government offices, community centers, libraries, and post offices. Trip generators within Activity Centers include retail and other commercial jobs. While other destinations may be important, these trip generators were the primary ones utilized to understand demand. Map 6 shows the locations of the various trip generators and the existing bicycle facilities.

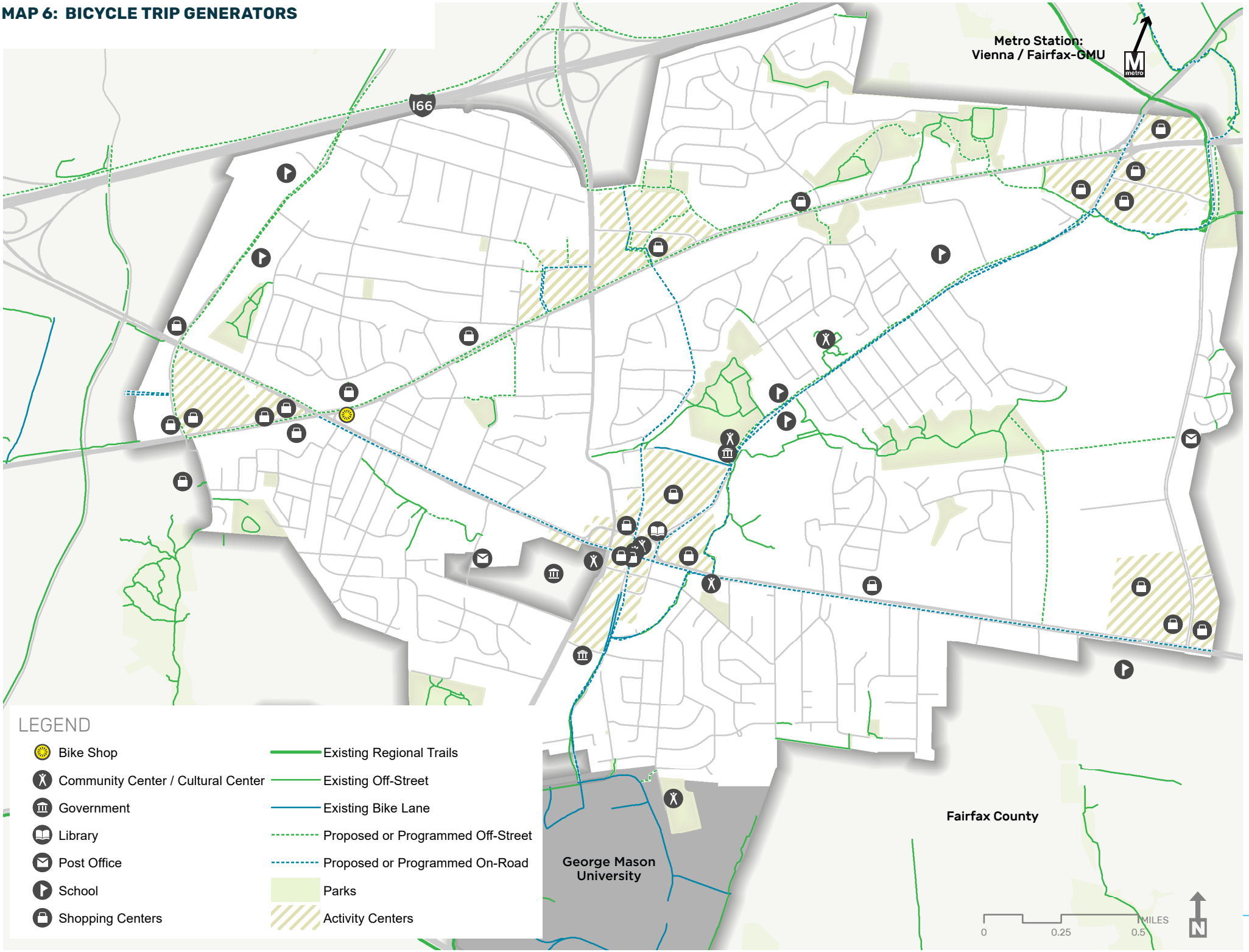
The key findings from this review that will influence the development of a low stress bike network include:

- Activity Centers are located at nexus points of the highest demand corridors. The high volume, high speed corridors that connect many of the areas people want to reach are often a barrier to bicyclists, such as Main Street, Fairfax Boulevard, Chain Bridge Road, and University Drive.
- Map 6 on the following page illustrates a development pattern organized around high volume, high speed roadways that can be unsafe and uncomfortable for many bicyclists. Modifying these roadways to provide a low stress bike experience will require high cost improvements.
- Identifying neighborhood streets or off-street trail opportunities that connect to the trip generators may provide a low cost alternative to the development of the low stress network.

Bicycle Trip Generators



MAP 6: BICYCLE TRIP GENERATORS



Chapter 3: Recommended Bicycle Network

CHAPTER 3

Recommended Bicycle Network

Network Approach

The proposed bicycle network aims to reflect the plan's vision and goals, the core of which is to provide a connected network of low stress bikeways that is safe and comfortable for people of all ages and abilities. A connected network of neighborways, off-street paths, spot improvements, and long term improvements—such as separated bike lanes—aim to achieve this vision of a low stress network. Other improvements such as standard bike lanes and super sharrows complement the low stress network. These facility types are described in detail on the following pages.

The proposed bicycle network was developed to:

- Build upon existing plans and proposals
- Provide low stress facility recommendations
- Provide feasible alternative routes to the major arterials
- Provide connections to existing trails, schools, parks, Activity Centers, and other key destinations
- Address gaps in the network
- Address the desires and needs of the public
- Provide seamless transitions between bicycle facility types

Basis of the Recommended Bicycle Network

EXISTING CONDITIONS

Previous Plans + Policies

Current Road Conditions

Safety Analysis

Level of Traffic Stress

Trip Generation

Circulation Patterns

Fieldwork

+

PUBLIC INPUT

Steering Committee

User Survey

Interactive Map

Public Workshop

PROFESSIONAL JUDGMENT

Best Practices

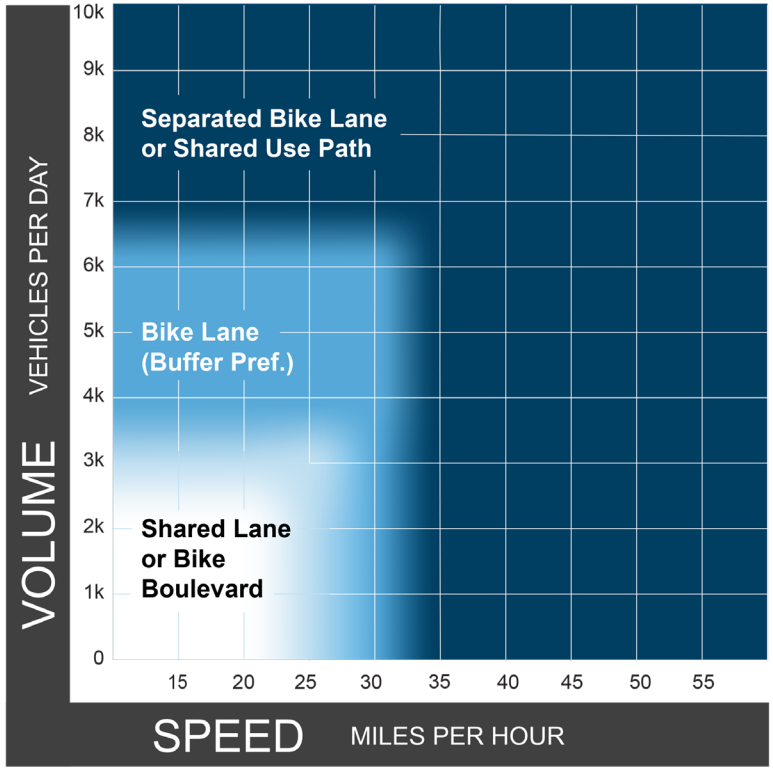
Engineering Judgment

Facility Selection

As outlined in the Federal Highway Administration's *Bikeway Selection Guide*, different types of bikeways are better suited for different roadways based on considerations such as how fast and how frequently vehicles use the road and the roadway width. The bikeways defined on the following page are part of the recommended network design "toolbox". The proposed bikeway facility types are meant to provide a variety of options to serve the Four Types of Bicyclists, as defined in Chapter 2, including more comfortable facilities for the "interested but concerned," which likely makes up the majority of residents in Fairfax. Bikeways that are comfortable for the "interested but concerned" include neighborways, off-street paths, and separated bike lanes (the bicycle facility types are described in further detail on the following page).

The FHWA chart to the right can guide recommendations for the preferred type of bikeway given roadway speeds and volumes. The chart is used by first identifying the daily traffic volume and travel speeds on the existing or proposed roadway, and then locating the facility types indicated by those key variables. Streets with higher speeds and volumes should have more separated bikeway facilities.

The *FHWA Bikeway Selection Guide,* and the associated chart, are meant to be a starting point to select a bikeway facility type in addition to the results of the existing conditions analysis, public input, and professional judgment.



The Preferred Bikeway Types chart shown above from the FHWA Bikeway Selection Guide provides a great resource when selecting the appriopriate facility for varying roadway contexts.

Notes:

-Chart assumes operating speeds are similiar to posted speeds. If they differ, use operating speeds rathar than posted speed.

Facility Types

RECOMMENDED: 43 Locations
Spot improvements are design features aimed to improve challenging locations, usually at intersections and crossings.

RECOMMENDED: 19.7 MILES
Neighborways are streets with low vehicle volumes and speeds that accommodate bicycle travel through signage, pavement markings, and/or traffic calming.

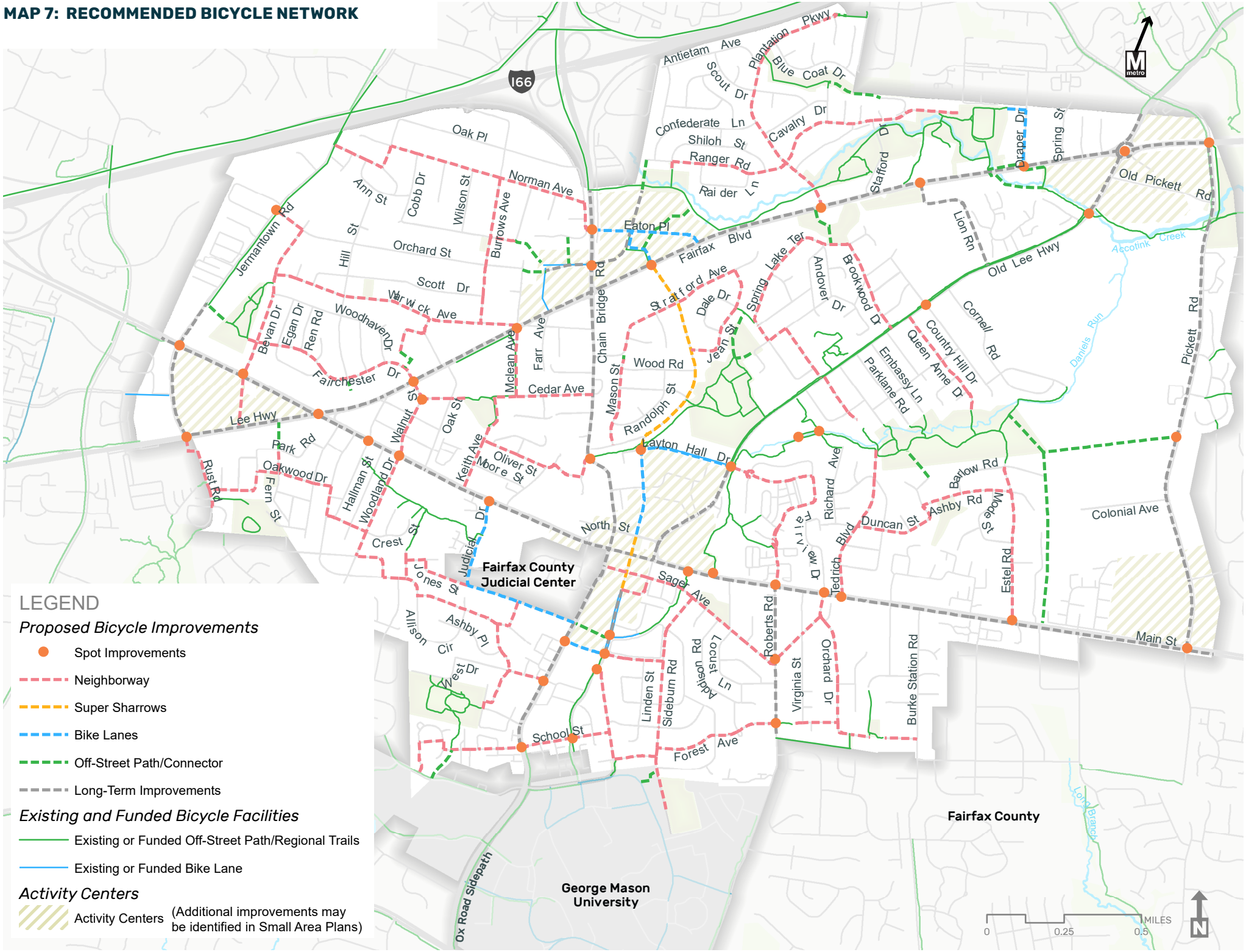
RECOMMENDED: 0.87 MILES
Super sharrows are enhanced large pavement markings centered in the travel lane used to reinforce that bikes share the road with motor vehicles.

RECOMMENDED: 2.4 MILES
Bike lanes provide a dedicated lane for bicycle travel on the roadway utilizing striping, pavement markings and signage.

RECOMMENDED: 3.5 MILES
Off-street paths provide a bike facility completely separated from the roadway, are often shared with pedestrians and may vary in design and location (e.g. park trails, sidepaths next to roads, or short connector trails).

RECOMMENDED: 13.6 MILES
Long term improvements identify higher volume / higher speed corridors that will likely require long planning horizons and major investments.

MAP 7: RECOMMENDED BICYCLE NETWORK



Neighborways

> *"Roads are designed for high vehicle speeds, which makes them intimidating to ride on."*

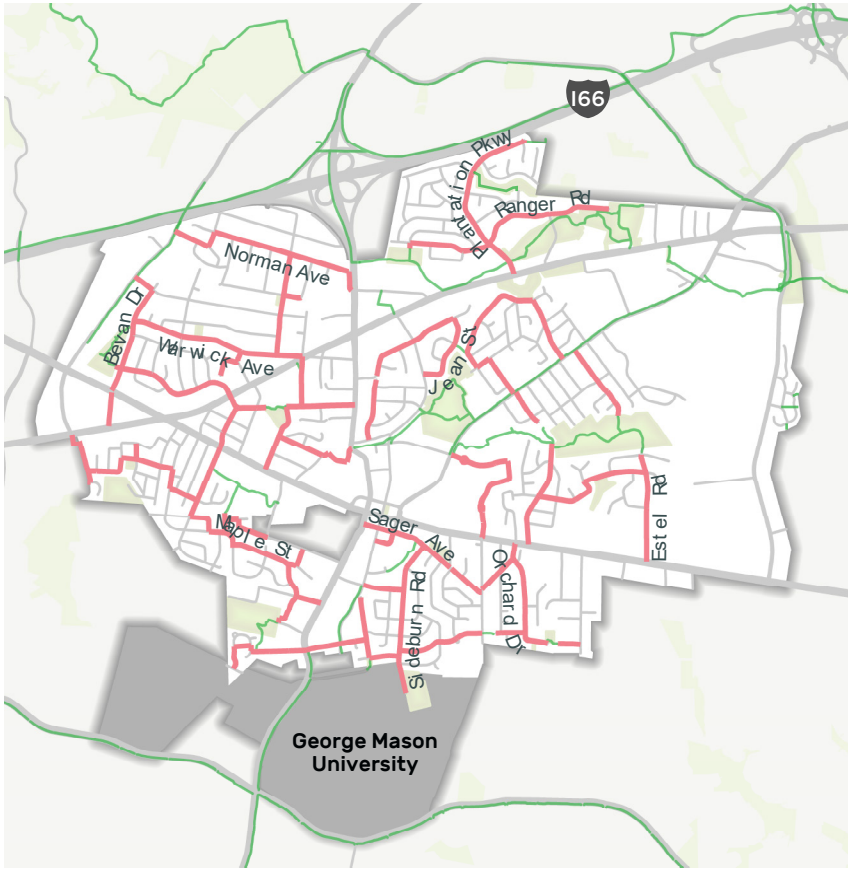
Description

Neighborways are streets with low vehicle volumes and speeds that prioritize bicycle travel through signage, pavement markings, and/or traffic calming. More than any other type of bikeway, this plan is focusing on the development of a neighborway network (nearly 20 miles recommended in total) that provide continuous, comfortable bicycle routes on the local street network instead of busy arterials. In residential neighborhoods, neighborways—also known as neighborhood greenways or bicycle boulevards—improve travel for bicyclists while calming traffic and adding green infrastructure, if feasible. Neighborways are shared by automobiles and bicycles, but at speeds that make travel more comfortable for bicyclists.

Benefits

- Provide a low stress route that is safe for all ages and abilities.
- Can be implemented with relatively low cost materials.
- Bicycle travel is prioritized using a variety of tools, from simple branding/signage to more robust traffic calming treatments such as speed humps or traffic diverters.

MAP 8: RECOMMENDED NEIGHBORWAYS



The full list of recommended neighborway projects can be found in Appendix B.

Elements of Neighborways

DISTINCT VISUAL IDENTITY

Unique pavement markings and wayfinding signs increase visibility of neighborway routes, assist with navigation, and alert drivers that the roadway is a priority route for people bicycling.

BICYCLE PRIORITY

Traffic calming treatments such as traffic circles, diverters, and chicanes, sometimes in place of existing stop signs, can help prioritize bicycle through travel and reduce motor vehicle traffic speeds.

SAFE, CONVENIENT CROSSINGS

Traffic controls, warning devices, and/or separated facilities at intersections help facilitate safe and convenient crossings of major streets along the neighborway network.

Spot Improvements

"Need better crossing points across major traffic arteries. Drivers are unpredictable and aggressive, and they frequently don't stop for red lights or pay attention to pedestrians or cyclists in crosswalks."

Description

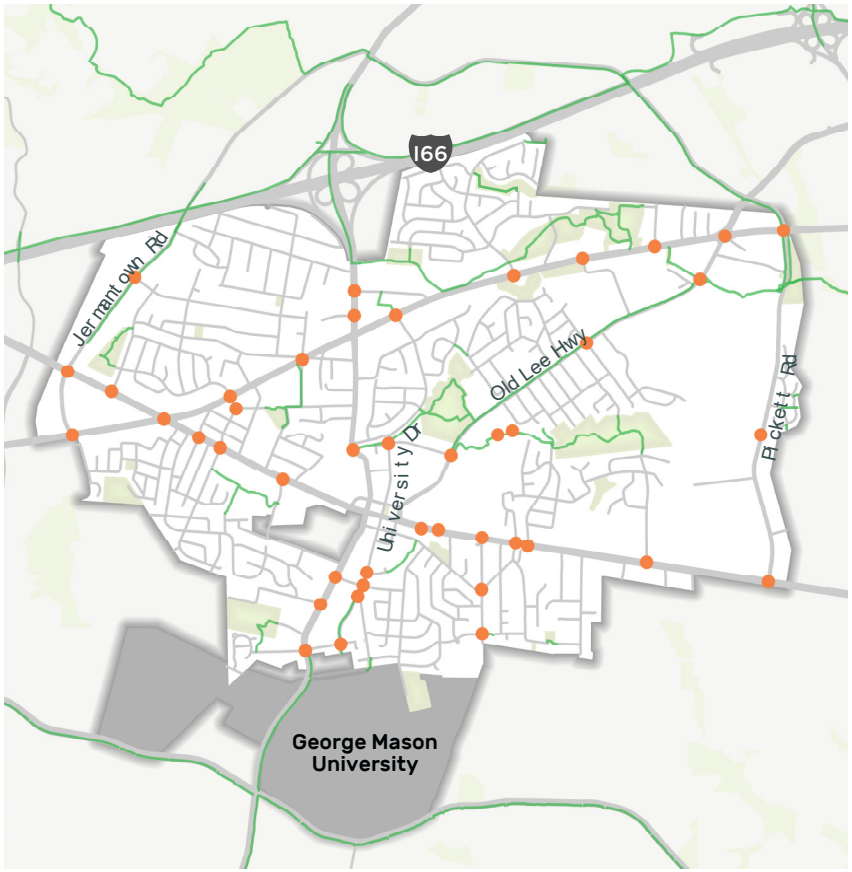
Spot improvements address locations that present a barrier to safe, comfortable, and convenient bicycle travel. Spot improvements are usually located at potential points of conflict between motor vehicles and bicyclists such as intersections and crossings. Spot improvements include a variety of tools and specific improvements should be context-sensitive.

These spot improvements recommendations are a critical piece of the low stress network. In several instances, spot improvements should be coordinated with the implementation of the neighborway network to ensure a connected network of improvements.

Benefits

- Support bicycle crossing of major roadways.
- Provide enhanced connections between two bicycle facilities and/or from a bicycle facility to a destination.
- Address existing gaps or missing links in the bicycle network.

MAP 9: RECOMMENDED SPOT IMPROVEMENTS



The full list of recommended spot improvements can be found in Appendix B.

Spot Improvement Examples

Rectangular rapid flashing beacons (RRFB), above left, alert drivers at unsignalized intersections of people walking or biking. New street end connections, above right, enhance access for people walking and biking.

Two stage turn queue boxes, above left, provide a dedicated space for bicyclists to turn left, often when crossing multiple lanes of traffic. A combined bike lane / turn lane, above right, can improve positioning for motor vehicles and bicyclists at right turns.

Bike boxes, above left, provide a dedicated space for bicyclists ahead of motor vehicle traffic at signalized intersections. Bicycle crossing markings, above right, provide clear direction for bicycle travel through an intersection.

The photo above shows a protected intersection using low cost materials such as plastic bollards and paint.

Super Sharrows

> *"Old Town has so much potential as a route and a destination."*

Description

Super sharrows are large pavement markings centered in the travel lane with dotted line markings to ensure drivers are aware bicyclists may legally take the full lane. Super sharrows are recommended on University Dr in Old Town where space is limited but the need for more awareness is high. Although super sharrows have benefits to bicycle travel, described below, they do not provide separation from vehicles and should not replace other more separated facilities as a long term project where space allows. Facilities with greater separation will be considered along University Drive, for example, as a long term improvement.

Benefits

- Can be utilized to enhance wayfinding and route direction along a bicycle route.
- Indicates the preferred positioning for people bicycling.
- Alerts road users of bicycle travel and encourages safe passing from motor vehicles.
- Gives bicyclists more encouragement to take the lane and generates greater driver respect and courtesy.

Super sharrows can either have dotted line markings, above left, and/or be enhanced with green paint, above right.

TABLE 3: RECOMMENDED SUPER SHARROW LOCATIONS

Street Name	From	To
University Dr	Layton Hall Dr	Fairfax Blvd
University Dr	South St	North St

Bike Lanes

"I bike with my kids (ages 9 and 11) and I would like to see more bike lanes and preferably separate bike lanes so they can feel comfortable biking around the city."

Standard bike lanes are shown above left. A buffered bike lane is shown above right and has an extra painted buffer to separate motor vehicles from bicyclists.

Description

Bike lanes provide a dedicated lane for bicycle travel on the roadway utilizing striping, pavement markings and signage. Where possible, buffered bike lanes with vertical separation are recommended.

There are limited opportunities for low stress bike lane implementation in Fairfax today due to streets with high traffic volumes and limited right of way. Several roadways are recommended as potential candidates for bike lanes, but more traffic analysis is needed to determine if bike lanes can be implemented in conjunction with a change in the number or width of travel lanes, or a change in on-street parking.

Benefits

- The dedicated lane provides separation between bicyclists and motor vehicles.
- Increases predictability of both bicyclist and motor vehicle behavior.

TABLE 4: RECOMMENDED BIKE LANE LOCATIONS

Street Name	From	To
Eaton Pl	Chain Bridge Rd	Fairfax Blvd
Roadway Network Northfax East	Eaton Pl	Fairfax Blvd
Draper Dr / Beech Dr	Fairfax Blvd	Draper Dr Park
University Dr	North St	Layton Hall Dr
Judicial Dr	Jones St / Judicial Dr	Main St
Judicial Dr	Jones St / Judicial Dr	Chain Bridge Rd
Armstrong St	Chain Bridge Rd	George Mason Blvd
Layton Hall Dr (eastbound)	University Dr	Old Lee Hwy

Off-Street Paths

> *"The trail system is a huge benefit to our community especially when many people can't go to gyms during the pandemic. Please keep adding trails and park land. On heavily populated trails, I suggest have one area for pedestrians and one for bikes."*

Description

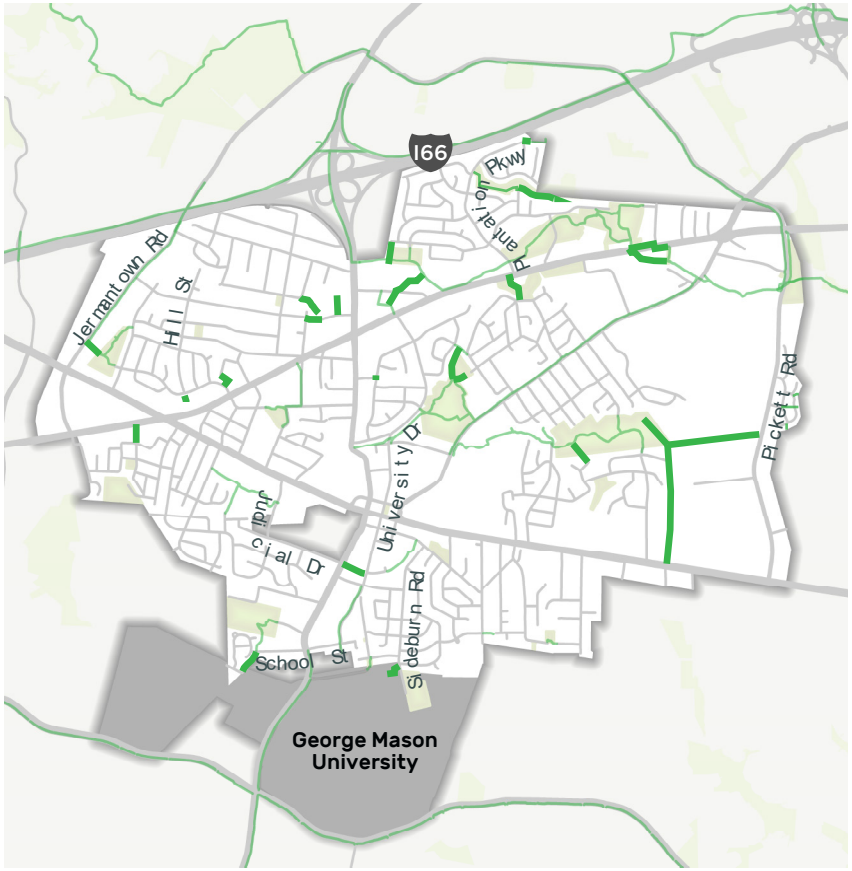
Off-street paths are completely separated from the roadway and are typically shared by bicyclists and pedestrians. Paths can be directly adjacent to the roadway, follow creeks and railroad corridors or may be located in parks and recreational areas.

The recommended off-street path connections are important parts of the low stress bike network. These missing links provide direct connections to the I-66 trail and to existing trails in the city or within Fairfax County. Please note the off-street path alignments are approximate and are dependent upon further study.

Benefits

- Increase opportunities for recreation.
- Safe and comfortable for people of all ages and abilities.
- Can provide safe bicycle routes with limited to no interruption from motor vehicles.

MAP 10: RECOMMENDED OFF-STREET PATHS



The full list of recommended off-street paths can be found in Appendix B.

Improvements to Existing Off-Street Paths

In addition to new off-street paths, improvements to *existing* off-street paths are also recommended. As shown in the photos to the right, many of the existing off-street paths are narrow, unpaved, and have connection points that do not meet accessibility standards. Widening, paving, and improving path entrances through signage and curb ramps will make the off-street paths safer, more comfortable, and more useful for year round biking for recreation or to access destinations. In addition, amenities such as lighting, benches, trash receptacles, drinking fountains, public art, and bike repair stations should also be considered. Specific improvements will vary for each trail segment and will need to reflect current policies and practices.

It's critical to preserve the natural environment and original intent of the existing trail segment. Not all trails will be used for transportation or improved. An inventory of existing segments of off-street paths that are incorporated into the recommended low stress network is needed to determine what segments should be considered and prioritized for future improvements.

Many of the existing off-street paths are narrow and unpaved, as shown above.

Long-Term Improvements

> *"Sharing roads with motorists is terrifying. They're always in a hurry and very insensitive to sharing the road with others. We really need more bike dedicated spaces (trails and separate lanes for bikes)."*

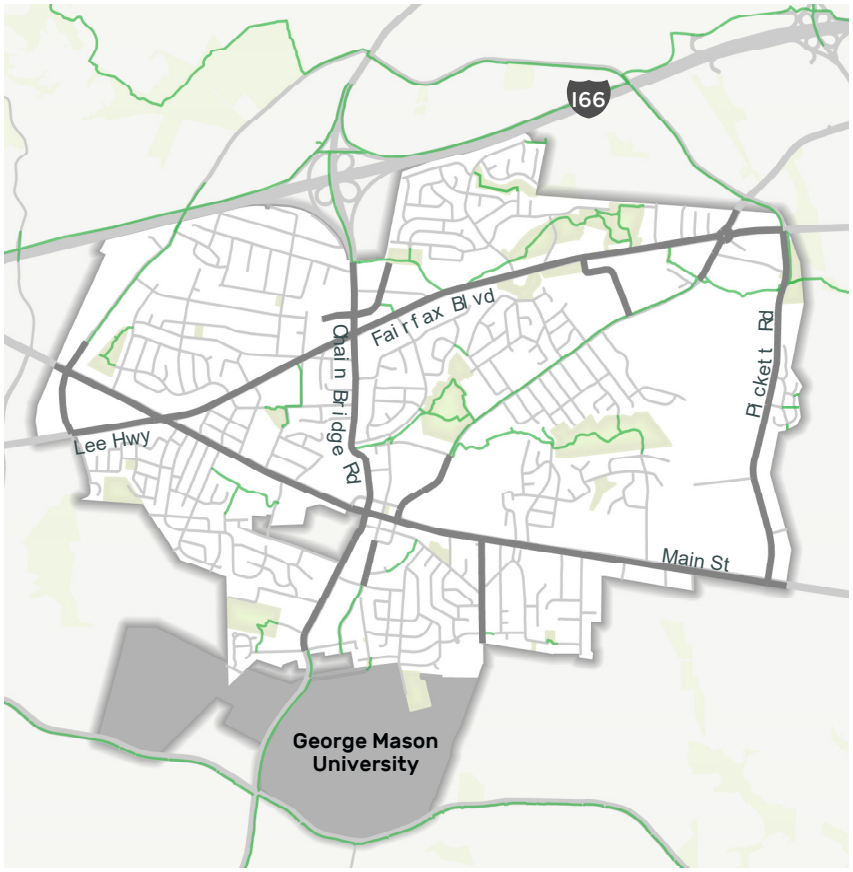
Description

Adding bike lanes or widening outside travel lanes on corridors like Main Street or Fairfax Boulevard won't provide a low stress experience. Long-term improvement projects were identified to address the higher volume/high speed corridors that aren't feasible for a low stress bikeway without major investment, but are an important part of the future network. Long-term improvements sometimes require multi jurisdictional collaboration and complete roadway reconstruction, and therefore can take many years of planning and design before implementation.

Benefits

- Provides direct access to popular destinations, such as Activity Centers, and requires less out of the way travel
- Increases safety for all users along high crash corridors
- Provides access to regional destinations and can be coordinated with other proposed regional improvements.
- Can be combined with green stormwater infrastructure such as bioswales and street trees, as described on page 54.

MAP 11: RECOMMENDED LONG-TERM IMPROVEMENTS



The full list of recommended long term improvements can be found in Appendix B.

Long-Term Improvements: Separated Facilities

Separated bike lanes can be defined as an on-street bikeway that is physically separated from motor vehicles by a curb, median, planters, or other barrier. Another type of separated bicyle facility is a shared use path, which is shared with pedestrians and may run parallel to the road instead of a sidewalk.

As mentioned on the previous page, the recommended long term improvements are on major roadways with higher traffic volumes and speeds such as Fairfax Blvd, Chain Bridge Rd, and Pickett Rd. As referenced previously, the *FHWA Bikeway Selection Guide* recommends that streets with higher speeds and volumes should have separated bike lanes or shared use paths to provide a comfortable and low stress bikeway for all ages and abilities. The goal, therefore, for the long-term improvements is to aim for more separation where recommended by FHWA guidance and pending corridor feasibility studies. More information regarding the recommended long term improvement locations and basic considerations for the corridor feasibility studies of these locations is described in other sections of the plan.

The separated bike lane shown above is separated from motor vehicle traffic by a concrete curb and landscaping.

The separated bike lane shown above is protected from motor vehicle traffic through on-street parking and is commonly known as a "parking-protected bike lane."

Long Term Improvements: Green Infrastructure

Long term improvements, such as separated bike lanes, present an opportunity to not only improve travel for all modes, but also to improve the environment through green infrastructure. Green Infrastructure is a catchall term that describes sustainable stormwater management practices and infrastructure. Through strategies including biofiltration planters, bioretention swales, trees, and permeable pavement surfaces, more water can return to the ground and natural systems while reducing strain on existing water systems.

Green infrastructure can be incorporated into bicycle facilities, within buffers, to improve drainage and user safety. Green infrastructure can also reduce vehicle speed and vehicle volumes along a corridor when used as curb extensions, medians, pedestrian refuge islands, and diverters.

The curb extension shown above can be incorporated into the long term design of neighborways to beautify the street, reduce stormwater runoff, and slow down motor vehicles.

The separated bike lane shown above incorporates landscaping into the buffer.

Benefits

- Reduces the surface temperature of the street and the surrounding area.
- Improves water quality, air quality, and reduces energy use by capturing stormwater runoff.
- Provides habitat for a variety of insects and birds and improves habitat in local watersheds.
- Improves mental and physical health through better air quality, shade and cooler temperatures, beautification and contact with nature.

Long-Term Improvements: Feasibility Study Needs

Each long term project will need to be studied to develop alternatives and evaluate the impacts of potential improvements. Specifically, each feasibility study should address vehicle speeds, traffic congestion, access management and safety for all roadway users. These studies should also consider the land use connection and context as described in the "Link + Place" typology adopted in the *Comprehensive Plan*. The community should be involved in the decision making process, from visioning to implementation.

TABLE 5: RECOMMENDED LONG-TERM IMPROVEMENT LOCATIONS

Street Name	From	To
Fairfax Blvd / Lee Hwy	western City limit	eastern City limit
Main St	City limit (East of Pickett Rd)	Fairfax Blvd
Pickett Rd	Main St	Fairfax Blvd
Jermantown Rd	Lee Hwy	Kutner Park Trail
Chain Bridge Rd	southern City limit	I-66 Ramps
Old Lee Hwy	Main St	Layton Hall Dr
Old Lee Hwy	Ridge Ave	Fairfax Circle
Roberts Rd	southern City limit	Main St
New Street (Northfax Small Area Plan)	Orchard St	Ranger Rd
Lion Run	Fairfax Blvd	Old Lee Hwy

An example of an existing long term improvement already underway is the Old Lee Highway multimodal improvement project, shown in the rendering above, which has taken many years of planning and design.

Many of the long term improvements proposed in this plan are along wide arterial roadways with auto-oriented commercial development. The above image shows a similar context with many long term improvements such as a separated bikeway, lighting, and decorative paving.

Chapter 4: Policies + Programs

CHAPTER 4
Policies + Programs

While physical infrastructure such as bike lanes, shared use paths, and neighborways are critical components of a safe, comfortable, and connected bicycle network, it is also important to develop policies and programs to help make Fairfax a truly bicycle friendly community and achieve the plan's goals. Recommended policy and program strategies in this chapter are organized by the following topics:

- **Engineering Policies** should be adopted to ensure best practices in designing and maintaining comfortable routes and supporting facilities such as bicycle parking.
- **Education and Encouragement Programs** should help teach people skills to become more confident bicyclists, make all road users aware of their rights and responsibilities on the road, inspire people to try biking and create a welcoming environment for bicycling in the community.
- **Traffic Safety + Legislative Policies** should complement engineering, education, and other efforts to raise awareness and positively reinforce safe behaviors on the road.
- **Evaluation Strategies** should assess how the infrastructure, policies, and programs support the goals of the bicycle plan in order to inform changes or additional strategies.

Substantial increases in bicycling requires a comprehensive approach of many different, complementary interventions. Bike to work day events provide a great opportunity for bicycle safety education and encouragement.

Engineering Policies

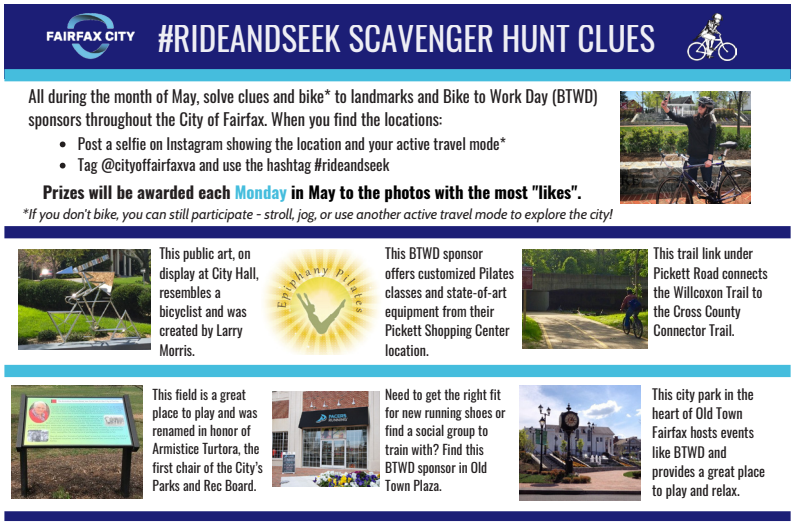
- Adopt expanded bicycle parking guidelines for installing bicycling parking in both the public rights of way and as part of private developments.
- Establish a program to fund the on going construction of bicycle improvements such as intersection improvements and bicycle parking in public rights of way.
- Update the City's Public Facilities Manual (PFM) with current best practices for the design of on-street and off-street bicycle facilities, shared use paths, and bicycle friendly intersections. Best practices may incorporate accepted guidance from VDOT, AASHTO, NACTO, or other sources. This update should specifically include standards that support physically separated bicycle facilities on major roadways.
- Update the "Link + Place" street design guidelines in the Multimodal Transportation chapter of the *Comprehensive Plan* to provide additional clarity on the desired bicycle facilities along specific corridors.
- Establish a maintenance program and create policies to fund bikeways and keep City bikeways in good repair.
- Update and promote the traffic calming program and use traffic calming measures to reduce speeds on priority bicycle routes. Evaluate traffic speeds and volumes to prioritize traffic calming.
- Explore "quick build" or "tactical urbanism" strategies to support innovation and incremental implementation through more flexible approaches such as pilot projects.

The images above and left show parking lanes converted into bicycle parking areas, called "bike corrals." Bike corrals provide substantially more bicycle parking and reduce sidewalk congestion, particularly in heavily used commercial areas.

Education & Encouragement Programs

- Implement a bike share program to increase biking levels and facilitate the first and last miles of transit trips. The program should be monitored for ridership, equity and safety.
- Collaborate with the FCPS Safe Routes to Schools program to expand bicycle education and encouragement at City of Fairfax Schools. This may include (but is not limited to) support for traffic safety or "learn to ride" classes, school events such as bike to school day, development of a "traffic garden", or other programs in collaboration with the schools.
- Host "learn to ride" classes for adults.
- Continue to host encouragement events such as Bike to Work Day; support events hosted by others (such as community rides or races).
- Develop and maintain information such as an updated City website about bicycling resources and updated map of bicycle facilities. Include information about and encourage the use of electric bicycles.
- Develop a Transportation Demand Management (TDM) program to guide encouragement programs implemented by developers and employers. Identify and promote public incentives such as bicycle commuter benefits.
- Support continuing education or professional development opportunities for City staff on bicycle transportation to improve design, operations, and enforcement practices.
- Initiate programs that facilitate and incentivize bicycling as an alternative commuting method (e.g. Commuter Connections incenTrip app).

Helmet giveaways are popular with families and encourage safe riding habits for children.



The above screen capture shows a "Ride and Seek" scavenger hunt event held during National Bike Month.

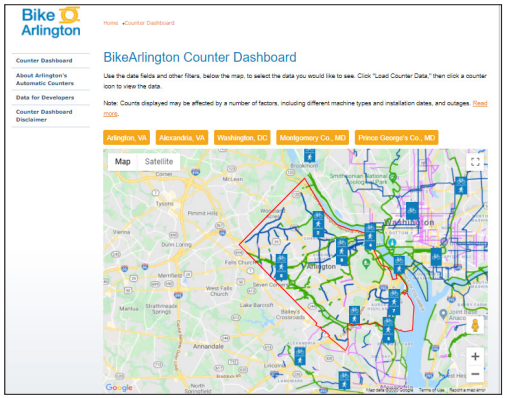
Traffic Safety & Legislative Policies

- Continue collaborating with the police department and other relevant departments to identify safety “hot spots” and targeted enforcement needs for all modes.
- Continue collaborating with the police department and other relevant departments to identify and promote traffic safety education campaigns for all modes.
- Collaborate with the City’s ADA coordinator to review policies and opportunities to:
    - educate bicyclists and pedestrians about safety on shared facilities such as trails and shared use paths;
    - ensure new projects within the city meet current accessibility standards; and
    - provide equal opportunity to all residents to enjoy improved mobility.
- Review City ordinances and codes pertaining to bicycles and update as appropriate.
- Support legislation at the local, state, and federal levels to improve safety for bicyclists.

Permanently mounted speed feedback signs can be used to heighten awareness of speed limits.

Evaluation Strategies

- Establish performance targets for bicycle infrastructure, programs, and outcomes and provide periodic reports on the City's progress towards its goals.
- Establish a regular bicycle count program. This may include automated counting equipment or periodic manual counts to provide continuous count locations at signalized intersections.
- Establish a process to evaluate the benefits and impacts of major bicycle and trail projects, such as bicycle "level of service" metrics, environmental benefits and impacts, and equity impacts.
- Pursue recognition programs such as the League of American Bicyclists "Bicycle Friendly Community" designation.
- Consider establishing a bicycle advisory committee to guide implementation and progress of the bicycle plan.
- Consider establishing a City position and/or internship to support bicycle programs.
- Continue coordinating with regional partners such as Fairfax County, NOVA Parks, FABB, MWCOG and NVRC to evaluate bicycling needs and to leverage opportunities for improvement.
- Support regional efforts such as increased bicycle parking at WMATA Metrorail stations.



Arlington County has established a robust program of continuous, automated bicycle and pedestrian counters. The Rosslyn Bikometer provides a highly visible, engaging and fun view of the volume of bike usage on the Custis Trail in Arlington.

Chapter 5: Implementation

CHAPTER 5

Implementation

The infrastructure, policy, and program recommendations in previous chapters provide strategies for making Fairfax more bicycle friendly. The purpose of this chapter is to provide guidance and action steps for implementing the recommendations.

Implementing the recommendations within this plan will require leadership and dedication to bicycle facility development on the part of a variety of groups and agencies. It will be important to identify opportunities to coordinate with other city and regional improvements (such as complete streets improvements, street repaving, or drainage improvements.) Equally critical, and perhaps more challenging, will be meeting the need for a recurring source of revenue. Even small amounts of local funding could be very useful and beneficial when matched with outside sources.

The City is currently implementing several bike projects including the two way separated bike lane on the north side of Old Lee Highway.

Network Prioritization

Given limited funding, the City of Fairfax must decide where to prioritize its effort implementing projects recommended within this plan. In order to identify high priority initiatives, the project team developed prioritization criteria to guide short term and long term projects. Using the criteria shown below and feedback from the steering committee, projects were sorted into short term and long term categories. These recommendations are shown in Map 12 and a full project list can be found in Appendix B.

TABLE 6: PRIORITIZATION CRITERIA

Criteria	Description
Connectivity	Identify projects that help expand the existing network to provide a continuous, safe biking experience.
Demand	Identify projects located in areas with the highest demand, based on access to destinations such as Activity Centers, schools, parks, and regional networks.
Feasibility	Identify "low hanging fruit" projects that may be easier to implement in the short term, such as the neighborway network.
Safety	Identify projects with the highest potential safety impacts based on crash patterns and vehicle volumes and speeds.
High Need	Identify projects located in areas of high need across the city, which includes projects that provide access to jobs.

A qualitative approach was used to prioritize projects. As described below, the short term projects provide the greatest benefits—meeting most of the criteria in Table 6 and meeting the plan's goals—for the lowest cost. Long term projects are mostly along major arterials and require significant investment, planning, and coordination. The neighborway network, for example, was identified as short term because they can be implemented at a relatively low cost, are safe and low stress facilities, and connect people throughout the city to various destinations.

Short Term Projects

21.5 Miles and 22 Spot Improvements

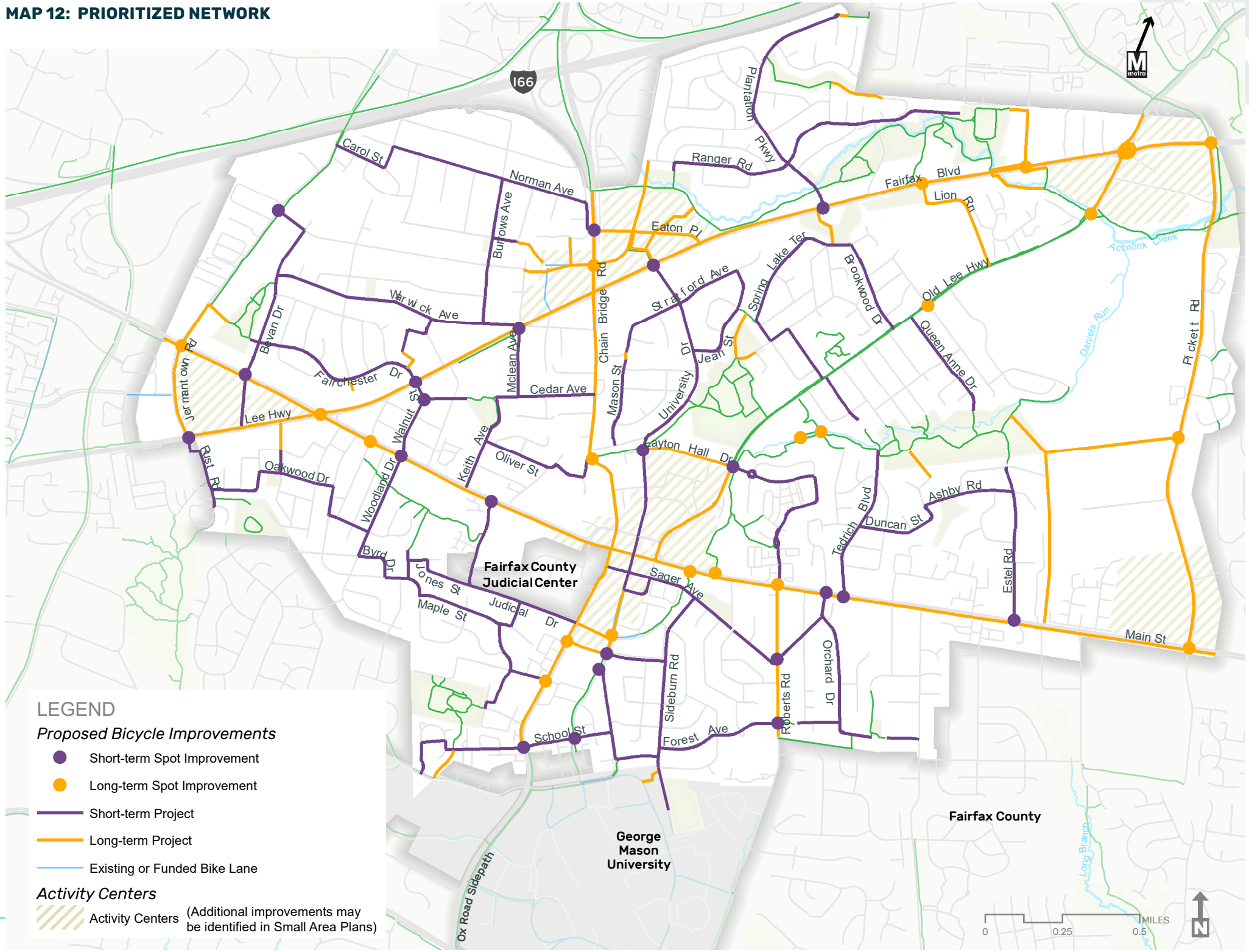
Short term projects are projects that are recommended for completion within the next 5 years. The short term network includes the entire neighborway network, mentioned above, to be implemented in several phases (see Short Term Strategies for more detail). Additional projects were included in the short term network that meet the prioritization criteria described in Table 6.

Long Term Projects

18.5 Miles and 21 Spot Improvements

Long term projects require additional traffic studies and a community design process to evaluate trade offs, and may require multi-agency coordination. The projects identified in the long term network are more complicated and require more time to outline strategic implementation. Long term projects, however, could be implemented sooner if an opportunity arises to coordinate with a redevelopment project or other capital project.

MAP 12: PRIORITIZED NETWORK



Short Term Project Strategies

ACTION ITEM: SHORT TERM PROJECTS

NETWORK BRANDING + WAYFINDING

The City should engage stakeholders in a collaborative design process to develop placemaking signage for the neighborway network. A cohesive brand should be developed that covers the spectrum of on-street bikeway, pedestrian, trail, transit wayfinding and even vehicular signage. Once a brand is developed, the City should evaluate and implement wayfinding for the entire short term network.

ACTION ITEM: SHORT TERM PROJECTS

NEIGHBORWAY CONCEPT DEVELOPMENT

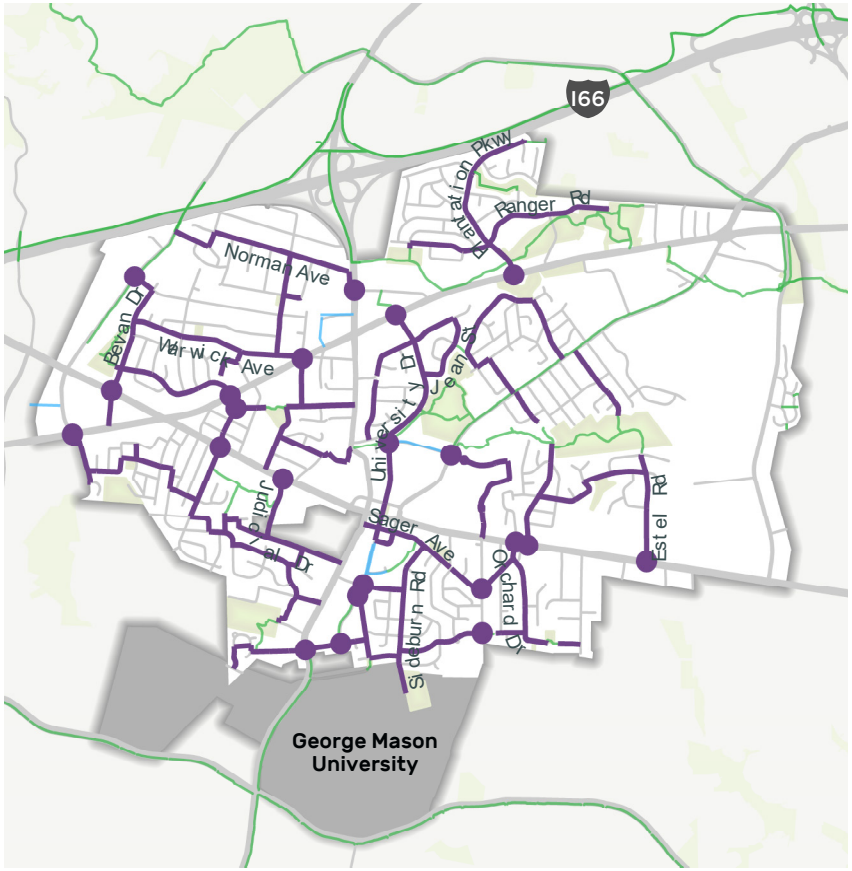
The recommended neighborway network should be evaluated to determine where traffic calming elements are needed in order to ensure a low stress biking experience.

ACTION ITEM: SHORT TERM PROJECTS

SPOT IMPROVEMENT + BIKEWAY IMPLEMENTATION

The short term network includes 22 spot improvements and bikeway implementation along Judicial Dr and University Dr. The first step of implementation should include additional traffic engineering and design efforts to determine the ultimate concept for each location. Upon developing these concepts, the spot improvements may need to be prioritized again, based upon the criteria in Table 6, to determine which of the short term spot improvements are the highest priority.

MAP 13: RECOMMENDED SHORT TERM PRIORITY PROJECTS



The full list of recommended short term projects can be found in Appendix B.

Long Term Project Strategies

ACTION ITEM: LONG TERM PROJECTS

CORRIDOR STUDIES

The City should first prioritize the long-term projects (using the prioritization criteria in Table 6) and then secure funding to develop a series of feasibility studies for the long term projects on arterial streets such as Main St, Fairfax Blvd, and Pickett Rd. Corridor studies will rely on technical data to assess the practicality of bikeway implementation as well as stakeholder engagement. Each study can be used to identify a future implementation strategy.

ACTION ITEM: LONG TERM PROJECTS

FOCUSED COMMUNITY ENGAGEMENT

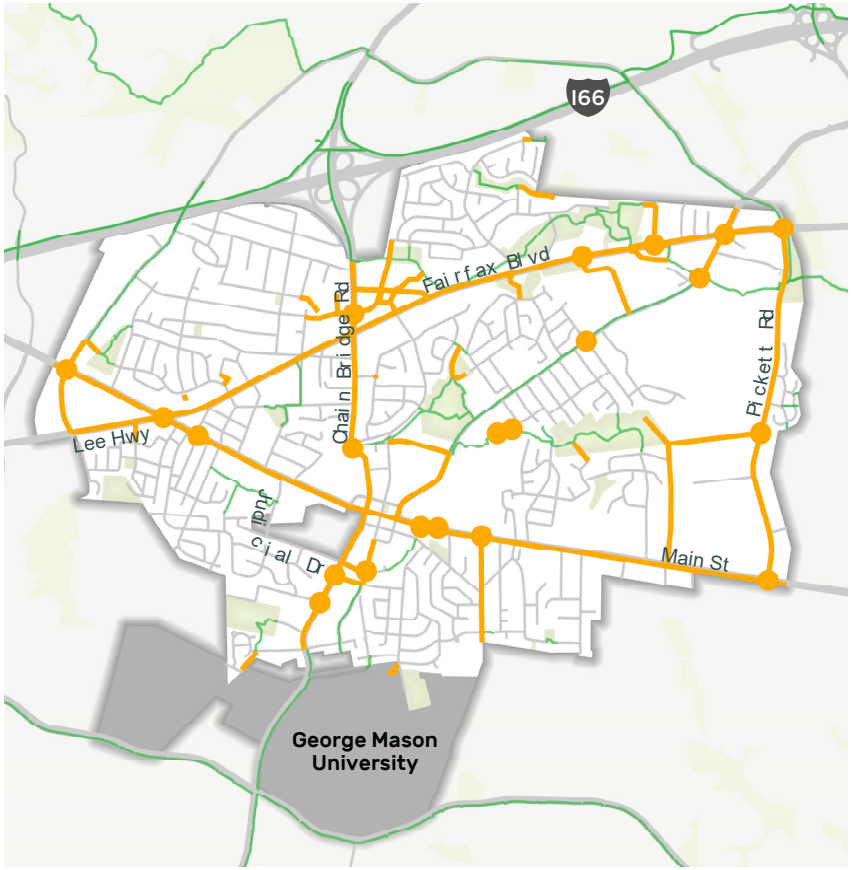
Several of the projects identified in the long term network have trade offs associated with implementation of a low stress bike network such as restricting on-street parking or increasing traffic delay. The City should initiate focused community engagement to present different alternatives to the long term projects.

ACTION ITEM: LONG TERM PROJECTS

SECURE FUNDING

Several of the long term projects are more complicated and may have a high cost to implement. Once a general concept and design strategy has been developed for the long term projects, the City should work to secure funding for project implementation.

MAP 14: RECOMMENDED LONG TERM PRIORITY PROJECTS



The full list of recommended long term projects can be found in Appendix B.

Program and Policy Implementation Strategies

The following action items outline a strategy for implementation of the recommendations found in the *Bike Fairfax City* plan. The action items are not shown in order of priority and aren't meant to be static in nature. This section is meant to provide a high level overview to guide implementation.

ACTION ITEM: FUNDING

LEVERAGE FUNDING OPPORTUNITIES

Leveraging the investments in other city projects should be a high priority. Infrastructure recommendations in this plan could be completed at the same time as other projects involving major work on a street, including bus rapid transit, paving, or safety projects. The complete streets approach helps to reduce construction impacts and provides benefits to the city and its partners.

ACTION ITEM: PROGRAMS + POLICIES

UPDATE COMPREHENSIVE PLAN

Update the Comprehensive Plan, and other related city plans, to reflect the recommendations of the *Bike Fairfax City* plan.

ACTION ITEM: PARTNERSHIPS

COORDINATION WITH PARTNERS

The city should promote partnerships and programs to engage state, regional and advocates such as Fairfax County, VDOT, FABB. Commuter Connections, NVRC, and MWCOG. This level of collaboration will help to ensure that resources can be leveraged and common goals achieved. In addition, a standing Bicycle Advisory Committee is recommended to help oversee implementation of the *Bike Fairfax City* plan.

ACTION ITEM: DESIGN

DESIGN STANDARDS + GUIDANCE

All bicycle facilities should be designed to meet or exceed the latest federal, state and local guidelines. The city should evaluate and update the Public Facilities Manual and zoning code to reflect national best practices and resources such as:

- AASHTO Guide for the Development of Bicycle Facilities
- FHWA Separated Bike Lane Planning and Design Guide
- NACTO Urban Bikeway Design Guide
- FHWA Bicycle Facilities and the Manual on Uniform Traffic Control Devices
- FHWA Incorporating On-Road Bicycle Networks into Resurfacing Projects
- FHWA Bicycle Network Planning and Facility Design Approaches in the Netherlands and the United States
- FHWA Bikeway Selection Guide
- APBP Bicycle Parking Guidelines

ACTION ITEM: DESIGN

QUICK BUILD PROJECTS

The city should consider developing a "quick build" implementation approach for some projects, informed by similar policies and standards being developed in other communities. Consistent with the *Comprehensive Plan* goal of using pilot projects to evaluate new concepts, a "quick build" approach will allow the city to test new designs for a lower cost and on a faster timeline before committing to a larger capital project.

ACTION ITEM: DESIGN

STAFF TRAINING

Provide training for City staff on bicycle facility design best practices, the bicycle project delivery process, and project evaluation techniques.

ACTION ITEM: MAINTENANCE

MAINTENANCE + OPERATIONS

Ensure facilities are properly maintained for year round access and that the project scoping process accounts for future maintenance needs. The city should evaluate and update existing maintenance policies and standards.

ACTION ITEM: PROGRAMS + POLICIES

IMPLEMENT PROGRAMS + POLICIES

The city should continue to build upon existing safety educational and encouragement programs, and create new programs as outlined in Chapter 4. In addition, conducting a thorough review of existing policies and identifying updates or implementing new policies will help to ensure that bicycle safety, comfort and access is addressed comprehensively.

ACTION ITEM: ECONOMIC DEVELOPMENT

SUPPORT ECONOMIC AND COMMUNITY DEVELOPMENT

The city should continue inter-departmental coordination to support events (e.g., bike tourism and festivals.) and projects (e.g., bicycle parking) that encourage neighborhood level active transportation and access to local businesses. The city should also implement the proposed bike share system, which has been shown to promote economic development.

ACTION ITEM: EVALUATION

PROJECT EVALUATION

Evaluate and monitor projects by conducting before and after data collection, including incorporating new technology and user perception surveys.

ACTION ITEM: EVALUATION

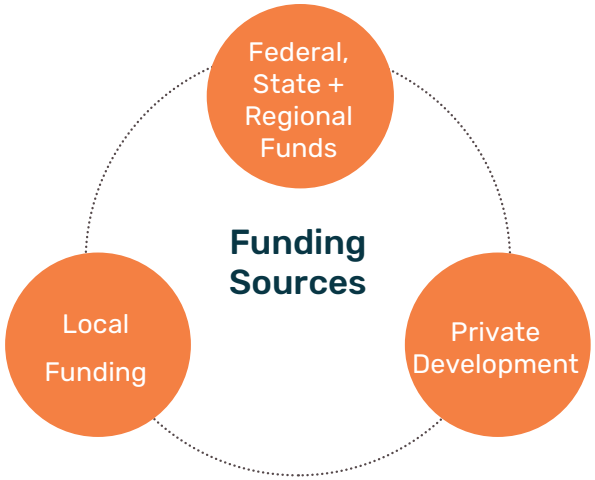
DEVELOP ANNUAL REPORT CARD

The development of an annual report card to highlight accomplishments and evaluation metrics is recommended. This report card will provide a key communication tool between the city and the public to ensure transparency and accountability. The annual report card may require updates to the plan, particularly in regards to the implementation strategy.

Potential Funding Sources

In order to achieve the goals of this plan, the City of Fairfax and its local partners will need to fund improvements from a variety of funding sources and partners. Funding sources will need to be opportunistic and consistent in order to implement this plan. Several primary funding sources make up the core funding strategy for this plan:

- **Federal, State, + Regional Funds:** Federal funding is typically directed through state agencies to local governments either in the form of grants or direct appropriations, independent from state budgets. In Virginia, federal monies are administered through the Virginia Department of Transportation (VDOT) by the Commonwealth Transportation Board (CTB). Regional organizations may also administer federal and regional funding sources. Most, but not all, of these programs are oriented toward transportation, with an emphasis on reducing congestion and providing intermodal connections.



- **Local Funding:** Fairfax can use the concepts and policies presented in this plan to fund bicycle implementation through the following strategies:
  - *Annual Budget:* Implement through a dedicated bicycle improvement funding stream or through regularly scheduled capital projects, such as streetscape projects, street resurfacing, stormwater improvements or new public or private property construction.
  - *Capital Improvement Program (CIP):* Establishing a funding program with annual increases can help advance capital projects consistently. Issuing a transportation bond referendum is another option to help raise capital funding.
  - *Grants:* Competitive grants through public agencies or through private or non profit foundations can generate additional resources for projects and programs. To increase readiness for grant funding, preliminary plans (30% construction drawings) can be developed for priority bikeway and pedestrian projects.
  - *Fundraising Campaigns:* Fundraising through neighborhood groups, advocacy groups, or public partnerships can help generate additional resources for projects and programs.
- **Private Development:** Fostering partnerships with private developers provides an opportunity to generate revenue to fund infrastructure projects, or incorporate improvements into planned developments, such as sidewalk and off-street path construction.

Measuring Progress

Performance measures are critical for assessing and understanding whether the goals of the plan are being achieved over time. While these measures focus on evaluating progress over the long term, data should be collected on a regular basis to track interim progress. Frequent tracking will provide the City of Fairfax with feedback on whether policy adjustments are needed to progress beyond the current baseline.

The performance measures in Table 7 are outcome based and focus on achieving policy objectives. These performance measures are focused on tracking changes to bicycle use.

In addition to the specific bicycle related performance measures, as shown in Table 7 below, the *Bike Fairfax City* plan aims to be a key component in achieving the following performance metrics identified in the *2017 Fairfax Multimodal Transportation Plan*:

- Decrease crashes of all types on major and minor arterials, especially crashes involving bicyclists and pedestrians.
- Create a city of "15-minute neighborhoods" to ensure that 100% of residents can access a Local Activity Center via a safe 15-minute walk from home (currently 44%).
- Ensure 100% of residents are connected to green space, trails, or open space via a safe 15-minute walk of home (currently 88%).
- Ensure 100% of residents have access to transit by providing a transit stop within a safe 10-minute walk of each residence (currently 79%).
- Increase choice, reliability, and efficiency in travel by achieving at least a 40% non-drive alone mode share for commute to work trips (currently 28%).

TABLE 7: RECOMMENDED PERFORMANCE MEASURES

Baseline Measurement	Performance Target
User Counts: The number of bike trips occurring at select locations.	Increase the total number of bicycle trips 5% by 2025.
Mode Split: Biking is currently <1% of existing (2017) mode share (ACS data).	Increase the bike mode share to 2% by 2025.
User Needs: Collect and evaluate qualitative data to understand user needs and existing challenges.	Target to be determined after survey questions are developed.
Network Implementation of Short Term Projects: There are 43 segments and 22 spot improvements proposed for short term improvement projects.	Implement 25% of short-term priority projects and complete feasibility studies for 2 long term projects by 2025.
Safety: There were 46 bicyclist-involved collisions in Fairfax between 2008 and 2019.	Decrease the number of bicyclist-involved collisions by 2% by 2025.

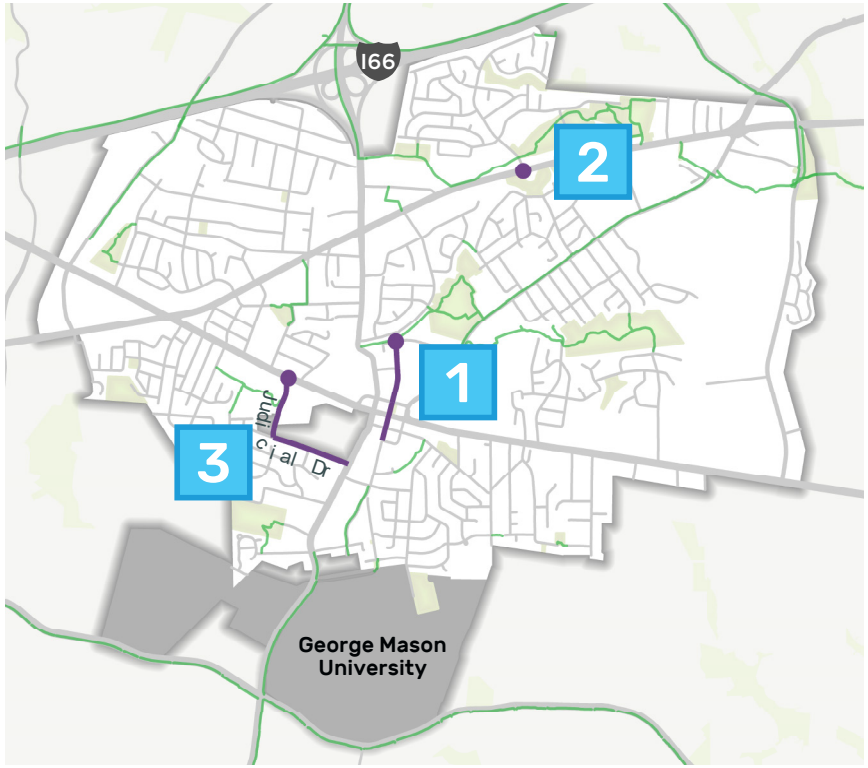
Example Projects

Appendix C offers detailed information on three example projects, including individual project maps. These projects were selected based on input from City staff, the steering committee, and the general public. In addition, these projects represent opportunities for short term implementation that would fill critical missing gaps in the existing network. The example project cut sheets provide planning level design concepts only. Additional traffic analysis and design will be necessary before implementation.

Each project section features the following information:

- Project Description
- Trip Generators
- Traffic Volumes (AADTs)
- Speed Limit
- Existing ROW estimates (based on aerial imagery)

MAP 15: EXAMPLE PROJECTS



Example Project Locations

1 University Drive

2 Plantation Parkway & Fairfax Blvd

3 Judicial Drive

Endnotes

1 *LiveHealthy Fairfax. Community Health Dashboard. Adults 20+ obese. http://www.livehealthyfairfax.org/indicators/index/view?indicatorId=39&localeId=2977*

2 *LiveHealthy Fairfax. Community Health Dashboard. Adults 20+ who are sedentary. http://www.livehealthyfairfax.org/indicators/index/view?indicatorId=1065&localeId=2977*

3 *Kelly, P., Kahlmeier, S., Götschi, T. et al. Systematic review and meta-analysis of reduction in all-cause mortality from walking and cycling and shape of dose response relationship. Int J Behav Nutr Phys Act 11, 132 (2014). https://doi.org/10.1186/s12966-014-0132-x*

4 *Boyd, H., Hillman, M., Nevill, A., Pearce, A. and Tuxworth, B. (1998). Health-related effects of regular cycling on a sample of previous non-exercisers, Resume of main findings*

5 *Alta Planning + Design graphic based on national data (https://www.bikeleague.org/content/national-household-travel-survey-short-trips-analysis)*

6 *Joh, K., Ph.D., AICP. (2021, January 21). 2017-2018 REGIONAL TRAVEL SURVEY BRIEFING: CHANGE IN OBSERVED TRIPS SINCE 2007/08 [PDF]. National Capital Region Transportation Planning Board.*

7 *Rosén, E., & Sander, U. (2009). Pedestrian fatality risk as a function of car impact speed. Accident Analysis & Prevention, 41(3), 536-542 https://doi.org/10.1016/j.aap.2009.02.002*

8 *Source: Wesley E. Marshall, Nicholas N. Ferenchak. Why cities with high bicycling rates are safer for all road users, Journal of Transport & Health, Volume 13, 2019.*

9 *Liu, J., & Shi, W. (2020). Understanding Economic and Business Impacts of Street Improvements for Bicycle and Mobility – A Multicity Multiapproach Exploration. TREC Final Reports. https://doi.org/10.15760/trec.248*

10 *European Cyclists' Federations. (2016). Cycle More Often 2 Cool Down the Planet! Quantifying CO2 savings of cycling.ast Company https://medium.com/fast-company/as-we-discuss-big-solutions-to-climate-change-dont-forget-people-friendly-streets-18514fe56a43*

11 *Greenhouse Gas Emissions Inventory for the Metropolitan Washington Region (2005-2012): http://www.mwcog.org/store/item.asp?PUBLICATION_ID=521*

12 *AAA. (2019). Average Annual Cost of New Vehicle Ownership. https://www.aaa.com/autorepair/articles/average-annual-cost-of-new-vehicle-ownership*

13 *LiveHealthy Fairfax. Community Health Dashboard. Households without a vehicle. http://www.livehealthyfairfax.org/indicators/index/view?indicatorId=281&localeId=2977*

14 *US Censis Bureau. QuickFacts: Fairfax City, Virginia. https://www.census.gov/quickfacts/fact/table/fairfaxcityvirginiacounty/IPE120219#IPE120219*

15 *Four Types of Cyclists. (2009). Roger Geller, City of Portland Bureau of Transportation. Supported by data collected nationally since 2005*

16 *Levels of Traffic Stress Definitions, ODOT Analysis Procedure Manual, Version 2*