MERRIFIELD BIKESHARE FEASIBILITY STUDY
A Closer Look at Merrifield, VA and Potential Bikeshare Options
Prepared for the Fairfax County Department of Transportation
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Prepared in UAP 5794 Environmental Planning Studio
With support and direction from Ralph Buehler.
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Photo Credit: Clark, Source: Flickr
EXECUTIVE SUMMARY

Bikeshare is a convenient mode of neighborhood circulation that can also improve first and last mile access to public transportation. In the Fall of 2016, Fairfax County launched bikeshare in Tysons as well as Reston. In an effort to further expand their bikeshare network, the Fairfax County Department of Transportation has reached out to Virginia Tech to develop a feasibility study for a bikeshare expansion to Merrifield, Virginia.

This study takes into account a variety of important factors and goals that are listed below. These factors and goals helped to identify the study area as well as to provide a framework for the development of the bikeshare system’s station siting.

**Analysis factors include:**
- Attractions and Points of Interest
- Libraries, Recreation Centers, Theaters, Restaurants and Schools
- Demographics and Equity
- Population Density, Household Income, and Educational Attainment
- Economics and Jobs
- Employment Density
- Existing Transportation and Infrastructure
- Bus Routes, Existing/Future Bicycle Infrastructure and Other Transit
- Regional Mobility
- Future Infrastructure

**Goals:**
1. Highlighting Opportunities & Challenges
2. Identify Best Locations for Bikeshare
3. Propose a Phasing Plan
4. Summarize Projected Capital, Startup, Installation, and Implementation Costs
5. Provide Better Connectivity to Core Areas and Future Expansion to Tysons

**Station Siting**
To determine station locations, we used both quantitative models and qualitative data gathered from site visits. We discovered that there were more suitable locations for bikeshare stations than could be built with current funding constraints. Taking this into consideration, we propose to split the Merrifield expansion into two phases. In phase one we proposed exact placements of bikeshare stations based on an in-depth analysis of each location. We proposed ten stations and suggest three alternative locations in this phase, which can be built immediately with current funding and infrastructure. Several of the stations will require approval from property owners, as not all stations can be constructed on public right of way. For phase two, we propose seven stations but without exact placement locations. We did not conduct detailed analysis on these stations, as we envision phase two be constructed at a later date when funding becomes available and demand for bikeshare increases.
System Costs and Funding
Our client, Fairfax County, has indicated that it expects to budget approximately $400,000 for bikeshare expansion in Merrifield, and we aimed to keep capital and launch costs within this limit. Most funding for bikeshare is available from federal programs and distributed by VDOT. The county has applied for the Transportation Alternatives Set-Aside funding for FY18, and we believe that this is the ideal source of funding for bikeshare in Merrifield. However, Transportation Alternatives Set-Aside funding can only account for a maximum of 80 percent of capital costs with a 20 percent local match. An alternative to this could also be the Congestion Mitigation and Air Quality (CMAQ) funding. In addition, as it was done when implemented bikeshare in Reston and Tysons, the county should pursue partnerships with local business and real-estate developers to split capital and operational costs through sponsorship opportunities.

Conclusion
We examined cycling infrastructure in Merrifield, as well as the population density, employment density, traffic data, and future development of the Merrifield Suburban Center in developing this feasibility study. Three core areas in Merrifield were analyzed using qualitative and quantitative research. Within these three areas, we developed a bikeshare plan in two phases. We anticipate that phase one can be built as soon as funding is available, and phase two can be built as the usage pattern of bikeshare becomes apparent.
INTRODUCTION TO BIKESHARE

Photo Credit: Elvert Barnes, Source: Flickr
A bicycle-sharing system, or a bikeshare, is a form of public transportation that offers residents and visitors an additional mode of transportation throughout the city. Bikeshare has been implemented in a number of cities worldwide with 55 systems in the United States during 2016. Modern bikesharing systems allow riders to ‘rent’ a bicycle to travel between two places, by taking a bike from one station and returning it to another. Systems vary in price structure, but in most cities, an annual or monthly subscription or a day charge gives riders access to bikes in the system without an additional fee for the first 30 minutes of riding. This encourages the use of biking for shorter trips and ensures that each bicycle is available for several trips a day. Bikeshare is a convenient mode of transportation that also offers health benefits since the user switches to an “active” mode of transit.

Capital Bikeshare, or CaBi, first began operation in 2010 and was the Washington area’s second attempt at developing a bikeshare system. The first program had launched in 2008 and was the first bikeshare system in the United States with docking stations. The District of Columbia, Arlington County, the City of Alexandria, Fairfax County, and Montgomery County operate CaBi as a partnership. It is intended that bikeshare will be used for short and medium length trips by users and to provide first mile/last mile access to Metrorail and other transit throughout the Washington Metropolitan Area. Each locality bears the responsibility for financing, operating, and planning of bikeshare when joining CaBi, and there is minimal regional coordination when operating the system.

Most recently, Fairfax County adopted CaBi, joining the system in October 2016 with stations in Reston and Tysons. This expansion consisted of 29 stations and over 200 bicycles. Fairfax County has expressed interest in expanding bikeshare to other areas, including Merrifield and Vienna. This document aims to provide a strategy for expansion of bikeshare along the Gallows Road corridor from the Dunn Loring-Merrifield Metrorail Station to the Mosaic District, as well as the residential areas west of Mosaic and south to Route 50 to connect with large employers in the area such as Inova Fairfax Hospital. This report will also touch upon a possible expansion north along Gallows Road to connect with Tysons.
MERRIFIELD IN REVIEW

Photo Credit: Matt Johnson, Source: Flickr
MERRIFIELD

Merrifield represents a unique opportunity to expand bikeshare as part of a greater mission to prepare Fairfax County for the challenges of the next century. The specific interest in the expansion of Capital Bikeshare into Merrifield lies in a mix of factors that has lead regionally comparable areas to successfully launch CaBi operations: location, rapid development, demographics, concentration of attractions and a significant and growing employment base. Projecting these factors forward, it appears that CaBi operations in this area of the county would be successful and, given time and an appropriate expansion strategy, may rival nodes of activity in such areas as Arlington County and the City of Alexandria.

Three initial factors were analyzed when determining the potential of bikeshare in Merrifield compared to other areas in Fairfax County include current population and employment density as well as existing transport infrastructure (mass transit options and bike-friendly infrastructure).

The Study Area

The Study Area for this report is defined as the Merrifield Suburban Center in the Fairfax County Comprehensive Plan. It is important to note that the Merrifield Suburban Center boundary differs from the census-defined place (CDP), which is also called Merrifield. The Study Area is approximately 1,550 acres or 2.42 square miles. The Study Area is roughly located south of Interstate 66, north of Woodburn Road, west of Holmes Run, and east of Long Branch Stream Valley and Prosperity Avenue (Figure 1). The area contains a mix of uses, including office, commercial, medical facilities, hotel, residential, light industrial, and retail.

Due to the recently municipally-defined boundary of the Merrifield Study Area, the rapid growth and socioeconomic change is not intrinsically apparent in traditional mapped boundaries. Such changes as population and employment growth need to be considered in the application of a regional bikeshare system, and this is why the Study Area boundary had to expand beyond Merrifield CDP. At the same time, while the boundary needed to be larger than the traditional extent, it still had to be based on a Fairfax County defined area. Therefore, the choice of using Merrifield Suburban Center defined boundary for the study area, accomplished both feats.
Figure 1
Areas of Interest

Three areas of interests were identified in the Merrifield Study Area. The first is the Transit Station Area, which surrounds the Dunn Loring-Merrifield Metrorail Station, and the second is the Town Center, located at the center of the Merrifield area. Both are identified in the Fairfax County Comprehensive Plan as locations with the highest concentrations of development. These two areas currently offer a wide array of attractions (Figure 3). The Transit Station Area and the Town Center are densely populated with residents and businesses, making this area a live, work and play community (Figure 2).

Figure 2

Residential and Mixed Use Buildings
Merrifield, Virginia
The third area of interest is the Inova Fairfax Hospital campus located on the southern end of the Merrifield Study Area.

Following analysis, the area to the east of the Capital Beltway within the Study Area was not included in the bikeshare deployment phases. Despite having approximately three million square feet of office space, the lack of attractions, the relative distance and poor connectivity to the three areas of interest make this area ill-suited for bikeshare.

Figure 3

Areas of Interest
Merrifield, Virginia

Legend
- Dunn Loring-Merrifield Metro
- Areas of Interest
- Study Boundary
The Merrifield Suburban Center Plan outlines the main goals and objectives of the revitalization center with reference to future bicycle infrastructure. Stated objectives regarding bicycle planning are as follows:

- Encourage revitalization and redevelopment of portions of the Merrifield suburban center to create more attractive and functionality efficient commercial and residential areas with pedestrian and bicycle-friendly transit oriented environments;

- Encourage mixed use development that includes pedestrian, bicycle and auto circulation systems that integrate development both internally and externally, resulting in transit oriented and pedestrian friendly environments;

- Develop a cohesive pedestrian and bicycle circulation system linked to open space such as plazas, courtyards, greenways, and parkland in order to facilitate walking and reduce reliance on private automobiles.7

While the plan does not specifically mention the use of Capital Bikeshare or another bikesharing method, there is a desire to have an alternative mode of transportation in and around the area of study to support the new urban cores. Additionally, the Fairfax County Bicycle Master Plan does not mention Ca-Bi as it was not introduced in the county when the plan was written. Since 2013, when the final draft of the Bicycle Master Plan was adopted, Reston and Tysons have implemented bikeshare programs. While these programs are relatively new, there is a consensus that these initiatives will be productive and serve the area well. This Merrifield Area Feasibility Study was developed using the Reston and Tysons Capital Bikeshare programs as examples.
The Merrifield CDP is a community of 16,412 people and is comparable to the population of Tysons of 22,437. The population of Merrifield is growing and has increased by 1,197 people since 2011. According to the US Census Data, an average resident of this area is relatively young (33.8 years old), well educated (72.3% with bachelor’s degree or higher) and relatively affluent ($108,000 median household income). Finally, a relatively high percentage (19.2%) of the residents in the area commute to work by public transit. These commuters are the ideal target demographic who could use bikeshare to cover their first/last mile of the trip (Table 1).

Over the next 10 years, the Merrifield Study Area’s population is expected to double (Figure 4). According to projections analysis of the Metropolitan Washington Council of Governments’ (MWCOG) Cooperative Forecasts by Transportation Analysis Zones, population growth in the Study Area will exclusively focus in the Transit Station Area and the Town Center. These projections are consistent with the Fairfax County’s Comprehensive Plan for the Merrifield Suburban Center.
<table>
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<th>Merrifield</th>
<th>Fairfax County</th>
<th>US</th>
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<td>Total Population</td>
<td>16,412</td>
<td>1,128,72</td>
<td>316,515,021</td>
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<tr>
<td>Median age</td>
<td>33.8 years</td>
<td>37.4 years</td>
<td>37.6 years</td>
</tr>
<tr>
<td>Percent Non-White</td>
<td>51.3%</td>
<td>4.6%</td>
<td>26.4%</td>
</tr>
<tr>
<td>Percent Hispanic or Latino</td>
<td>12.7%</td>
<td>16.1%</td>
<td>17.1%</td>
</tr>
<tr>
<td>Percent family households</td>
<td>56.0%</td>
<td>71.4%</td>
<td>66.1%</td>
</tr>
<tr>
<td>Percent Bachelor's degree or higher</td>
<td>72.3%</td>
<td>59.9%</td>
<td>29.8%</td>
</tr>
<tr>
<td>Percent unemployed</td>
<td>8.2%</td>
<td>3.5%</td>
<td>4.6%</td>
</tr>
<tr>
<td>Median household income</td>
<td>$108,154</td>
<td>$112,552</td>
<td>$53,889</td>
</tr>
<tr>
<td>No vehicle available in a household</td>
<td>4.1%</td>
<td>5.8%</td>
<td>9.1%</td>
</tr>
<tr>
<td>Mean travel time to work</td>
<td>33.3 min</td>
<td>32.0 min</td>
<td>25.9 min</td>
</tr>
<tr>
<td>Percent travelling to work by transit</td>
<td>19.2%</td>
<td>9.8%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Percent travelling to work by bicycle</td>
<td>1.1%</td>
<td>0.3%</td>
<td>0.6%</td>
</tr>
</tbody>
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*Source: U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates*
EMPLOYMENT

Merrifield’s ideal central location has made it the fourth largest office submarket in Fairfax County\textsuperscript{10}, a third of which is located to the east of I-495 in Fairview Park.\textsuperscript{11}

In 1998 a commercial revitalization district was designated and two core areas were identified for future development.\textsuperscript{12} The first area is around the Dunn Loring-Merrifield Metrorail Station which is undergoing a transformation. The second is a new town center, also as the Mosaic District, has emerged and is attracting a variety of new businesses, like CustomInk and many other retail establishments. This is expected to continue as the core areas are being built out. Merrifield is also home to headquarters of the two Fortune 500 companies - General Dynamics and Northrop Grumman. In addition to its sizable office market, Merrifield also has about 2.6 million square feet of industrial/flex space, 1.8 million square feet of retail development and five hotels.

Inova Fairfax Hospital, a regional medical center located at the southern end of the Merrifield Study Area, is the area’s largest employer. Nearly 6,000 employees\textsuperscript{13} work within this campus alone. Additionally, Inova facilities are spread throughout the Study Area (Figure 6). The Inova Health System is also in the process of expanding east of Gallows Rd. to occupy the 117-acre former ExxonMobil campus and create a new center for research.

According to projections analysis of the MWCOG’s Cooperative Forecasts by Transportation Analysis Zones, nearly 10,000 jobs will added to the between the Transit Station Area, Town Center and Hospital Campus Area (Figure 5).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{employment_growth.png}
\caption{Employment Growth in Merrifield Study Area, MWCOG}
\end{figure}
Figure 6
Commercial, Industrial, and Inova Buildings
Merrifield, Virginia

Legend

- Dunn Loring-Merrifield Metro
- Inova Facilities

Buildings selection

TYPE
- Commercial
- Industrial
- Merrifield Boundary
The Merrifield Study Area is currently served by Metrorail at the Dunn Loring-Merrifield Metrorail Station on its northern edge. Five Metrobus routes and three Fairfax County Connector routes also serve this station. All bus routes run along Gallows Road. Fairfax County Connector routes 401 and 402 run the length of Gallows Road through the Merrifield study area, while others branch off. Peak headways on these bus routes range from 15-45 minutes, however on weekends there is no service or headways are greater than an hour. Additionally, a shuttle bus runs from the Mosaic District and to the Metrorail station during morning (6am-10am) and evening (3pm-7:30pm) rush hours at 12 minute intervals. The Capital Beltway/Interstate 495 and Interstate 66 provide regional access. Gallows Road runs north and south through the Merrifield Study Area connecting Tysons with Annandale, Arlington Boulevard (Route 50) and Lee Highway (Route 29) are major east-west thoroughfares which connect Arlington County to the City of Fairfax.

The Washington Old Dominion Bike Route (W&OD Trail) runs just north of the study area in Merrifield. This is a major cycling route that connects the western portion of Fairfax County to the eastern portion providing cyclists with a safe and efficient route to major economic regional centers. The trail connects Herndon in the west to Vienna, Falls Church, Shirlington, then Alexandria in the east. Additionally, an intersection with the George Washington Trail allows these nodes to connect to Arlington City and Washington DC.
LOCAL BICYCLING CULTURE

Fairfax County adopted several ambitious cycling goals as the County expands bikeshare and fosters a more bike friendly environment. As part of the Bicycle Master Plan, the county aims to triple the number of annual bicycle trips, increase the number of center line miles of on-road bicycle facilities by five-fold, and reduce bicycle crashes and fatality rates by 2024.

The development of new, vibrant neighborhoods such as the Mosaic District attracts educated young professionals interested in walkable and well-connected communities. Moreover, the area has been identified as one of the most desirable places for cycle tracks and bike parking facilities, according to the County’s Bicycle Master Plan.

Currently, Merrifield has several bike racks in the Mosaic District and at the Dunn Loring-Merrifield Metrorail Station. There are also several bike lanes and trails that run throughout the Merrifield Study Area, which will be expanded and improved as roads are repaved and areas are redeveloped. The interest in cycling in Merrifield is growing, which is demonstrated by events such as the Bike to Work Day. In 2015 Merrifield hosted two Bike to Work Day ‘pit stop locations’ for participants in the Mosaic District and on the W&OD Trail. The event was supported by a number of local and national businesses, showing a strong interest in promoting cycling and sustainable modes of mobility.
Bicycle infrastructure within the study area is limited and should be expanded to encourage ridership and ensure safety for cyclists.

According to Fairfax County data, there is one corridor with a bicycle lane along Gallows road that connects Merrifield to Tysons. In many places, however, this bicycle lane is not easily recognizable and looks more like a shoulder, making drivers less aware of the potential presence of cyclists on the road. Within the study area the bike lane intermittently discontinues, leaving cyclists on a road indicated as the less preferred route by Fairfax County (Figure 8). Google, however, identifies Gallows as a trail used by cyclists, suggesting that riders continue along this road after the bike lane disappears (Figure 9).
Gallows road is a six-to-nine lane arterial road with heavy, high speed traffic (Figure 10). The official speed on Gallows road is 35 mph, however many motorists appear to drive faster than that, according to observations of the Fairfax Alliance for Better Cycling.\textsuperscript{17} Speeds above 35mph increase dangerous conditions for cyclists, and traffic calming measures on Gallows may improve safety for cyclists. According to data from the Northern Virginia Regional Commission, Gallows presents an unsafe environment for cyclists or pedestrians, with frequent crashes along this road, particularly at intersections (Figure 11).\textsuperscript{18} In addition to traffic calming measures, a clearly marked, protected bike lane is highly recommended for the stretch of Gallows Road within the study area.

Furthermore, cyclists could benefit from having bike lane son smaller streets parallel to Gallows. One alternative bike lane could begin at the Merrifield Metro Station on one of the streets marked as “bike friendly” (Figure 9) and continue along Merrilee Drive and Eskridge Road, connect to Williams Drive, cross Route 50 and connect to Williams Oak Corporate Drive taking a rider all the way to the Inova Campus. Merrilee and Eskridge are neighborhood roads without marked lanes and have much less traffic compared to Gallows. Having a bike lane start or be visible at the Dunn Loring-Merrifield Metrorail Station could encourage residents to use bikeshare for their first/last mile of their commute.

Finally, crossing Gallows Rd and Route 50 is hazardous because of traffic volume, high speeds, road width, and current intersection design. A redesign of these intersections to include safety features for cyclists and pedestrians is highly recommended. Elements such as colored pavement, markings, and bicycle signals provide for higher visibility of cyclists and pedestrians at intersections and reduce the risk of turning conflicts with motorists.\textsuperscript{19} See next two pages for images of intersections recommended for improvement.
INFRASTRUCTURE IMPROVEMENTS

Painting crosswalks or adding reflective material at these intersections may improve safety for cyclists and pedestrians.

Route 50 and Gallows Road: Existing  
Route 50 and Gallows Road: Improved

Lee Highway and Gallows Road: Existing  
Lee Highway and Gallows Road: Improved

Route 50 and Merrilee Road: Existing  
Route 50 and Merrilee Road: Improved
Gatehouse Road and Gallows Road: Existing

Prosperity Avenue and Gallows Road: Existing

Strawberry Lane and Gallows Road: Existing

Route 50 and Williams Drive: Existing

Gatehouse Road and Gallows Road: Improved

Prosperity Avenue and Gallows Road: Improved

Strawberry Lane and Gallows Road: Improved

Route 50 and Williams Drive: Improved
MERRIFIELD PROGRAM
DEFINITION

Photo Credit: Bryan Steckler
MERRIFIELD PROGRAM DEFINITION

On several levels, Merrifield is ideal for the expansion of bikeshare in Fairfax County. On a county level, Merrifield has a number of census block units that show high predicted demand for bikeshare, based on socio-economic factors such as residential population density and employment density. Narrowing the focus to the area around the Dunn Loring-Merrifield Metrorail Station, our defined boundary of Merrifield indicates a number of suitable locations for bikeshare stations based on a model derived from NACTO placement criteria. Finally, a qualitative assessment of Merrifield reinforces the NACTO model as well as shows additional station placement opportunities. The qualitative methodology applied in this review also accounted for site-specific factors to maximize potential bikeshare usage.

Other sources considered when determining bikeshare usage in the Study Area included the Capital Bikeshare Member Survey, placement criteria developed by NACTO, and equity considerations—how bikeshare would impact the livelihood of individuals living in the community.
METHODS: REGIONAL BIKESHARE DEMAND

Our demand forecast model identifies the Merrifield area as having high potential for bikeshare ridership. Using factors such as employment density, residential population density, and proximity to the Metro, a multiple regression model was constructed at the block level (R-squared .37).

This model was generated using population data from the 2010 decennial census, 2014 US Census Longitudinal Employer-Household Dynamics data, 2015 CaBi ridership data, and a proximity calculation to the nearest Metrorail station (Figure 12).

The model reveals a number of areas within Central Fairfax County that show a high demand for bikeshare. On the eastern side of the map East and West Falls Church show potential. To the north and west, Tysons and Reston show promise. Finally there is some indication that Fairfax City also has the potential for bikeshare riders. Merrifield is in the middle of all of these areas with a high demand located just south of the Dunn Loring-Merrifield Metro station. Considering that Fairfax County has already implemented bikeshare in Reston and Tysons, Merrifield represents an obvious next step. Our outlook for the study area is also strengthened by Merrifield’s projected population and employment growth.
QUANTITATIVE STATION SITING

The demand forecast identifying Merrifield as an area conducive to bikeshare, the next question becomes that of environment. Is the Merrifield Study Area conducive toward station citing?

NACTO has released a number of guide books to assist in the placement of bikeshare stations as well as the development of urban bike networks. These requirements are to be used as guidelines when placing stations and not as mandated specifications. However, some of their recommendations are quantitative in nature and can be developed into a ‘buffer’ to either eliminate or identify certain areas.

Generally, NACTO states that bikeshare stations are to be located in areas that are ‘accessible and convenient’, ‘designed for safety’, are convenient for ‘operational feasibility’, will ‘enhance the pedestrian realm’, and that bikeshare stations should be built in such a way as to ‘accommodate the street hierarchy’. Further some of these guidelines are given measurements by which to determine the spacing and location of bikeshare stations. For instance, it is stated that the average user of bikeshare in New York would not be willing to walk more than a quarter mile to access a bikeshare station. This speaks to the convenience element that users demand ready access.

After reviewing the NACTO Bikeshare Station Placement Guide, and other associated texts with biking user patterns, a conservative model was built to predict station location. To address convenience, a buffer around high density residential and commercial buildings in Fairfax County was created. This was joined to a buffer around a road-centerline line which was subsequently filtered to show roads less than 30 miles per hour. This benchmark of less than 30 mph was designed to address the general guideline set out by NACTO that stations are to be ‘designed for safety’; slower vehicle speeds increase bicycle and pedestrian safety. This statement is supported in NACTO guidelines for Route Planning of Bike Boulevards indicating they not be built on roads with speeds exceeding 20 mph (Bike Boulevard). Additionally, the NACTO guide recommends that bike lanes be built on roads with speed greater than or equal to 25 mph, but additional infrastructure is recommended for roads with speeds equal to or in excess of 35 mph (Conventional Bike Lane).

The requirement of having bikeshare stations near high density residential and employment location on roads that are less than 30 mph to accommodate safety concerns narrowed the number of potential sites within Fairfax County. In the Merrifield Study Area, the recommended highlighted in Figure 13.
Figure: Basemap chosen is from the ArcGIS online platform. The shapefile shown is created by Colin Chadduck from data collected from Fairfax County Open GIS Platform.
User profiles: Bikeshare users generally versus local users
Capital Bikeshare’s annual member survey gives insight into the characteristics of CaBi members and how they use the system.

Member Characteristics
Compared to the overall population of the Washington, D.C. metropolitan area, bikeshare users are more likely to be employed. In comparison to regular bike commuters, an average bikeshare user is younger, less affluent, and more likely to be male and Caucasian. It is important to note that while this data is informative, it is not necessarily predictive. The lower than average household income for bikeshare members may be a function of the younger average age. The higher white bikeshare membership may be due to the fact that more bikeshare stations and other cycling facilities are more commonplace in predominantly white neighborhoods.

The average resident of Merrifield is only slightly older and more affluent than the average CaBi user. According to the 2016 Capital Bikeshare Annual Member Survey, only 3% of respondents lived and worked in Fairfax County. However, 16% reported commuting to work from Fairfax County to the District of Columbia. This population would particularly benefit from bikeshare expansion to Merrifield, which would provide commuters with an option to cover the first and last mile of their commute using CaBi.
In 2016 most CaBi members (over 90%) used the system “to get around more easily or quickly.” This was even the primary motivating factor for using bikeshare for 56% of respondents. Only 8% of respondents said that they used bikeshare because their destinations were too far to reach on foot, indicating that walkable environments naturally lend themselves to bikeshare use.

We anticipate three major trip types:

1. Short distance trips to and from the Dunn Loring-Merrifield Metrorail Station;
2. Short distance mid-day trips to and from places of work to restaurants and retail establishments;
3. Recreational rides, including along the W&OD Trail.

The 2016 Capital Bikeshare Member survey supports these predictions. In this report, a majority of bikeshare users cited commuting and travel for social/entertainment purposes as their primary trip purposes. To facilitate these trips, Merrifield’s bikeshare system should connect members to major employers in the area, prominent entertainment destinations, and transit nodes. Connectivity to the Dunn Loring-Merrifield Metrorail Station is particularly important, as bikeshare can be an integral part of one or both ends of a commute – 71% of members at least occasionally used bikeshare to access transit, and 65% of users reported that commuting to work was their primary bikeshare purpose. This functions both ways, connecting those outside of the study area to jobs in Merrifield, and connecting Merrifield residents to employment elsewhere in the region. It will also connect with visitors from the Metro to attractions in the area, particularly in the Mosaic District.

Lower income employees who commute by Metrorail to Merrifield for retail and other service sector jobs can benefit from the increased mobility that bikeshare offers for the first/last mile connection. In 2016, Capital Bikeshare estimated that its members saved $631 per person annually by biking instead of taking trips by transit, taxi or ride-hailing service, or driving in a personal vehicle. Midday trips for personal appointments (42% of users reported this as a primary bikeshare trip purpose), errands (40%), going out for a meal or coffee (33%) are also common amongst bikeshare users, and – given the mix of commercial office space with retail and service sector establishments in this area – are easily accomplished by bikeshare in the study area.

Finally, while only about a fifth (22%) of bikeshare users reported using bikeshare for recreational purposes, the nearby Washington and Old Dominion trail offers a fantastic opportunity for recreational rides. Currently, it is listed on the Capital Bikeshare website as a “Popular Ride” in Arlington County. We recommend an additional section be added for a ride along the Fairfax County portion of the W&OD trail to promote its use by CaBi members.
EQUITY ANALYSIS

Bikeshare systems are becoming a widely used method of alternative transportation with the potential for decreasing transportation equity issues. CaBi has the opportunity to provide users with a low cost transportation alternative. The annual rate of $85 allows for unlimited 30-minute trips on any CaBi bike. Other rates include, $2 for 30 minute trips, $8 for 24 hours and $8 monthly payments for the annual pass. While the rates are low and affordable for many, potential barriers still exist for those of lower incomes. Some barriers may include the membership cost, needing a credit card, lack of bike training, and lack of stations at destinations.

Based on research, Merrifield has a median household income of $108,154. This indicates that there may be a low volume of individuals being excluded from bikeshare because of financial costs. If this becomes an issue in Merrifield, Fairfax County can consider starting programs such as Community Partners Program, MCLiberty or Bank DC. All of which provide financial assistance for those who wish to use the Capital Bikeshare system but cannot afford the cost. For more information on these programs, see the Appendix.

Aside from cost, other barriers may become an issue, such as station location, lack of a credit card or lack of bike riding ability. If or when these issues inhibit users from accessing the system, Fairfax County can use the Reston Feasibility Study Barrier Program to easily identify a solution to the barriers.
MERRIFIELD DESIGN & STATION LAYOUT

Photo Credit: Bryan Steckler
MINIMUM SYSTEM SIZE

NACTO has found that bikeshare system usage increases exponentially with station density. Ideally, bikeshare stations should be no further apart than a 5 minute walk or 1,000 feet. Using this criteria, 28 stations would be expected per square mile. Because of the distance people are willing to walk remains unchanged by neighborhood type, NACTO advises that stations should simply be smaller in less dense areas, instead of spreading stations further apart.

According to Alta Planning’s Reston feasibility study, a system of 10 stations provides an effective mix of trip origins and destinations to justify the cost of operations.

It is important to note that Fairfax County fire code require a 4’ clearance between fire hydrants and plantings and other obstructions.

Figure 14

Source: NACTO Bikeshare Siting Guide, p. 30
PROPOSED STATION PLAN

Figure 15

Planned Bikeshare Stations
Merrifield, Virginia

Legend
phase
- Phase One
- Phase Two
- Alternative

Merrifield Boundary
To arrive at the recommended station locations, a two-part evaluation method was used to determine where conditions are best for bikeshare. Three initial factors were analyzed when determining the potential of bikeshare in this area compared to other areas in Fairfax County: current population and employment density, as well as existing transport infrastructure (including mass transit options and bike-friendly infrastructure). We then used a similar analysis to identify prime locations for bikeshare in the study area and at a higher resolution. However, the recent development in Merrifield means that available data does not entirely reflect reality. Because of those limitations on current data, we followed up by selecting and evaluating sites based on qualitative criteria.

These factors, and their supporting variables, were chosen after review of Merrifield comprehensive plans, the 2016 Capital Bikeshare Member Survey, and academic literature.

<table>
<thead>
<tr>
<th>Population and Land use</th>
<th>Residential Density$^{31}$</th>
<th>Sites with no multi-family housing nearby received low scores, while those with an abundance of mid- and high-density multi-family housing received higher scores.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Employment/ job density</td>
<td>Sites with no nearby offices space or other non-industrial employers received low marks, whereas ample office space and retail/service sector employers earned higher scores.</td>
</tr>
<tr>
<td></td>
<td>Attractions</td>
<td>For this study, attractions were defined as retail, entertainment, restaurants, and public facilities (e.g. libraries). Sites with more attractions nearby received higher scores.</td>
</tr>
<tr>
<td></td>
<td>Topography</td>
<td>Flatter topography is more inviting to cyclists, particularly the more casual users that take advantage of capital bikeshare for utilitarian purposes. A flatter topography in the vicinity of the station earned higher marks in our analysis.</td>
</tr>
<tr>
<td>Transportation and Infrastructure</td>
<td>Pedestrian Suitability</td>
<td>Ample sidewalks, crosswalks, buffering from traffic, and a generally pedestrian oriented and human scale environment received higher marks under this criteria. Automobile-oriented environments with large building setbacks, little buffering between pedestrians and traffic, and small or nonexistent sidewalks received low scores.</td>
</tr>
<tr>
<td></td>
<td>Roadway infrastructure</td>
<td>Sites with nearby roads that have low traffic volumes and speeds, and fewer and narrower lanes received higher marks. Those sites with roads exhibiting high traffic speeds and volumes, and with many wide lanes were considered less suitable.</td>
</tr>
<tr>
<td></td>
<td>Connectivity</td>
<td>Sites with more roadway and bike route connectivity, giving cyclists more available routes and destinations received high scores. Sites that only offer cyclists limited options for travel received lower scores.</td>
</tr>
<tr>
<td></td>
<td>Bicycle infrastructure</td>
<td>Those sites near roadways suitable bikeshare infrastructure for the road type received high scores.</td>
</tr>
<tr>
<td></td>
<td>Distance to Metro</td>
<td>As discussed earlier, many bikeshare members use the service to access transit options, riders also report that they would use bikeshare more frequently if more bikeshare stations were available near Metrorail stations.</td>
</tr>
</tbody>
</table>
Based on the regression model and qualitative analysis of the existing conditions, sites were selected, graded, and ranked. Bikeshare tends to be most successful where there are a variety and density of land uses. Therefore, the bikeshare qualitative analysis was created by taking into consideration various factors including, higher intensity residential uses, employment centers, various retail and community attractions, topography, roadway design, bicycle infrastructure, traffic conditions, and visibility of the site.

The methodology includes a point scoring system; potential sites were graded from low, medium, and high on each of these variables. Locations most suitable for bikeshare have the highest ratings. Exceptions are made to connect the Inova Fairfax Hospital campus with the Dunn Loring-Merrifield Metrorail Station because these factors were not weighted in our analysis. Ease of access to the Dunn Loring-Merrifield Metrorail Station connects members to other destinations in the region, and the Inova Fairfax Hospital with its unparalleled employment density in the study area of over 5,700 employees. Figure 16 shows how many high, medium, and low marks each site earned using our previously mentioned qualitative criteria.

<table>
<thead>
<tr>
<th>Site Specific Criteria</th>
<th>Visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>It is of utmost importance so members know where they can pick up and drop off bikes. Half of Capital Bikeshare members report that they learned about CaBi by seeing station, so high visibility is also important as advertising. Most locations scored well on this, as we did not choose any locations that were not easily visible to pedestrians</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proximity to other stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>NACTO has found that bikeshare use increases exponentially with station density, recommending that stations be spaced 1000 feet apart. A station scored higher on this criteria if it was within close proximity to another proposed station.</td>
</tr>
</tbody>
</table>
Properties recently redeveloped with a mix of higher density residential use and retail represent opportunities for bikeshare. Due to ongoing development in the area, we envision the Merrifield expansion of Capital Bikeshare to be implemented in two phases. Phase one will target the areas most conducive to bikeshare, and will consist of the Dunn Loring-Merrifield Metrorail Station and the Mosaic District; as well as the Inova Fairfax Hospital, a major regional employer. Phase two will expand the system north across Interstate 66 as well as provide infill stations in residential neighborhoods. We anticipate that phase one can be built immediately with existing funding and infrastructure. Phase two may be completed at a later date, or implemented piecemeal as resources become available.

**Phase One**
Phase one will consist of ten stations. The first of these will be a 15-dock station located at the Dunn Loring-Merrifield Metrorail Station, while the rest of the proposed stations should be the more economical 12-dock stations. The second of these stations will be located across Gallows Road, ideally next to the office buildings on Park Tower Drive, where it would be visible to both nearby residents and office workers. This office complex houses to many regional employers, including the Transportation Security Administration and Lockheed Martin. We envision that this station will serve these employers as well as the residences located east of Gallows Road, in addition to providing extra capacity for riders travelling to and from the Dunn Loring station. The third and fourth stations of phase one will be located at Avenir Park and Halstead Square, respectively. We envision that these stations will serve the residential and mixed use areas south of the Metrorail station, but north of Mosaic proper. Stations five and six will be located in the core of the Mosaic District. Station five will be located at District Avenue and Strawberry Lane, and is intended to be the District’s primary station. Station six will be located at the southern end of the Mosaic District, at District Avenue and Penny Lane. It is intended that this station will serve the residences of Mosaic. Station seven will be located east of Gallows Road, on Gatehouse Road near the intersection with Telstar Court. This will serve the businesses and residential developments located east of Mosaic, including the Inova Health System and Fairfax County Public Schools offices and High Pointe at Jefferson Park. The eighth station will be on Willow Oaks Corporate Drive. Stations nine and ten will be centered around the Inova Fairfax Hospital, with one located at the green garage and main entrance, and the other located at the blue garage. These will allow employees of the hospital who live in the adjacent neighborhoods to commute without need for a car. Please see the adjacent map for locations of these stations.

Through several site visits, we have determined exact locations for our phase one stations. For several of these stations, we have developed multiple siting alternatives. These alternatives are outlined below:

**Halstead Square**
1. West Halstead (Halstead Square Rd and Merrilee Drive) in front of Village Yoga
2. East Halstead (Halstead Square Rd and Gallows Road). This would necessitate a station at Avenir Park

**Central Mosaic**
1. On Strawberry Ln in front of Target
2. On the south side of Strawberry Ln at Yates Way. This would possibly necessitate moving a lamp post.
Station 1: Dunn Loring-Merrifield Metrorail Station
We envision this station to be located in space currently occupied by public bike racks immediately west of the metro station entrance. These bike racks can either be removed entirely or relocated.

Station 2: Park Tower
This station is intended to not only provide additional capacity to the Dunn Loring Metrorail station, but also to serve the offices and apartments located east of Gallows Road. We envision this station to be located on the south side plaza bulb out of 2650 Park Tower Drive.

Photo Credit: Bryan Steckler
STATION PLACEMENT

Station 3: Avenir Park
This is an optional station, and dependent on the location of the station at Halstead Square. We believe this station will only be necessary if the Halstead East option is chosen. If constructed, it will require paving a strip of grass between the curb and sidewalk along Prosperity Avenue just west of the intersection with Merilee Drive and Avenir Place.

Station 4A: Halstead West
This station is one of two alternatives to serve Halstead Square. This station would be located on the sidewalk in front of Village Yoga. If this station was constructed, we do not believe the station at Avenir Park would be necessary.
Station 4B: Halstead East (Preferred)
This station would be located just east of the intersection of Halstead Square Road and Mia's Way, between the curb and the face of building. If this station were to be built, we believe it would require a station at Avenir Park.

Station 5A: Strawberry Lane and District Avenue (Preferred)
This station is intended to be the core station for the Mosaic District. We intend that it will be located on the sidewalk in front of Target.

Photo Credit: Bryan Steckler
Station 5B: Alternative Mosaic District Station
If the location in front of Target is unsuitable, this station could be moved further east towards the intersection of Strawberry Lane and Yates Way. We envision that this station would take the place of two parallel parking spaces on Strawberry Lane.

Station 6: District Avenue and Penny Lane
This will be the second station for the Mosaic District, serving residences and businesses towards the southern end. We envision this station to be located on the sidewalk of the property under construction on parcels F and G1. Based on examination of approved plans, we believe the plaza facing the southern end of District Avenue is of adequate size for a bikeshare station.
Station 7: Gatehouse Road
We envision this station to serve residential communities such as High Pointe at Jefferson Park and the office buildings located east of Gallows Road. We have concluded that the best location for this station is in the street right of way west of Telstar Court, marked off with flexi-posts.

Station 8: Willow Oaks Corporate Drive
This station will also serve the Willows Oaks Office Buildings, the Extended Stay America, and the residents at Amberleigh Apartments south of Willow Oaks Corporate Drive. We envision that this station would sit on the north side of Willow Oaks Corporate Drive.
Station 9: Inova Fairfax Hospital Blue Garage
This will be one of two stations serving Inova Fairfax Hospital. It will be located just off Gallows Road, and would require paving a patch of green space next to an existing sidewalk on the service road south of the Blue Garage.

Station 10: Inova Fairfax Hospital Main Entrance
This will be the second station serving the hospital, and the last station in phase one. We envision that this station will be located slightly west of the main hospital entrance in the street right of way, between a curb bulb out and the entrance to the Inova Heart and Vascular Institute.
Phase Two
Due to funding constraints limiting the system size, we did not conduct advanced siting or design for phase two. However, we envision further expansion of the Merrifield Bikeshare system will follow these recommendations. We envision that a future phase two will consist of seven stations. The first station will be located at the intersection of Gallows Road and the W&OD Trail, providing a layover point for those wishing to travel from Tysons to Merrifield via bikeshare. Station two will be located at the Dunn Loring Swim Club, the other at the intersection of Cottage Street and Bowling Green Drive. Station three will be located at Prosperity Flats, serving this development as well as future development west of Gallows Road. This station will also entail removing the concrete median on Prosperity Avenue where it intersects with Dorr Avenue to facilitate bicycle travel. Station four will be located on Hartland Road between Prescott Drive and Prosperity Forest Drive. This station will serve businesses such as Integration Technologies Group, MicroSystems Automation Group, and the apartment complexes east of Gallows Road. Station five can be built should future development in this area call for it, but may also serve several shops and industries in the immediate area. Station six will be located at the Merrifield Community Services Board offices located just south of Arlington Boulevard. The Merrifield CSB provides mental health services to the Merrifield area and Fairfax County. Station seven is intended to be located at Anderson Drive and Gallows road, serving the apartment complex just north of Inova Fairfax Hospital.

Each station will follow the standard Capital Bikeshare design, which is for a self contained bicycle rack and kiosk powered by solar panels. Each station will be sited to ensure maximum visibility and pedestrian accessibility, and also to ensure adequate sunlight.
FINANCIAL ASSESSMENT
SYSTEM COSTS

Amid tightening government budgets at all levels, system costs and funding sources are an important factor when considering an investment in transportation systems. Below is an overview of expected system costs and a collection of possible funding sources for the Merrifield expansion of Capital Bikeshare.

Bikeshare System Costs
Installing and operating a bikeshare system incurs launch costs, capital expenditures, and annual operating expenses. Each of these vary depending on the number of docks for each station. Below is a chart that breaks down expected system costs.

<table>
<thead>
<tr>
<th>Table 2: Merrifield Bikeshare System Costs</th>
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<tbody>
<tr>
<td><strong>Launch Costs</strong></td>
</tr>
<tr>
<td>Phase 1</td>
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<tr>
<td>Phase 2</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td><strong>Capital Costs</strong></td>
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<tr>
<td>Phase 1 Stations</td>
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<tr>
<td>Phase 1 Bikes</td>
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<tr>
<td>Phase 2 Stations</td>
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<tr>
<td>Phase 2 Bikes</td>
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<tr>
<td>Total Capital Costs</td>
</tr>
<tr>
<td><strong>Annual Operating Costs</strong></td>
</tr>
<tr>
<td>Phase 1</td>
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<tr>
<td>Phase 1 &amp; 2</td>
</tr>
</tbody>
</table>

Source: Adam Lind, Fairfax County Bicycle Program Coordinator and Reston Feasibility Study

Launch costs cover expenses not related to the station and bikes, such as advertising and marketing, site planning, and station installation. Capital costs are solely associated with the purchase of bike stations, kiosks, and bikes. While capital and launch expenses are the most significant immediate costs, operations for bikeshare must also be taken into account. Motivate, the company that currently operates the Capital Bikeshare brand, charges $96.17 monthly per bike dock. This expense covers necessary bike and station repairs, system rebalancing, customer service, and general operations, and is generally not eligible for federal funding.
FUNDING

There are both public and private sector funding opportunities, and we advise that Fairfax County take advantage of both to the maximum extent possible. Fairfax County expects to invest $400,000 into the initial phase of Merrifield’s bikeshare network.

Federal

TIGER (Transportation Investment Generating Economic Recovery) Grants: Created by the Congress in the wake of the 2008 financial crisis, this discretionary grant for surface transportation projects has proved to be very popular. While Congress has appropriated substantial funding to the program, it is widely considered to be oversubscribed. It is also likely that Fairfax County has larger, higher priority projects for which it is seeking TIGER funding. Taking into consideration these reasons, we do not recommend seeking a TIGER grant to implement bikeshare in Merrifield.

Transportation Alternatives: In December 2015, Congress passed the Fixing America’s Surface Transportation (FAST) Act. Among other things, it continued funding for non-motorized transportation projects as part of the Transportation Alternatives set-aside (TA set-aside) through FY20. This is the federal government’s main program for supporting bicycle projects, and bikeshare projects are eligible for funding. In Virginia, the University of Virginia’s bikeshare system received TA set-aside funding to help cover capital expenditures. Fairfax County is already seeking TA set-aside funding for FY18. Fairfax County may only receive funding from the TA set-aside program as a reimbursement for costs already incurred by the project, so it must provide the initial funding. Furthermore, TA set-aside awards require at least a 20% local match to federal funding for the projects.

Congestion Mitigation/Air Quality program (CMAQ): A federal program that provides funding for projects that promise to decrease emissions of certain pollutants in areas that do not meet National Ambient Air Quality Standards (NAAQS). In the absence of any non-attainment areas, states may use CMAQ funds for any project that would normally be eligible for funding. Because the Washington D.C. metropolitan area was found to be in non-attainment of ground-level ozone pollution standards in 2008 and has still not attained NAAQS, Capital Bikeshare should be eligible for funding under CMAQ. Funds from this program cannot be used to cover the 20% match.

State

While the Virginia Department of Transportation administers the federal Surface Transportation Program funds for the state, it does not have any specific bicycle programs of its own.

Private

Unlike other transportation projects, parts of a bikeshare system may receive substantial private sector funding via sponsorships. Arlington County offers sponsorship or station adoption opportunities to private entities – usually corporations or large real estate holders near potential bikeshare stations. This can be taken advantage of to mitigate or entirely cover capital and operating costs for bikeshare, and was used to great effect in implementing the Tysons bikeshare system. With this in mind, we have taken the existence of a possible nearby sponsor into account when producing our list of recommended station locations. Please see individual station evaluations for possible sponsors.
Determining the potential of bikeshare in Merrifield was a three step process. Merrifield was first identified as an area of possible bikeshare expansion within Fairfax County. Next, specific bikeshare station locations within Merrifield were determined to give a general idea of locations. Lastly, the station site locations were further analyzed to determine those best suited for site development. The initial stage relied on an empirical bikeshare demand model using US Census data. Explanatory variables included distance from Metrorail as well as population and employment density, identifying Merrifield as an area of possible bikeshare expansion. In addition it was a political choice based on Fairfax County development goals. After identifying Merrifield, a method to identify stretches of land that were suited for bikeshare stations was needed. Choosing among those stretches became a mix of quantitative and qualitative approach as the quantitative data driving the analysis was not reliable or available at this finer geographic scale of analysis.

This section will outline the methodologies in their order of scale; small to large. Where needed tables, graphs, and maps will lead through the thought process of conceptualizing where bikeshare would be best served in this community.

We developed a county-wide demand model for forecasting bikeshare ridership based on socio-economic data collected through the US Census as well as data tabulated from the CaBi system using a geostatistical approach. The idea was to first, determine the ridership pattern in Northern Virginia, then use socio-economic data, ridership levels, and Metrorail access to develop an equation which could be used to identify characteristics of ‘successful’ CaBi stations.

All of the data was analyzed and grouped at the ‘block’ census level to reflect the most relevant geospatial unit in Merrifield. CaBi data is available through the capital bikeshare web site. The data are released quarterly, January to March, April to June, July to September, and October to December, from the fourth quarter of 2010 to the fourth quarter of 2016. At the time of this research project, the last full year of data was for 2015 while 2016 had three of the four quarters available. The fourth quarter became available March 22, 2017, which was too late for this project’s use. The data was filtered to reflect trips completed by CaBi users who started and ended their trips at stations located within the Commonwealth of Virginia. This was to determine if there was a distinction between CaBi users within the larger system which includes Virginia, Maryland and the District of Columbia. Following the filtering process, the CaBi data was attached to a GIS point file which represented the location of each bikeshare terminal in Northern Virginia. That point file was then joined to the accompanying block group(s) the stations were located in. To account for riders accessing CaBi stations on foot, the extent of the join was not only to the block group immediately encompassing the point representing the bikeshare station but the surrounding blocks at the distance of 1000 feet. However, there was no determination made as to whether or not those individual blocks contained infrastructure conducive to providing riders in high-density residential communities. Since most of the bikeshare stations were located in areas of high employment or residential density, and many of these areas have expanded these uses since the release of the latest census data, the issue of analyzing blocks that would not yield riders was deemed minimal.
Specifically, the distance of 1000 feet was chosen based on NACTO guidelines, which specify that bikeshare stations were most successful when located within 1000 feet of each other. This is the distance an individual would be willing to walk, if one bike station is full, to a neighboring bikeshare station to park the bike.

At this point, we were able to map the CaBi rider data at the block level for 2015 in Northern Virginia. Of all of the data categories available within the CaBi data system, the most useful to model was the category of ‘starts’. There was very little difference between the maps of where riders choose to start

![Figure 17: CaBi Bikeshare Data for 2015, Starts and Ends](image-url)
The US Census data was joined to the existing block group shapefile representing CaBi riders. From prior research, the two variables deemed the most relevant to use of bikeshare facilities were population total and job total within reason. The higher the population and job total in a smaller geographic region, the more likely a proportion of those would use bikeshare. To represent job data, the Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics for Virginia in 2014 were used. Both files represent data at the block level, which required the ‘clip’ tool to be used to bring them to the geographic extent of bikeshare riders (Figure 18).

Figure 18  Resident and Job Density, Arlington and Alexandria VA
SITE IDENTIFICATION

Merrifield proved to have potential for bikeshare through the regression model. However, just because there is demand on the population, job and proximity level, does not mean the infrastructure in the area is setup to support bikeshare. NACTO, through a number of policy guides, sets best practices for bikeshare stations based on variables such as their proximity to each other and what the road conditions are like near the bikeshare station, among others. The next step in the analysis was to determine whether or not the local infrastructure meets the criteria set out by NACTO for successful bikeshare stations and were, approximately, those areas are.

The first step in this analysis was to create a shapefile that represented all of the locations within the determined Merrifield area that are on roads that have posted speeds less than thirty miles an hour, and are in front of buildings that are either high-density residential, commercial or mixed-use according to their zoning qualifications. To represent road conditions, data was collected from the Virginia Department of Motor Vehicles Traffic Analysis GIS file, as well as road files available through the Fairfax County Open Access Web Portal.

The key requirement for this shapefile was that it needed to represent an area between the building structure and the edge of the road. Preferential treatment was given to areas where bikeshare are usually located such as sidewalks, parking areas, grass area and the like. Buffers were build around each file so that their intersection would be ten feet. This geographic test of identifying areas that are near building of these three categories and are on roads with less than 35 mph speed limit eliminated a large portion of the Merrifield Study Area.

The next step was to rank these spaces by characteristics that NACTO deemed important to determine usage. The first one analyzed was how many spaces are within 1000 feet of each other. The rationale for this is that stations are recommended to be located within 1000 feet of each other to form clusters around nodes of activity. That way, if a rider where to approach a station that is full, there would be an alternative station nearby that would be available.

This analysis identifies two key points in station location. First, if a region were to have a large number of potential near it, this would indicate a station that may be best suited as a larger station as opposed to a smaller station. Second, areas that have a large number of potential station spots are also areas that have a large demand for bikeshare activity, with the reasonable nexus being how many people are actually in the zoned areas of high-density residential, commercial, or mixed use.
Figure 19  Potentional Bikeshare Station Locations

Legend

<table>
<thead>
<tr>
<th>1:14,000</th>
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</thead>
<tbody>
<tr>
<td>Bike Share Station Sites</td>
</tr>
</tbody>
</table>

*Est. HERE. DeLorme. MapmyIndia. © OpenStreetMap contributors. And the GIS user community*
The final element of analysis was a spatial join incorporating Census data on regional employment and residential density in Merrifield to the shapefile indicating the spaces for bikeshare station locations. A summation of these values was taken to represent an attraction node (Figure 5).

Highlighted areas represent preferred locations for bikeshare stations. This does not indicate a specific site, but only that the area of land per NACTO guidelines, is suited for a bikeshare station. The actual placement of a station is done through a site visit and qualitative analysis.

Figure 20  Ranked Bikeshare Station Locations

Highlighted areas represent preferred locations for bikeshare stations. This does not indicate a specific site, but only that the area of land per NACTO guidelines, is suited for a bikeshare station. The actual placement of a station is done through a site visit and qualitative analysis.
SITE ANALYSIS

Dunn Loring-Merrifield Metrorail Station

The Dunn Loring-Merrifield Metrorail Station represents an obvious location for a bikeshare station. By locating a larger station here, bikeshare can connect Merrifield with the larger Washington DC metropolitan area.

Population and Land Use

With Modera Avenir Place, Halstead at the Metro, Halstead Square, and the Westbriar Condominiums all in close proximity to the proposed site, residential density is high enough that there are many potential bikeshare users. Across Gallows Road there are two office towers that house Lockheed Martin, TSA, ActioNet, and other employers. U.S. Immigration and Customs Enforcement also has a field office also has a nearby field office at Prosperity Avenue and Halstead Lane. Substantial residential and employment density combine with a number of attractions in the area – such as the Harris Teeter and many casual, sit-down restaurants – to create a suitable environment for bikeshare. Furthermore, the land around the station is all relatively flat – there is a 2.2 percent slope downhill half a mile to the south, toward where most of the proposed bikeshare network is.

Transportation and Infrastructure

Sidewalks and Avenir Place and a shared use path on Gallows Road with buffers from automobile traffic provide pedestrians with safe routes to reach nearby locations. Crosswalks in the vicinity are marked, and the crosswalks on Gallows Road are signalized. Adequate pedestrian infrastructure is an important indicator of pedestrian activity, and bikeshare users are frequently pedestrians. While pedestrian infrastructure is in ample supply here, the bicycle facilities leave much to be desired. There is a southbound bike lane on Gallows Rd., however, it is poorly marked, frequently disappears at intersections and right turns, and does not provide enough separation from the higher speed automobile traffic that traverses Gallows Road. Despite this, ample connectivity exists between the Metrorail station and other destinations in Merrifield via the shared-use path along Gallows Road and via Merrilee/Eskridge Drive.

Site Considerations

Due to the station’s location immediately outside of the Dunn Loring-Merrifield Metrorail Station, it should be highly visible to transit users at the metro station. If WMATA is willing to move existing bike racks outside the Metrorail station, securing a spot for Capital Bikeshare station should not prove to be difficult. Furthermore, this bikeshare station’s location near other proposed stations portends high member usage.
District Avenue / Penny Lane Station

Population and Land-Use

Multi-family residential developments surround the proposed site, including the Avalon Mosaic to the southeast, and more Mosaic apartments currently under construction to the northeast. Employment density is also higher nearby, besides the many service and retail sector employers that attract both employees and customers, CustomInk’s headquarters, where over 500 people are employed, is located only a few blocks to the north. Like much of the area in Merrifield that has been recently redeveloped, the slope is only a slight here – 1.1 percent from ¼ mile north of the station to ¼ mile south.

Transportation Infrastructure

Low automobile speeds and traffic volume make both District Avenue and Penny Lane pleasant and safe to bike on, and ample sidewalks with human-scale streetscapes create a comfortable environment for pedestrians. Unfortunately, connectivity is not great at this location, as District Avenue does not connect east. Similarly, Penny Lane terminates a block north and south of the proposed site. While there are no bike lanes or sharrows on these two streets, the low speed and narrow right of way make these unnecessary. This bikeshare station would also connect riders to the Metro station – the one mile ride fits easily within the average time of most CaBi member trips.

Site Considerations

Due to its location on one of the main streets of the Mosaic District and the surrounding land uses, this bikeshare station would be highly visible to pedestrians. It’s nearby location to the proposed Strawberry Lane bikeshare station also gives riders another option for picking up or dropping off a bike. Ease of acquiring an easement or sponsorship for a bikeshare station is also an important consideration. Edens, the company that owns this property, may be convinced to sponsor a bikeshare station here as an amenity to its tenants.
Prosperity Flats

Population and Land-Use

Prosperity Flats is a large multi-family residential development, which is located immediately next to this potential bikeshare station, but no other residences are close enough to utilize it conveniently. The employment density also appears to be low, there is an office building across the street from the Prosperity Flats, but most nearby employers are light industrial. No attractions exist in the immediate vicinity, though there are some 1/3 of mile toward the Metrorail station, and are located closer to other potential bikeshare stations. There is around a 2 percent slope between Prosperity Flats and the Dunn Loring station.

Transportation Infrastructure

There are adequate pedestrian facilities nearby – sidewalks along the street with a grass buffer and painted crosswalks – but there is no physical buffer between pedestrians and traffic, and the large setbacks for buildings that are oriented more toward motorists do not make an invite environment for pedestrians. This location also has a major connectivity problem, in that a median prevents cyclists traveling westbound on Prosperity Avenue from turning onto Dorr Avenue Merrifield Ave is the only street that connects east until Lee Highway, and it terminates the next block over. Due to the difficulty of accessing this site, we cannot recommend a station be situated here.

Site Considerations

Visibility of the station would potentially be good for residents of Prosperity Flats. Nonetheless, due to low pedestrian traffic in this area, the station would not likely be seen by passersby. It would have the advantage of being located on private land, and if Prosperity Flats is willing to shoulder the installation and operating costs to have bikeshare as an amenity of its residents, there is little reason not to install a station here.
**Halstead Square**

**Population and Land-Use**

The four Halstead Square apartment buildings are immediately adjacent, providing ample residential density to support bikeshare. While employment density is not high here, there are some service industry employers such as the Lost Dog Café, Ovvio Osteria and Blackfinn Ameripub that also serve as neighborhood attractions for their patrons. The Dunn Loring Center on the west side of Merilee Drive is another nearby employment center.

**Transportation Infrastructure**

We found many advantages in the nearby infrastructure for this site. A Halstead Square station would benefit from being nearby to the Dunn Loring Metrorail station. Wide sidewalks with tree boxes, bollards, and on street parking produces an inviting environment for pedestrians. The character of Halstead Square Road as a neighborhood street with low traffic volume and speed create an environment safe for cyclists as well. Connectivity with the rest of the neighborhood is sufficient, as the station would sit between Merilee Drive and Gallows Road, two north/south corridors for Merrifield. Although, the traffic on Gallows Rd. remains a consideration, as the bike infrastructure on that street is wholly inadequate. A Halstead

**Site Considerations**

A location along Halstead Square Road would be highly visible to pedestrians and tenants of the apartment buildings, and the pedestrian-oriented development would aid in this. Halstead Square’s proximity to the proposed station on Strawberry Ln and District Ave (0.7 mi) and from the Dunn Loring bikeshare station (0.4 mi) also make it an ideal location for a bikeshare station. Because Halstead Square Drive is privately owned, Fairfax County would need to work with the property owner to get an easement – and possibly a sponsorship – for the bikeshare station.
Park Tower Drive

Population and Land-Use

Much of the multi-family residential land use for Merrifield can be found between this site and Providence Forest Drive, including the Westbriar Condominiums, the Merrifield Village Apartments, and Merrifield at Dunn Loring Station. There are also two office towers north of Park Tower Drive that house major employer. While both employment and residential density are high here, there are no other types of attractions to draw people to this area. Like most other proposed stations, there is no significant change in elevation in the surrounding area.

Transportation Infrastructure

The sidewalks are only 4 feet in width, however they are buffered from traffic by street side parking, many of the nearby pedestrian crossings are marked with varying types of crosswalks, although some are not. Gallows is signalized for pedestrians, although they face long wait times. Despite the sidewalks, low traffic speed and volume, buffering from traffic, and minimal setbacks make a moderately enjoyable pedestrian experience. Most streets east of Gallows Road are unpainted neighborhood streets, which have low enough traffic speed and volume to not warrant bike infrastructure. However, to reach any other destination, users departing from here would be required to cross Gallows Road. Some connectivity issues also exist with the residences to the east of the office towers. A park lined with a fence would inhibit those residents from easily accessing this bike station.

Given this site’s proximity to the metro station, it is uncertain that many would bike between the two locations, although it may act as a relief station in cases where the Dunn Loring-Merrifield Metrorail bikeshare station is either empty or full. Having a station here also serves the many office workers and nearby residents who may want to go elsewhere in Merrifield.

Site Considerations

Ideally, this station would be located in front of one of the office buildings, with either one of the tenants sponsoring the station, or the property owner. This would make it highly visible to those employed here, but not necessarily to the residents of this neighborhood. This decision was made because there simply is no location in the residential area where space exists for a bikeshare station.
Strawberry Avenue and District Lane

Population and Land-Use

At the heart of the Mosaic District, this station would be accessible from the nearby apartment buildings such as the Vantage Mosaic and Modera Mosaic Apartments. Employment density is also high for this station. CustomInk, which employs over 500 people, is housed in an office just northwest of the intersection. Target and the Angelika Theater are immediately next to the station site, and there are many smaller retail establishments and restaurants abound; these of course both attract patrons and employees. As is the case with most of the study area, there is little incline here for cyclists to contend with.

Transportation Infrastructure

This area was obviously designed with pedestrians in mind. Broad sidewalks, no building setbacks, and low traffic speed, and only two lanes of traffic create a comfortable environment for pedestrians and cyclists alike. Strawberry Avenue and District Lane have no bike facilities, although traffic speed is low enough to not necessarily warrant sharrows. Gallows Road has a southbound bike lane, but as stated previously it requires a greater degree of separation considering traffic speed and volume. Eskridge Road connects with Merrilee Drive, the proposed main street for future Merrifield development. Eskridge Road has four lanes and is 45 feet wide, provide ample opportunity for a road diet. Finally, this station lies firmly within the average trip time for a CaBi trip, but is perhaps too far from the Dunn Loring-Merrifield Metrorail Station for many pedestrians to walk.

Site Considerations

If Target and Edens would permit it, there is ample space in front of the Target along Strawberry Avenue for a bikeshare station. At this location it would be visible to pedestrians and cyclists travelling on both Strawberry Avenue and District Lane to Target patrons, and to folks using the park across the street. This station is also only a little more than 1000 feet from the proposed District Avenue/Penny Lane bikeshare station, which provides capacity relief and is near NACTO’s suggested 1000 feet distance between stations.
Prosperity Avenue and Avenir Place

Population and Land-Use

This station will be located near both the Modera Avenir Place Apartments and Halstead at the Metro. These two apartment complexes comprise the majority of multiunit residences at the Dunn Loring-Merrifield Metrorail station, and the residential density of this area is quite high. While there is little office space in the immediate area, many service jobs are provided by Harris Teeter and the large number of restaurants in the area. These restaurants also serve to increase the density of attractions in the immediate vicinity of the Metro station. Like much of the study area, the terrain is flat.

Transportation Infrastructure

The area in the immediate vicinity of the Dunn-Loring Metrorail Station is well connected, with a street grid and sidewalks up to nine feet wide. Distance to Metro is short, about a one or two minute ride. However, Prosperity Avenue and Avenir Place both have twelve foot wide travel lanes. Wider lanes have been shown to encourage drivers to drive at higher speeds. In addition, there are no bike lanes or sharrows on any of the streets.

Site Considerations

As this site would be on Prosperity Avenue, it would be highly visible to pedestrians and motorists. It will be easy to navigate to as well, a necessary component of serving as excess capacity for the docks located at the Metro station. However, since the site would be on private land, the property owner would need to grant permission for the installation of bikeshare docks. It is possible that the owner of the property may wish to sponsor the station.
**Gatehouse Road and Telestar Court Station**

**Population and Land-Use**

This proposed site is close to multi-family housing at the High Pointe Jefferson Park Condominiums that are located immediately to the south. This station would also be supported by nearby office space. The INOVA Health System has two office buildings nearby, and the Fairfax County Public Schools Administration Center is a short distance from the proposed station site. Although residential density and employment density is higher here, the only nearby attractions are at a traditional, automobile-oriented shopping center ¼ mile away along Gallows Rd. We identified this area as mostly flat.

**Transportation Infrastructure**

Gatehouse Road has two 20 foot lanes providing comfortable space for cycling. Regarding the quality of the pedestrian experience, both sides of the street have sidewalks, but they are a tight 5 feet in width. While on-street parking is permitted along the Gatehouse Road, the traffic volume is low and the speed limit is 25 mph. These conditions provide a friendly environment for cyclists.

**Site Considerations**

This site is weaker than the others in terms of visibility, as it is clearly more oriented toward automobiles. Drivers in the area may spot the station, but most CaBi members use the bikes to replace non-automobile based trips. This station is not located near any of the other proposed stations.
Hartland Road

Population and Land-Use

This station provides access to residences between Gallows Road and Interstate 495 and is adjacent to a couple hundred attached single-family homes and two-story garden apartments. This location is also immediately adjacent to about nine office buildings on the east side of Hartland Road. Proceeding south on Hartland Road for a short distance there are a few restaurants off of Lee Highway. Like most locations in the study area, this is mostly flat.

Transportation Infrastructure

The roads around this proposed station are automobile oriented, with larger building setbacks and cramped 4 foot sidewalks. Despite a built environment favoring automobiles, Hartland Road is a neighborhood street with a 25 mph speed limit and low traffic volume. Connectivity in the immediate vicinity is decent, although cyclists travelling to the west must cross Gallows Road, and if going south they have to contend with the traffic on Lee Highway. The biggest barrier here, however, is the Capital Beltway, which is impassible enough to prevent us from recommending any bikeshare stations on the east side of it.

Site Considerations

There is little pedestrian or automobile traffic on Hartland Road, making visibility an issue. Another weakness of this site is that it is not particularly close to any other proposed station.
Prosperity Avenue and Hilltop Road

Population and Land-Use

This station would connect to nearby employment centers and commercial office space immediately adjacent to the proposed site. Currently, however, there is light industrial development, just passed the development, which may be less conducive to bikeshare users. There is no nearby residential development and no attractions within close proximity to this proposed station. The area is, however, mostly flat.

Transportation Infrastructure

There are sidewalks that flank Prosperity Avenue, although they have no physical buffering from the five lanes of traffic near the intersection, and the sidewalks are narrow. 13 foot lanes also promote higher vehicle speeds, in spite of the 35 mph speed limit. Higher speeds warrant more bicycle facilities, although Prosperity Avenue does not even have sharrows. As this area is redeveloped, it may be worth implementing traffic calming measures along this road and adding bike lanes.

Site Considerations

A station here would be approximately 2000 feet from the proposed station at Strawberry Lane and District Avenue, twice the ideal distance, but not impossibly far. However, a station here would face visibility issues related to the automobile oriented nature of the road.
**Washington & Old Dominion Trail**

Population and Land-Use

The W&OD Trail crosses Gallows Road north of Merrifield. The area is primarily suburban low density residential, with detached single family units dominating the landscape. In keeping with this residential use, employment density is low, comprising a school and a handful of churches. However, the W&OD Trail provides access to Vienna to the west, and Falls Church to the East. The grade is about 3% in this location.

Transportation Infrastructure

The W&OD Trail is a paved bicycle and walking trail running along a former rail corridor from Alexandria, Virginia to Leesburg, Virginia. The trail is mostly separated from roads. A shared use path exists along the south side of Gallows Road, however the road is signed for 35 miles per hour, with most of the traffic exceeding this. Other than the shared use path, sidewalks are narrow and the road is designed at an auto-oriented scale. There is minimal connectivity in the area, as most minor roads end at cul-de-sacs in residential neighborhoods. However, this area is also less than one mile from the Dunn Loring-Merrifield Metrorail station.

Site Considerations

A location at the intersection of Gallows Road and the W&OD Trail would serve mainly as a layover point in cycling from Tysons to Merrifield. Given the low density and predominantly residential use of the area, we do not expect that it would see much use by the surrounding communities. This station would also not be in close proximity to other stations, with the closest one being located at the Dunn Loring-Merrifield station, and the next closest one being approximately 1.5 miles away in Tysons.
**Merrifield Service Center**

**Population and Land-Use**

The Merrifield Service Center is a large facility providing mental health services. It is located in a suburban office park environment designed at an automobile scale. Residential neighborhoods comprised of single family homes are to the south, and the Amberleigh Apartments are to the east. Employment density is high here, with several office parks adjacent to the Service Center. There is a one percent slope in the area surrounding the service center.

**Transportation Infrastructure**

Due to the auto oriented nature of this area, pedestrian facilities are limited. However, there is a sidewalk along the Professional Center Access Road, which connects the Service Center to Inova Fairfax Hospital. Public transportation in this area is limited to buses, with bus stops being located at the Service Center as well as along Arlington Boulevard. Traffic is relatively slow moving at 30 miles per hour, and the roads connecting the service center with the hospital and other office parks have few vehicles.

**Site Considerations**

A location at the Merrifield Service Center would provide an alternative means of commuting to a relatively dense employment center, as well as serving as a layover point between the Dunn Loring-Merrifield Metrorail station, the Mosaic District, and the Inova Fairfax Hospital. The station would be situated in front of the service center, and would be easily visible by those commuting to and from it. In addition, seeing as the station would be located in front of a public building, it is unlikely that a corporate sponsor for it could be found.
Inova Fairfax Hospital Main Entrance

Population and Land Use

This station would serve the main entrance at Inova Fairfax Hospital. While we envision that hospital employees would be the main users of this station, it would not be exclusive to them. Inova Fairfax is bordered on three sides by residential developments, Woodburn Village, Amberleigh Apartments, and Strathmeade Square. While these are low to medium density neighborhoods, their close proximity to the hospital makes the area a strong candidate for bikeshare. The hospital itself employs approximately 5,000, making job density quite high despite the fact that few other attractions exist. The topology surrounding the station is primarily flat, with slopes approximately one percent.

Transportation Infrastructure

Inova Fairfax is currently served by bus two bus routes, WMATA’s 1A, between Vienna-Fairfax Station and Ballston Station and 1C, between Dunn Loring-Merrifield and West Ox Road. Pedestrian infrastructure in this area is high quality, with five foot wide sidewalks, painted crosswalks, and curb bulb outs at intersections on hospital grounds. Many roads have paved or grassy medians and 14 foot wide travel lanes, providing room for both cars and cyclists to pass, despite the lack of bicycle infrastructure.

Site Considerations

As the main entrance to Inova Fairfax is not located on Gallows Road, the station would have little pedestrian visibility. However, we expect that its proximity to the hospital would still result in high usage. Inova Fairfax would also have to agree to install the station, as the land and roads in the hospital complex are private. This would be one of two stations at the hospital campus, the other being located at the blue garage. However, the next closest station in phase one would be at the southern end of the Mosaic District.
Gallows Road and Anderson Drive

Population and Land Use

This station is intended to serve the Amberleigh Apartments complex just north of Inova Fairfax Hospital. This complex is composed of medium density garden apartments, and is in close proximity to the hospital, which is a significant regional employer. However, there are few other attractions besides the hospital that would necessitate bikeshare. The terrain is very suitable, with slopes of approximately one percent in the surrounding area.

Transportation Infrastructure

The site is located on primarily local roads which see minimal traffic throughout the day. Sidewalks also provide high levels of pedestrian connectivity. This area is also served by WMATA’s 1A and 1C buses. However, bike infrastructure is lacking and the site is a long distance from the Dunn Loring-Merrifield Metro station.

Site Considerations

Due to its location just off of Gallows Road, we expect that this site will have high visibility. It will also be in close proximity to the other two Inova Fairfax Hospital stations, and can be used to provide additional capacity for hospital employees.
ENDNOTES

1. (Engel, 2017)
2. (Capital Bikeshare, n.d.-d)
3. (Welle et al., 2015)
4. (Griffin, 2017)
5. (Fairfax County, 2016)
6. (Fairfax County, 2013)
7. (Fairfax County, 2013, pp. 4-5)
8. (USDOC, 2016)
9. (Metropolitan Washington Council of Governments, 2016)
10. (Fairfax County Economic Development Authority, n.d)
11. (Fairview Park, n.d.)
12. (Office of Community Revitalization, n.d.)
13. (Wells Associates, 2016)
14. (WMATA, 2016)
15. (Fairfax County Department of Transportation, 2014)
16. (Fairfax County Department of Transportation, 2014)
17. (Wright, 2012)
18. (NRVC, n.d.)
19. (Welle et al., 2015)
20. (NACTO, 2016)
21. (NACTO, 2016)
22. (NACTO, 2016)
23. (LDA Consulting, 2016)
24. (USDOC, 2014)
25. (LDA Consulting, 2016)
26. (Capital Bikeshare, n.d.-e)
27. (Capital Bikeshare, n.d.-b)
28. (Capital Bikeshare, n.d.-c)
29. (NACTO, 2015)
30. (Alta Planning and Design, 2014, p. 34)
31. (Buck & Buehler, 2011)
32. (Buck & Buehler, 2011)
33. (USDOT, n.d.)
34. (Virginia Department of Transportation, 2016)
35. (Virginia Department of Transportation, 2017)
36. (Federal Highway Administration, 2016)
37. (NACTO, 2016, p. 2)
38. (Federal Highway Administration, 2008)
39. (Capital Bikeshare, n.d.-a)
40. (NACTO, 2016, p. 4)
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