An Evaluation of Cyclist and Pedestrian Safety at Virginia Ave NW and G St NW

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Introduction

Washington, DC is home to a growing number of cyclists and pedestrians who rely on the city's roadways for commuting, recreation, and daily activities. However, the increasing reliance on these non-car modes of transportation has coincided with persistent safety concerns, highlighting the need to ensure a hazard-free environment for travel. Thus, as part of a city-wide effort for safer streets, the District Department of Transportation (DDOT) has undertaken many initiatives, adopting a safe system approach to road design and usage to reduce injuries and deaths. Despite these efforts, challenges remain, particularly at critical high-traffic intersections like Virginia Ave NW and G St NW. This project seeks to evaluate the effectiveness of the intersection's existing design, utilizing a multimethod analysis of design standards literature, community experiences, and traffic flows to illuminate areas where improvements are needed. By offering targeted recommendations, we aim to enhance responsive urban mobility and connectivity along the Virginia Ave NW corridor, thereby supporting the District's grander vision of an equitable and safe transportation network.

Background on Study Area

Figure 1. The intersection of Virginia Ave/G St NW, facing northeast. (Credit: Grace Lemoine)

Situated in the Foggy Bottom neighborhood, the Virginia Ave NW and G St NW intersection serves as a useful case study in urban transportation design because it facilitates the interaction of pedestrian, cyclist, and vehicular traffic flows. As shown in Figures 1 and 2, the intersection involves two crosswalks across Virginia Ave NW and one across G St NW, all of which are signaled with additional signs indicating that cars should stop for crosswalk traffic. Furthermore, there is a two-way Protected Bike Lane (PBL) on the south side of Virginia Ave that transitions to a one-way PBL along the median. At the intersection, the two-way PBL also merges to connect to the two-way PBL on G St NW. DDOT first installed the G St cycle track in July 2020, and, upon their May 2021 review of the intersection, remodeled the Virginia Ave cycle track in March 2022. At all points, these cycle tracks are protected to concurrent vehicular flows by a raised curb that further delineates them from street parking lanes.

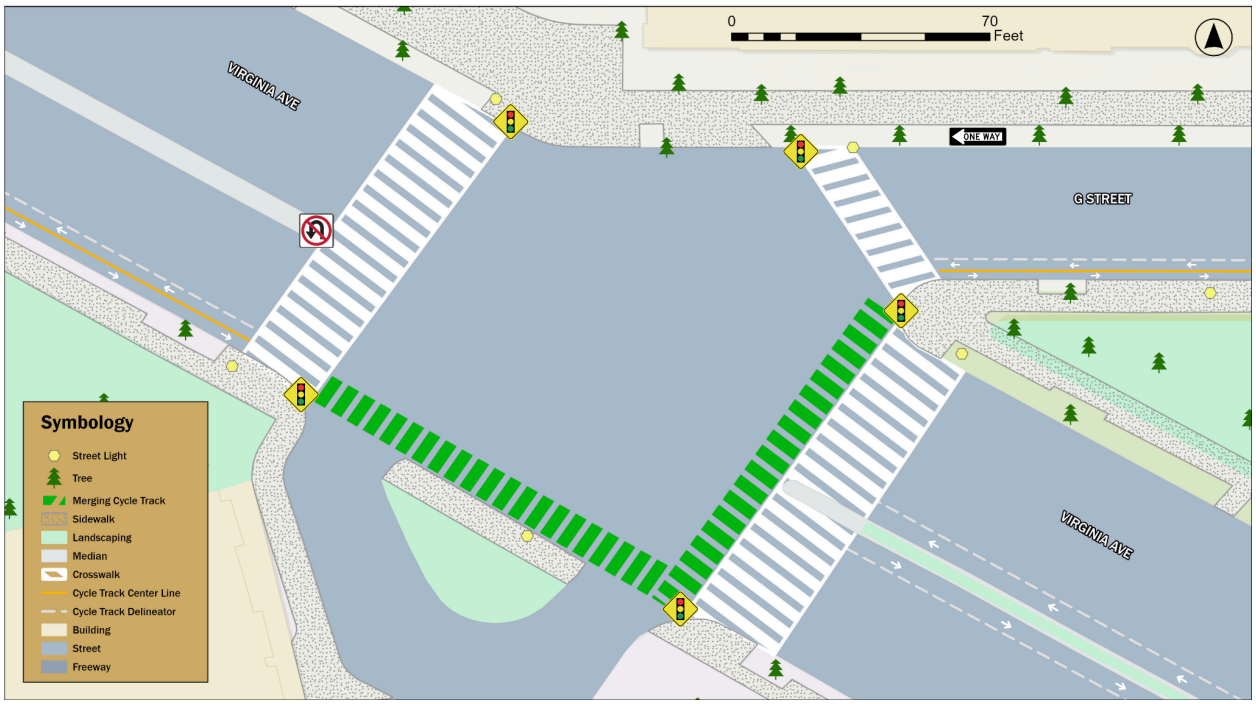

Figure 2. Map of the Virginia Ave NW/G St NW intersection detailing designated car, cyclist, and pedestrian pathways and movement. (Created By: G. Lemoine | Sources: ESRI, Open Data DC, US Census Bureau, Canva)

Vehicular traffic at the intersection flows in three main directions: eastbound along Virginia Ave toward Constitution Ave, westbound along Virginia Ave toward Rock Creek Parkway, and westbound from G St NW. There is also a minor volume of merging to and from the driveway loop in front of 2440 Virginia Ave NW, and all exits from this roadway are signaled by a traffic light. On Virginia Ave, cars are prohibited from making U-turns and are subject to a speed limit of 25 mph. Traffic on both streets is further regulated by stop controls for left and right turns, ensuring a managed flow of vehicles at the intersection. Additionally, slightly east of the study area, a bus stop serves westbound transit vehicles traveling along Virginia Ave.

Methodology

To best achieve our stated objectives and construct a comprehensive analysis of the intersection, we utilized a four-pronged approach to data collection that integrated quantitative and qualitative methods.

Review of Design Standards

It is generally understood that heavily car-based infrastructure is more hostile to pedestrians. However, this report, in collaboration with DDOT, aims to provide a systematic review of current conditions and offer potential street design elements. Given the task of improving the conditions of the large intersection at Virginia Ave. and G st., it is important to look at evidence-backed methods of intervention, as well as evidence-backed reasons *for* intervention in the first place. This report and its literature review attempts to determine both why intervention is necessary and how that should occur in the specific case of the intersection at Virginia Avenue and G st in the Foggy Bottom neighborhood of Washington, D.C. To do this, we'll be referencing a variety of journal articles studying the effectiveness of different types of implementations. Additionally, we have centered our analysis around a specific set of design standards. Broadly, design standards are significant in "maintain[ing] an adequate level of safety by learning from historical experience of the participating stakeholders".[1]

In this study, our team primarily refers to standards and implementations recommended by the National Association of City Transportation Officials as a starting point for answering both of these questions. Their 2013 design guide and related sources inform the majority of our work in this report. This choice was made primarily because of Washington, D.C.'s close association with the organization. It is one of twenty-six NACTO member cities in the United

[1]Kritzinger, D. (2006). Standards and regulations. In D. Kritzinger (Ed.), *Aircraft system safety* (pp. 23–42). Woodhead Publishing. https://doi.org/10.1533/9781845691509.23

States.[2] Even more tellingly, NACTO's Urban Bikeway Design Guide and Urban Street Design Guide forms one of four industry guides used in the creation of the D.C. Bicycle Facility Design Guide, where the NACTO publication is cited twenty-three separate times.[3]

More than just an ideological alignment, using NACTO as our main authority follows city-wide precedent. Washington, D.C. has routinely involved NACTO design standards in its efforts to improve urban street design. Two examples include the Eastern Avenue Rehabilitation project in 2017 and the Mid-City East Livability Study in 2014. In the former, the design principles were used to "replace deteriorated sidewalks" and intersection design to "improve pedestrian safety and ensure visibility" at all intersections.[4] In the latter, the NACTO design guide was a part of a larger study of the Mid-City East area, a scope predominantly in Ward 5 but involving parts of Wards 1 and 6 as well. Here, the design standards were used to recommend an intersection improvement regarding signal lights and signal spacing[5]. This strong history of NACTO implementations in Washington, D.C. guided our team's decision to use the organization's suggestions as a central guiding force, while referring to policies that are scalable across the city and already in motion.

Field Observation

The second component of our methodology was field observation, which allowed us to gather real-time insights into the current traffic conditions of the intersection. Two 15-minute

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[2] National Association of City Transportation Officials. (n.d.). *Member cities*. https://nacto.org/member-cities/
[3] District Department of Transportation. (2020). *DDOT bicycle facility design guide: Version 2* [PDF]. https://ddot.dc.gov/sites/default/files/dc/sites/ddot/DDOT%20Bicycle%20Facility%20Design%20Guide%20-%20Version%202%20%28Final%29.pdf
[4] Government of the District of Columbia Department of Transportation. (2017). *Scope of work: Eastern Avenue rehabilitation* [PDF]. https://ddot.dc.gov/sites/default/files/dc/sites/ddot/page_content/attachments/Scope%20of%20Work%20Eastern%20Avenue%20Rehabilitation%20.pdf
[5] Government of the District of Columbia Department of Transportation. (2014). *DC Mid-City East livability study: Part 2* [PDF]. https://ddot.dc.gov/sites/default/files/dc/sites/ddot/page_content/attachments/DC%20Mid-City%20East%20Livability%20FINAL%20web_Part2.pdf

field observation sessions were conducted during high-traffic commuting periods: one on the morning of October 30, 2024, from 8:30 to 8:45 AM and another in the afternoon from 4:15 to 4:30 PM. These sessions focused on measuring the traffic volume of pedestrians and cyclists, as well as observing interactions between cyclists, pedestrians, and vehicles. The goal was to capture how users navigate the intersection and identify potential conflicts among different modes of transportation. An additional morning session was conducted on November 15, 2024, from 8:45 to 9:00 AM to specifically focus on cyclist behavior. This task included mapping desired paths, or the informal routes taken by users outside of designated infrastructure, of a random sample of cyclists to provide a better understanding of how cyclists actually travel relative to the intended design.

Crash Mapping

The third method of analysis involved utilizing open-source crash data to assess the safety of the Virginia Ave NW and G St NW intersection. This approach aimed to visualize the prevalence and spatial distribution of accidents within the study area and thus identify high-risk zones. To achieve this, two hotspot maps were created in ArcGIS Pro to highlight where accidents were most concentrated. The first map depicted all reported accidents since 2014, and the second illustrated those accidents specifically involving cyclists and pedestrians. By comparing the general distribution of all accidents with those involving non-car users, a targeted evaluation of the level of safety facilitated by the infrastructure in the study area could be conducted.

Community Survey

The fourth component of our methodology is a community engagement-based survey focusing on the local population, specifically pedestrians who use the intersection regularly. The data and feedback would help understand the community's attitudes, opinions, experiences, and

needs about the interaction. The survey used in this study is opinion-based, mostly asking participants to rank on a scale of 1-5, along with some open-ended questions. This survey also investigates whether the intersection poses risks or safety hazards based on the participants' observations and potential redesign ideas.

Several QR codes linked to the survey question were placed on the light pole near the intersection to ensure accessibility to the target populations and data accuracy. Additionally, group members conducted a few field surveys. By evaluating the community's feedback, the study helps better understand the intersection's daily activity and user-friendliness.

The survey questions are as follows:

- Do you remember a time before the bike lane was installed?
- How often do you use this intersection?
- How safe do you feel crossing this intersection?
- Is the intersection clearly marked and easy to navigate?
- Are there any issues you notice on a daily basis? (e.g., visibility, maintenance, near-miss accidents)
- How would you rate the risk of accidents here (e.g., involving cars, bikes, or pedestrians)?
- Are you satisfied with the Department of Transportation's recent updates?
- How effective is the current intersection design for daily use?
- How long have you lived in this area?
- Do you have any suggestions or concerns about the intersection?
- How does this space affect the neighborhood?
- Would you rather something else be here? If you could change this area and make it better

Literature Review

The following literature review can be understood in two parts. The first heavily relies on the aforementioned NACTO *Urban Street Design Guide* in order to examine general best-practice design principles for urban roadways. The second part relies less heavily on the design guide in order to focus on specific street design elements and their effectiveness as proven through a variety of journal articles and government reports.

The NACTO guide outlines certain "design controls" that inform how transportation departments ought to look at street design. The central idea is to design roadways for the most vulnerable user and the "desired" behavior, as opposed to current operating behavior.[6] The most important and scalable of these design controls are compactness and speed reduction, which we focus on here. When reviewing intersections, NACTO suggests prioritizing compactness. Wide, open, and unrestricted intersections make non-motorized forms of transportation an unpleasant and unsafe experience. The design guide proposes that compactness reduces pedestrian exposure, slows traffic near conflict points, and increases visibility.[7] Regarding a fix for intersections with poor sight visibility, the guide looks to compactness: "Compact intersections place more activity within the sight triangle, giving all users a better view of potential conflicts."[8]

Another important design control is speed reduction. Physical and visual complexity is the primary way to achieve this. NACTO suggests things like: narrower lane widths, roadside landscaping, speed humps, and curb extensions to reduce speeds.[9] This is in line with a 2008 Transportation Research Board report, which states that "roadway design elements, environment, traffic type, and other factors help drivers determine an appropriate speed," furthering the idea that interventions that "contribut[e] to the visual complexity (or simplicity) of the roadway

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[6] National Association of City Transportation Officials. (2013). *Urban street design guide*. Island Press.
[7] Ibid.
[8] Ibid.
[9] Ibid.

edge," can be an effective speed reduction tactic.[10] Looking to reduce speeds is important primarily for pedestrian safety. Age- and gender-adjusted research suggests that pedestrian fatality risk "at 50 km/h [is] more than twice as high as the risk at 40 km/h and more than five times higher than the risk at 30 km/h," meaning any reduction in a neighborhood area where all of the above speeds are seen is a large step in the right direction.[11] Other literature corroborates this, as Richards, D.C. writes that, "the risk increases slowly until… around 30 mph. Above this speed, the risk increases rapidly – the increase is between 3.5 and 5.5 times from 30 mph to 40 mph," a significant number by all accounts.[12] With these important guidelines in mind, the next step was to research effective road designs for compactness and speed reduction. The following data provides a strong backing for curb extensions, bus bulbs, and roundabouts.

Curb extensions are perhaps the simplest way to reduce simplicity, lane widths, and speeds while heightening pedestrian visibility. Johnson, R.S. writes that "curb extensions contribute to a significant reduction in the average number of vehicles that pass a waiting pedestrian before yielding to the pedestrian," further explaining that pedestrians on the side of the curb extension benefited from increased visibility and thus more cars yielding in comparison to pedestrians on the non-extended curb.[13]

Meanwhile, bus bulbs are a specific type of curb extension. They align a bus stop with the parking lane. This narrows the street, increases pedestrian visibility, and makes bus boarding more efficient as the bus never has to pull over.[14] Fitzpatrick et al. examine whether bus bulbs accomplish their intended purpose. They write that, "buses experienced approximately a

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[10] Ray, B., Kittelson, W., Knudsen, J., Nevers, B., Ryus, P., Sylvester, K., Potts, I., Harwood, D., Gilmore, D., Torbic, D., Hanscom, F., McGill, J., Stewart, D. (2008). *Guidelines for selection of speed reduction treatments at high-speed intersections* (NCHRP Report 613). Transportation Research Board. https://nacto.org/docs/usdg/nchrp613_ray.pdf
[11] 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
[12] Richards, D.C. (2010). Relationship between speed and risk of fatal injury: pedestrians and car occupants.
[13] Johnson, R. S. (2005). *Pedestrian safety impacts of curb extensions: A case study*. Oregon State University.
[14] National Association of City Transportation Officials. (2013). *Urban street design guide*. Island Press.

7-percent increase (about 0.5 mph [0.8 km/h]) in both the northbound and southbound directions" while, "the number of buses affecting vehicles in both travel lanes did decrease," due to the efficiency of the bus bulb eliminating the need for the bus to pull over.[15] The report also relates that vehicle speeds in general actually go up with a bus bulb, but this is attributed to the increased efficiency of the public transportation system. This was further shown by the pedestrian flow rate, which improved by 11 percent when a bus bulb was present, as pedestrians could more easily navigate around those waiting at the stop.[16]

Finally, roundabouts are often the first thing to come to mind when looking at U.S. intersection redesign, and they are certainly no stranger to the District. The aforementioned Transportation Research Board report singles out roundabouts as an improvement to intersection safety. It states, "crash reduction research for conversions of all types of intersections to roundabouts (55 sites studied) found a 35% reduction in all crashes and 76% reduction in injury crashes," certainly a significant number.[17] With such a clear impact, the literature suggests that roundabouts should be considered if and when possible. A Federal Highway Administration report provides insight into this process, listing conditions where a roundabout might be necessary. Among these are: documented observations of speeding, high traffic volumes, careless driving activities, and safer conditions for non-automobile users. For more explicit traffic-calming purposes, the report recommends a mini-roundabout instead.[18]

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[15] Fitzpatrick, K., Hall, K. M., Farnsworth, S., & Finley, M. D. (2001). *TCRP report 65: Evaluation of bus bulbs*. Transportation Research Board.
[16] Ibid.
[17] Ray, B., Kittelson, W., Knudsen, J., Nevers, B., Ryus, P., Sylvester, K., Potts, I., Harwood, D., Gilmore, D., Torbic, D., Hanscom, F., McGill, J., Stewart, D. (2008). *Guidelines for selection of speed reduction treatments at high-speed intersections* (NCHRP Report 613). Transportation Research Board. https://nacto.org/docs/usdg/nchrp613_ray.pdf
[18] Robinson, B., et al. (2000). *Roundabouts: An informational guide* (NCHRP Report FHWA-RD-00-67, pp. 1-277). Federal Highway Administration.

Experimental Results

The results presented offer insights into two paradigms informing our evaluation of the effectiveness of the current intersection design: traffic conditions and community experience. The former thus focuses on influential factors such as traffic volume, cyclist behavior, and crashes, while the latter considers metrics such as challenges facing pedestrians.

Traffic Analysis

Table 1. Summary of Traffic Counts Gathered During Field Observations.

	Pedestrians		
	Virginia Ave NW	G St NW	**Cyclists**
8:30 - 8:45 AM	19	6	46
(Estimated) 8 - 9 AM	*76*	*24*	*184*
4:15 - 4:30 PM*	-	-	14
*(Estimated) 4 - 5 PM**	-	-	*56*

**Pedestrian traffic volume was not measured during the afternoon session.*

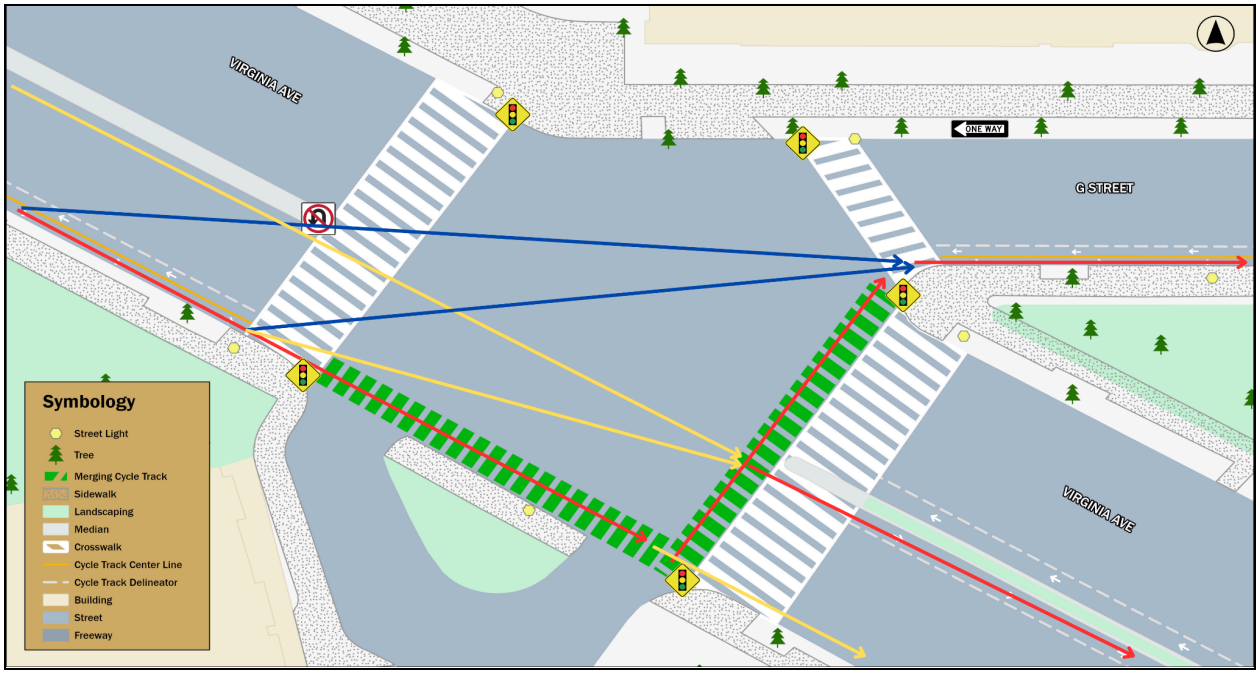


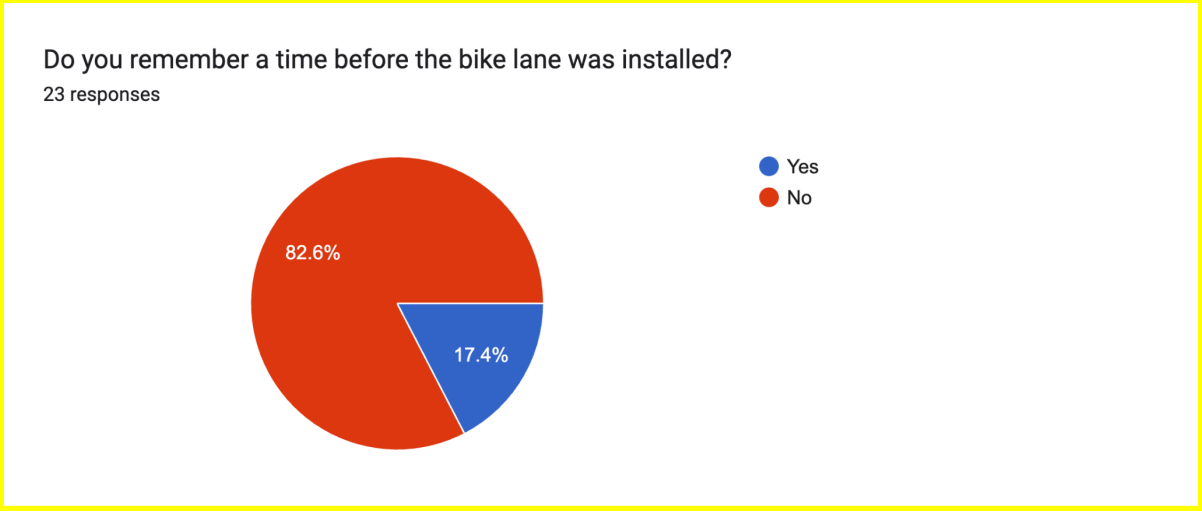
Figure 3. "Desire paths" of cyclists on Nov 15, 8:45-9:00 AM. (Created By: G. Lemoine | Sources: ESRI, Open Data DC, US Census Bureau, Canva)

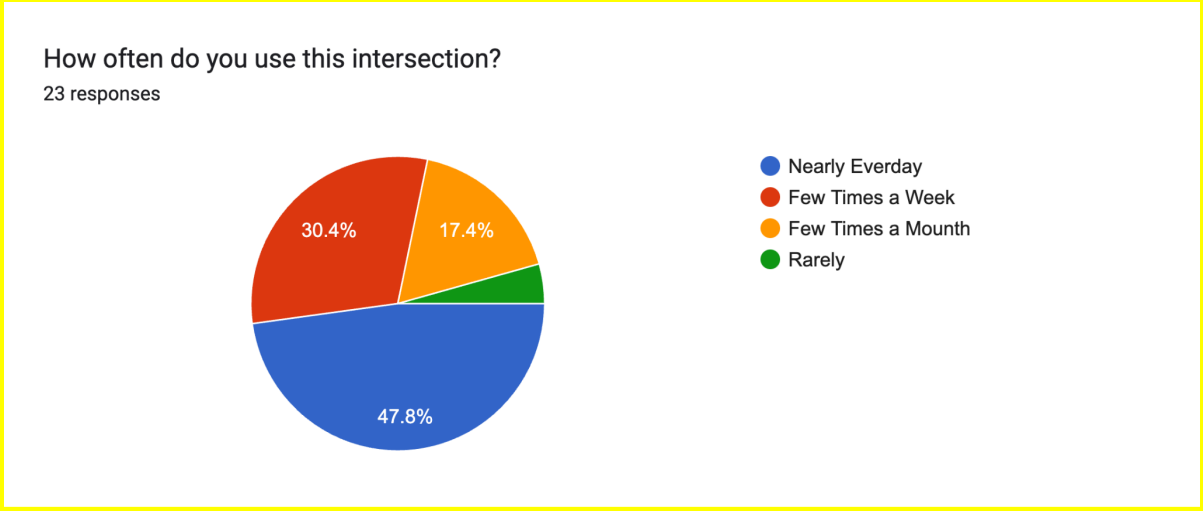
Figure 3 visualizes routes taken by a random sample of 16 cyclists during the observation period on November 18. All cyclists were observed traveling east from Virginia Ave. The map demonstrates the intended path for cyclists with red arrows. The yellow arrows mark alternative routes utilized by those continuing to travel east on Virginia Ave, and the blue arrows mark alternative paths used by those merging to G St NW. Out of the 10 of 16 cyclists that continued on Virginia Ave, only 5 used the cycle track as designated. Similarly, of the 6 cyclists who merged onto G St NW, only 2 used the cycle track as intended.

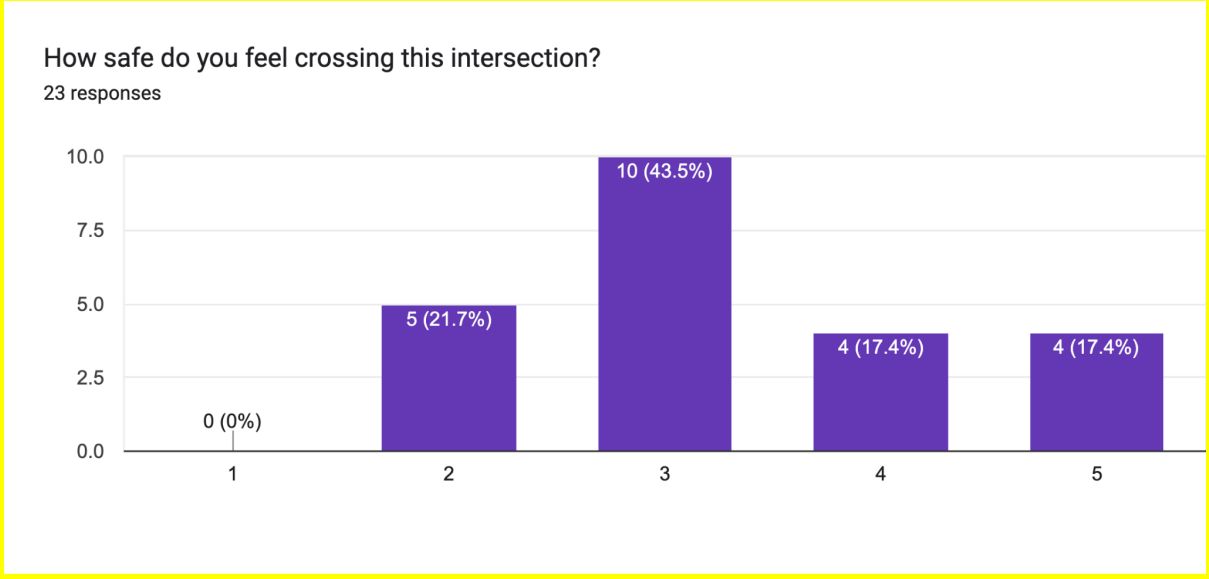
Figure 4. Hotspot maps of crashes at Virginia Ave NW and G St NW from 2014 to 2024. The left map shows total crashes and the right crashes involving pedestrians or cyclists.

The crash data utilized to construct the maps in Figure 4 indicated that there have been 26 crashes at the intersection of Virginia Ave NW and G St NW in the last decade, the most recent of which occurred in February 2022. Within this crash pool, 6 had involved pedestrians and 5 had involved cyclists. The last crash involving either non-car mode happened in March 2019.

Survey Responses:

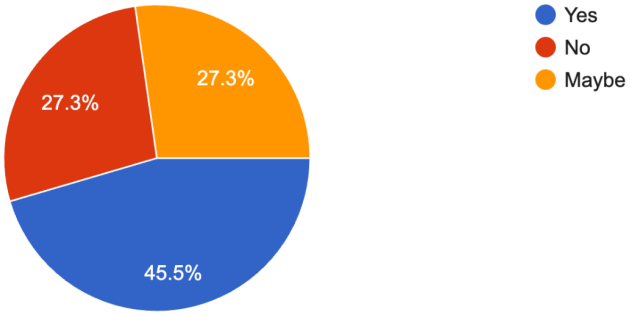






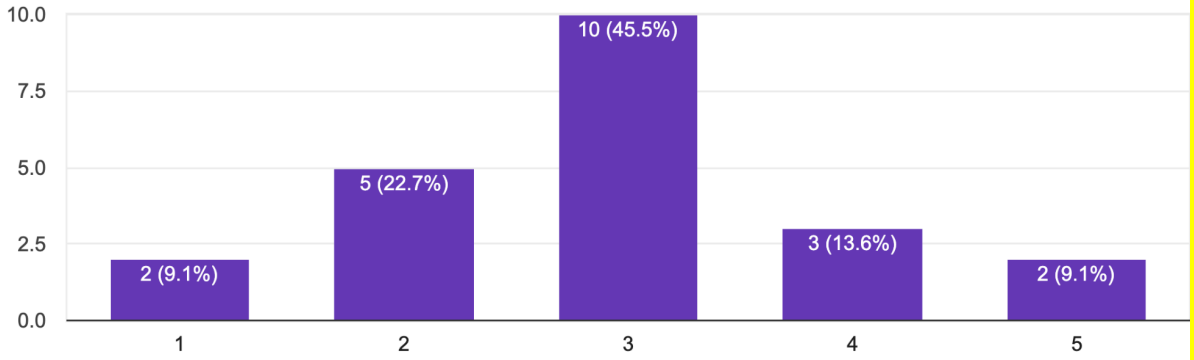
Is the intersection clearly marked and easy to navigate?

22 responses



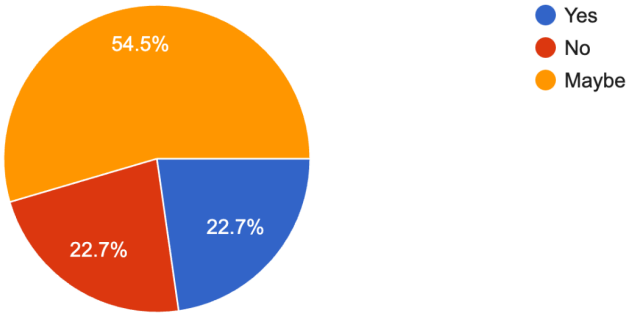
How would you rate the risk of accidents here (e.g., involving cars, bikes, or pedestrians)?

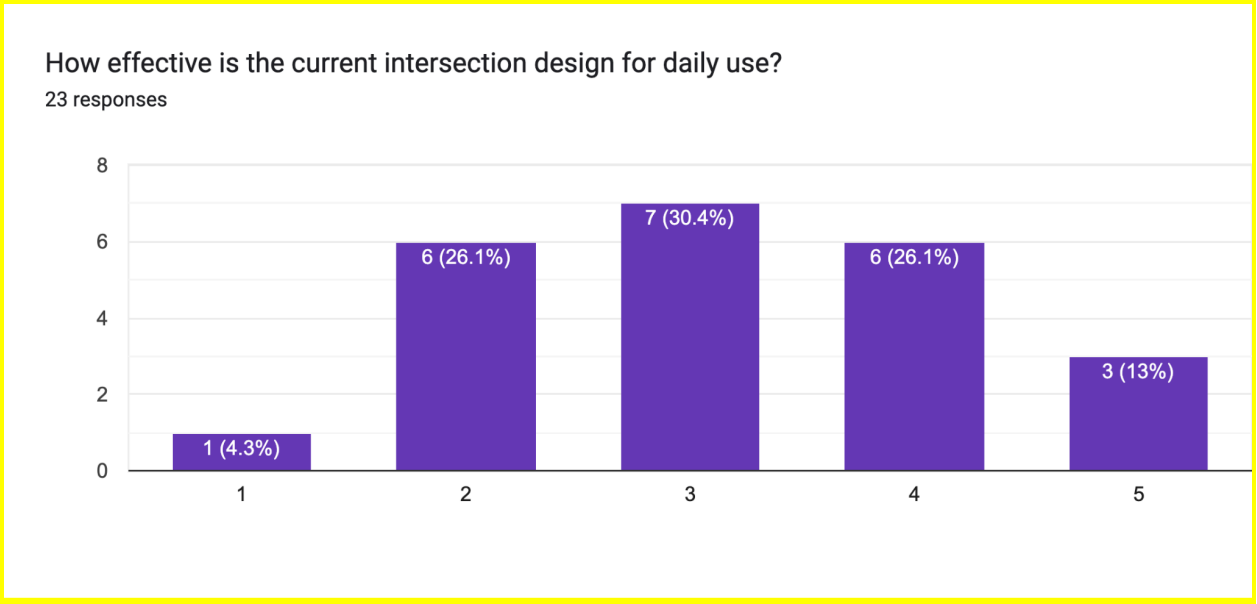
22 responses

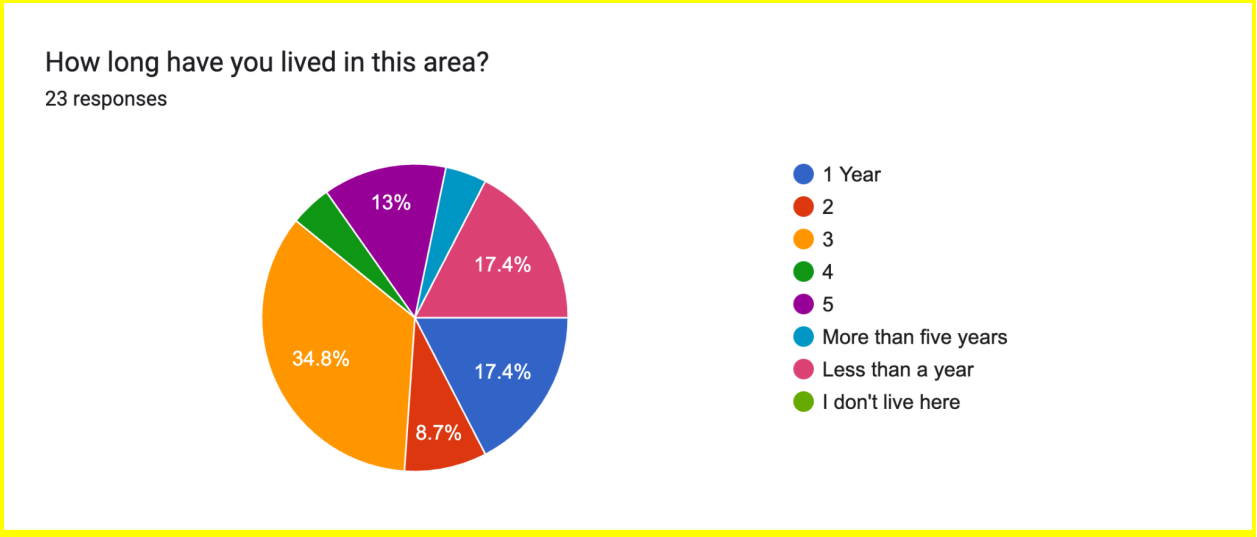


Are you satisfied with the Department of Transportation's recent updates?

22 responses







Do you have any suggestions or concerns about the intersection?

- *Think it's very awkward for cyclists and cars on Virginia Ave often block the box*
- *Visibility is hard with pedestrians on sidewalks and bikers behind railings. The non-perpendicular intersection of G St. also makes perception from the other area very challenging to view*
- *Visibility with pedestrians crossing south. Often cars do not see me when I'm walking home.*
- *Crossing on a bike is difficult. I have to pay attention to cars coming from 6 different directions (including the underpass).*
- *Visibility*

- *Bikes not stopping for pedestrians*
- *Kinda confusing car signs*
- *Lots of drivers seem to barrel down VA ave going NW and are caught off guard by the sudden crosswalk and traffic light, leading to either slammed brakes or running reds.*
- *Visibility is definitely an issue, cars don't always stop for pedestrians*
- *Cyclists not yield to pedestrians.*
- *Confusing when cars consulting at you and the no bike lane*
- *no more than the average intersection*
- *As a cyclist, the bike path is not my favorite. I generally dislike center lane bike paths and I'm often turning on 23rd so it is not a safety add. As a pedestrian o feel very safe generally, however, the button to walk used to be louder and announce when to cross and I miss that*
- *People not stopping at the nearby 24th St and G intersection - there should be a four-way stop*

Are there any issues you notice on a daily basis? (e.g., visibility, maintenance, near-miss accidents)

- *It's just pretty wide*
- *I know it's not likely but I would love a crosswalk across virginia at 24th not just at g*
- *Making the intersection more efficient*
- *More trees*
- *No, I've lived here and used this intersection everyday since before there was a light here! I feel so much safer now that the light has been installed. I used to call this intersection 'Frogger Crossing' because it felt like you were playing Frogger trying to cross as a pedestrian.*
- *Mark turn lanes on the ground*
- *It needs to have better bike lane distribution. Bikers always get caught not knowing where to go. In addition, it should have more barriers to protect pedestrians and better visibility.*
- *Cars don't need to use G Street as a thoroughfare. Block it off, add some tables and chairs, and incorporate the grassy patch next to it into a park.*

How does this space affect the neighborhood?

- *It's right in front of my apartment building so it'd be nice if it was safer*
- *Makes it easier to walk around*
- *Feels like a very sudden departure from smaller, quieter streets to a wider road with a ton of traffic lights.*
- *It is now a safe and easy crossing*
- *I think it prioritizes cars over pedestrians*
- *It cuts off my apartment from the rest of the foggy bottom, making it hard to get places.*
- *Negatively, it's hard to walk or bike even with all the trails so close.*
- *It's a real dividing line between the Columbia Plaza complex and the historic Foggy Bottom housing*
- *It's hard annoying to cross VA Ave from 24th St coming south because you have to walk out of the way NW to cross at the crosswalk off to the side*

Would you rather something else be here? If you could change this area and make it better

- *See above re nearby G & 24th St intersection - should be 4-way stop*
- *I don't know much about urban planning so I'm not really sure*
- *Think a roundabout or similar free-flowing intersection wouldn't be a bad idea*
- *I worry about what happened to the homeless that lived around here and the space isn't being utilized now that they're gone either. It does seem like it was the best way to implement a bike lane however I would argue this is an area where a bike lane may not have been ideal. Now if you want to follow up about the bike lanes on Columbia between 18&Connecticut. That renovation SUCKS and is possibly the worst from a bus rider/bike rider safety aspect.*
- *Making the traffic flow more efficient perhaps*
- *Nope I'm fine with it, maybe more trees are always better*
- *No, I think the intersection and the area around has improved greatly in the last few years.*
- *Remove it altogether because there is another intersection that is done better down the road. I think we could remove the part of G Street that connects to Virginia and make it an extended park for use by the church and community.*
- *Yes, a park would be great, like you often see in New York when Broadway intersects with a street.*
- *I wish the intersection was a bit smaller and more straightforward*

Discussion

The experimental results outlined above reveal significant insights into the dynamics of multimodal transportation at the Virginia Ave NW and G St NW intersection as well as the existing challenges to cyclist and pedestrian safety. By contemplating the field observations, traffic flow mapping, community survey feedback, and design standards review together, several key themes regarding the intersection's design and usage emerge, warranting deeper examination.

To begin, the traffic count data from Table 1 provides a snapshot of the intersection's usage by non-car modes. On average, it could be assumed that a greater number of cyclists utilize the roadways than pedestrians, but the absence of direct data in the afternoon session limits the certainty of this conclusion. In terms of the way in which the intersection is being used, pedestrians tend to use the crosswalks as designated, with little to no jaywalking taking place. On the other hand, Figure 3 indicates a tendency among cyclists to diverge from the cycle track. Only 50% of cyclists traveling east on Virginia Ave utilized the cycle track as designed, and even fewer (33%) adhered to the cycle track when merging onto G St NW. This deviation underscores potential deficiencies in the design's intuitiveness or functionality. Desire paths often reflect an unmet need for directness or perceived safety, suggesting that existing infrastructure may not align with cyclists' priorities or perceived risks. More broadly speaking, however, the uneven utilization of the PBLs could stem from factors such as unclear signage, poor connectivity to adjacent infrastructure, or insufficient physical separation from vehicular traffic.

The hotspot crash analysis in Figure 4 further contextualizes the vulnerability of non-car users at this intersection. There have been 26 reported crashes in the past decade, with 11 directly involving pedestrians or cyclists. Looking at the distribution across the intersection, a significant number of crashes seem to occur on Virginia Ave NW, especially when a non-car user is

implicated. Notably, no such crashes have been reported since 2019, which predates the installation of both the Virginia Ave NW and G St cycle tracks and could suggest the successful implementation of safe infrastructure. However, this data alone does not account for near misses or unreported incidents, which could paint a fuller picture of the risks faced by non-car users.

The above survey revealed a high level of dissatisfaction and safety concerns at the Virginia Ave and G St intersection. Pedestrians expressed frustration when they had to constantly pay attention to traffic from six different directions, causing them to feel overwhelmed and unsafe. Pedestrians also reported that poor visibility has made drivers much more difficult to observe pedestrians and cyclists due to the non-perpendicular intersection design. Additionally, drivers are often caught off guard by the sudden crosswalk and traffic light, leading to either slammed brakes or running reds.

The above survey data generally demonstrates that the pedestrian experience at the Virginia Ave and G St. crossing is not a positive one – the vast majority of respondents rated safety, navigability, and accident risk at a 3 or lower on a 1-5 scale. Furthermore, specific comments included a lack of pedestrian visibility, and unclear stopping points for all users, with non-motorized forms of transportation put most at risk because of this confusion. As such, we've determined that implementations from the literature that target compactness (and result in lower speeds) should be the primary focus of our redesign. The idea that this intersection redesign should look towards compactness first is not only corroborated by survey data, but by satellite imagery as well. When compared to surrounding intersections, Virginia Ave + G St has a far greater total area. This is demonstrated in the figure below, which shows how the study area measures about 9319 ft^2 between crosswalks, while nearby intersections have between-crosswalk areas of 1424 ft^2 (A) and 893 ft^2 (B) – both significantly lower. The only other comparable

intersection is Virginia Ave and 23rd St, which is notably more complex due to wide medians, narrower lanes, and pedestrian islands.

Figure 5. The intersection of Virginia Ave/G St NW is in red, compared to nearby intersections in orange.

To achieve some of this kind of complexity, curb extensions can be one of the simplest ways to make lanes more narrow. Narrow lanes make for shorter pedestrian crossings, nicer footpaths, reduced street speeds, and space for trees, benches, or other public uses. We suggest a curb extension at the mouth of the intersection that would re-appropriate a vast amount of street space to be for public, pedestrian usage instead of wasted space in the intersection. This intersection also has a bus stop for the 42 and 43 lines nearby. If that stop were moved just fifty meters east, it would allow for a bus bulb aligned with the parking lane. This would provide much-needed lane narrowing while reducing confusion in the intersection, as buses do not have to interfere with traffic as much, and would grant pedestrian visibility as they are now in line with the parking lane.

Survey results revealed that pedestrians often complain about the harsh left turn going east from G st, while our team observed a confrontation between a cyclist and a vehicle on this exact turn. A roundabout would smoothen this process out immensely, as the Federal Highway

Administration cites crashes due to “right angle, head-on, left/through, U-turns, etc.” as those that could be solved by a mini roundabout.[19] Crash data from Figure 4 suggests that the majority of automobile crashes occur in the vast, open middle of the intersection as well, meaning a roundabout would be best for all parties involved.

[19]Robinson, B., et al. (2000). *Roundabouts: An informational guide* (NCHRP Report FHWA-RD-00-67, pp. 1-277). Federal Highway Administration.

Recommendations

In response to the findings above, this project proposes four potential redesigns of the Virginia Ave NW and G St NW intersection. These proposals will be evaluated on the basis of their contribution to the safety of non-car modes of transportation.

Proposal 1 - Curb Extension

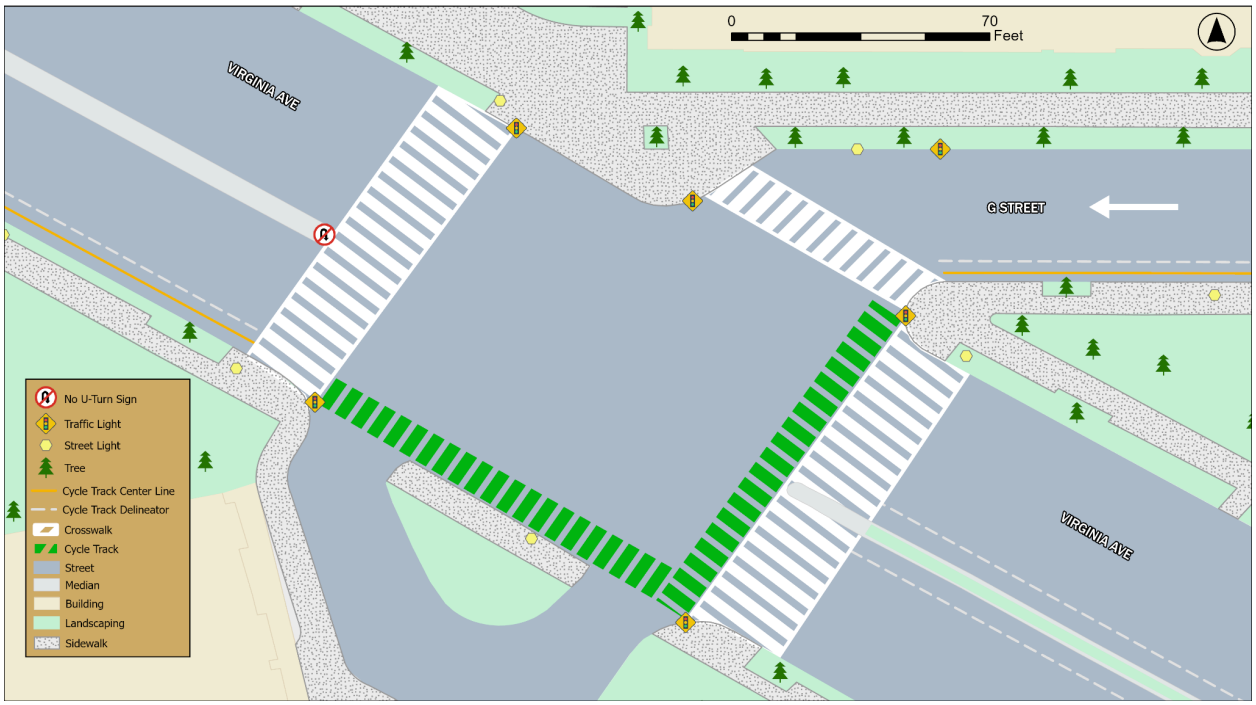


Figure 6. Map of the Virginia Ave NW/G St NW intersection with a curb extension. (Created By: S. Loupus | Sources: ESRI, Open Data DC, US Census Bureau, Canva)

Under the existing configuration of the intersection, cars are able to merge onto Virginia Ave from G St, which incentivizes them to speed through the intersection. This comes at the detriment of pedestrians and cyclists. Proposal 1 adds additional concrete to the north side of the intersection, which forces traffic from G St to make a proper right turn. The new crosswalk would be less visible to westbound cars on G St, so a new traffic signal was added to give drivers and cyclists advanced warning of current traffic flows at the intersection.

Proposal 2 - Curb Extension and Bus Bulb

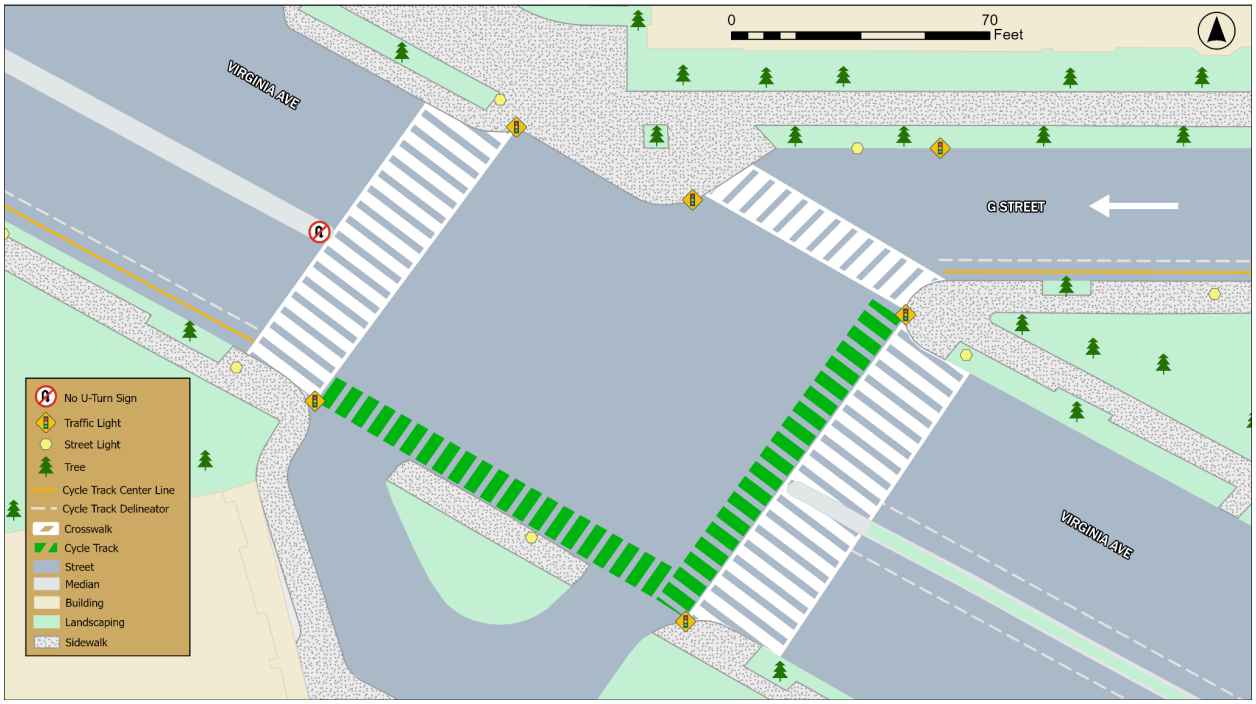


Figure 7. Map of the Virginia Ave NW/G St NW intersection with a curb extension and bus bulb. (Created By: S. Loupus | Sources: ESRI, Open Data DC, US Census Bureau, Canva)

Along with the changes proposed in Proposal 1, Proposal 2 includes the implementation of a bus bulb along Virginia Ave. The space paved over is currently utilized for on-street parking, but if converted into a bus platform, buses could stop at the curb without having to veer off of the road. If implemented, this bus bulb would become the new stop for the westbound 42/43, which currently stops right before the crosswalks on the east side of the intersection.

Proposal 3 - New Bike Lanes

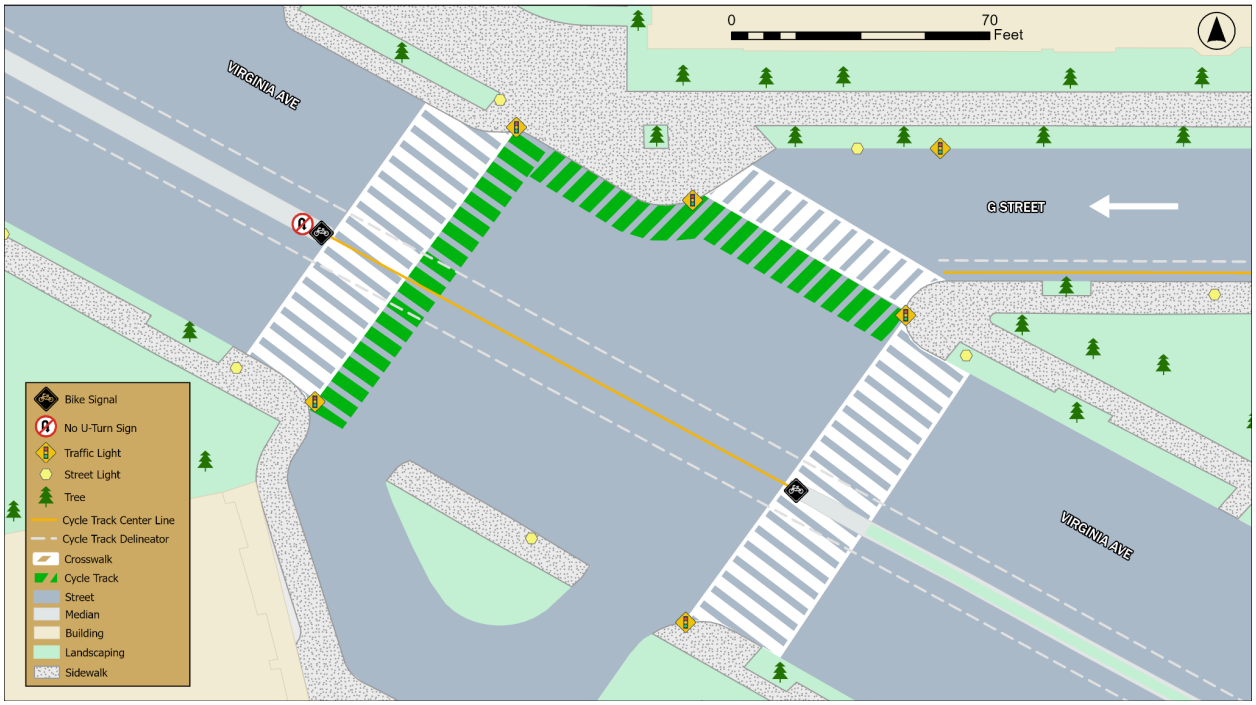


Figure 8. Map of the Virginia Ave NW/G St NW intersection with repositioned bike lanes. (Created By: S. Loupus | Sources: ESRI, Open Data DC, US Census Bureau, Canva)

Proposal 3 incorporates the changes from the other proposals and adds a redesigned bike lane. This turns one desired path into a marked path, which streamlines the flow of cyclist traffic. To prevent conflict with pedestrians, bike signals were installed at the intersection, and the designated cyclist crosswalks were moved to the north sides of the intersection.

Proposal 4 - Mini Roundabout

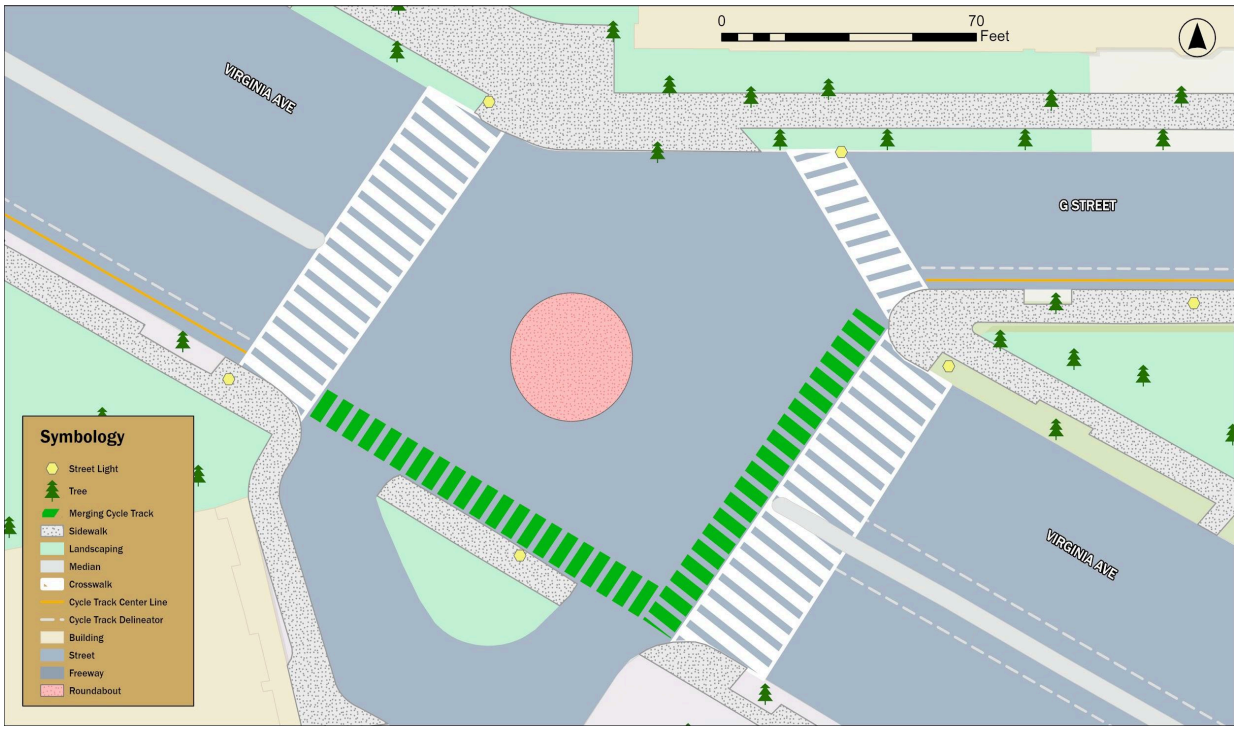


Figure 9. Map of the Virginia Ave NW/G St NW intersection with a center island. (Created By: G. Lemoine | Sources: ESRI, Open Data DC, US Census Bureau, Canva)

The last proposal takes a different approach to changing traffic flows. Implementing a mini roundabout would not require any modifications to current surrounding infrastructure, while forcing drivers to slow and clarifying all left turns. A simple mini roundabout from cost-effective materials would resolve the sharp turns from G St. going East and from the parking garage going west. Additionally, the reported issues of unclear signals for all users would be resolved and replaced with a change in required driver behavior, going from active to passive. The success of this mini roundabout would be contingent on traffic flows, and whether the roundabout can handle the appropriate volume. A more thorough site analysis, involving measuring turn radii and land widths more closely, and traffic volume data could help inform this decision.