Glen Echo Park

Traffic and Pedestrian Safety
Context Sensitive Solutions Assessment

Final Report

April 2019

Prepared for:

U.S. Department of Transportation
Federal Highway Administration

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Project Need

Located along the Clara Barton Parkway and the Potomac River in Glen Echo, Maryland, Glen Echo Park has been a dedicated space for leisure since 1891, when it was founded as a National Chautauqua Assembly. The park later served as an amusement park for the Washington, D.C. area from 1911 to 1968. In 1971 Glen Echo Park became a historic culture and arts center owned by the National Park Service (NPS) and operated with the support of the Glen Echo Park Partnership for Arts and Culture. Nearly 400,000 people visit the Park each year to take part in events like arts programs and public festivals.

In response to safety concerns observed on the transportation facilities that serve Glen Echo Park, the Federal Highway Administration – Eastern Federal Lands Highway Division (FHWA-EFLHD) and NPS initiated this **Traffic and Pedestrian Safety Context Sensitive Solutions Assessment**.

This report includes safety observations and recommended improvements pertaining to vehicular access to the park from Clara Barton Parkway and MacArthur Boulevard. The assessment also considers safety and accessibility improvements for pedestrians and cyclists, specifically at locations along MacArthur Boulevard and along Cabin John Access Road.

The Clara Barton Parkway provides access to Glen Echo Park, which receives nearly 400,000 annual visitors

Project Team

The project team for the Glen Echo Park Traffic and Pedestrian Safety Context Sensitive Solutions Assessment consisted of representatives from NPS, FHWA-EFLHD, and the consultant team. Development of the plan also included close coordination with the Montgomery County Department of Transportation for the planned traffic signal at the intersection of MacArthur Boulevard with Oberlin Avenue and the Glen Echo Access Ramp.

In December 2017, several community members participated in a stakeholder event to provide feedback regarding transportation conditions in the study area and their suggestions for related improvements. Additional stakeholders provided input to the project team after the event took place.

Specific contributors to this effort are listed on page 2 of this report.

Findings

Field Observations

The project team conducted field visits and analyzed crash data to identify key safety issues in the Glen Echo Park study area. Safety observations included limited sight distances, ramp queuing, poor pavement conditions, and a lack of striping and signage, which pose safety risks for drivers in the vicinity of Glen Echo Park. The project team also observed unsafe intersection maneuvers at some locations, as well as nonstandard shoulder usage by pedestrians and cyclists.

Detailed field observations can be found on page 11 of this report.

Site Improvements

The project team conducted a targeted safety analysis for the following seven sites in and around Glen Echo Park:

- Cabin John Access Road Ramps at Clara Barton Parkway
- Cabin John Access Road from Clara Barton Parkway to MacArthur Boulevard
- MacArthur Boulevard near Cabin John Access Road
- MacArthur Boulevard at Glen Echo Access Ramp
- Clara Barton Parkway near U-Turn
- Clara Barton Parkway East of Ramps
- Clara Barton Parkway Westbound and Access Ramp

The project team recommended specific improvements for each of these sites, including intersection realignment, installation of warning signage, pavement repairs, restriping, and improving delineation of shared use paths.

The full list of site-specific recommendations can be found in this assessment, starting on page 12.

General Improvements

Other general safety improvements were recommended for implementation throughout the study area, including wayfinding improvements for roadways and shared use paths, replacement of guardrail end treatments, and standardization of shared use path widths. This assessment also contains descriptions of safety improvement options that were deemed infeasible for the Glen Echo Park area facilities at this time.

More information about the general safety improvements for the study area can be found in this report, starting on page 30.

Major Reconfiguration Options for Glen Echo Ramps

This assessment also contains descriptions and schematics for two options to reconfigure the Glen Echo Ramps that connect MacArthur Boulevard to Clara Barton Parkway, where significant safety challenges were observed.

The first reconfiguration option (Major A) consists of a lengthened westbound weave area and a relocated U-turn lane. The second option (Major B) proposes a westbound through traffic flyover via an existing unused bridge.

These options are described in more detail with accompanying schematics in this report, beginning on page 33.

Implementation Scenarios

Three implementation scenarios that vary in level of ambition and cost of implementation were explored:

- **Implementation Scenario 1:** Scenario 1 involves already planned or low cost safety improvements. The majority of Scenario 1 improvements can be implemented feasibly in the short term with minimal design and approval processes required.
- **Implementation Scenario 2:** Scenario 2 is a moderate scenario that builds upon Scenario 1, involving several higher cost short-term safety improvements. Scenario 2 also contains several aspirational long-term improvement options, including the Major A option for the Glen Echo ramp reconfiguration. Scenario 2 is estimated to by the most costly of the three implementation scenarios.
- **Implementation Scenario 3:** Scenario 3 replaces or enhances several of the Scenario 2 improvements to address identified safety challenges in the area. Scenario 3 includes the Major B option for the Glen Echo ramp configuration, as described previously.

Details of the implementation scenarios and total cost estimates for these scenarios can be found on page 36 of this report.

Preferred Implementation Scenario

The project team identified Implementation Scenario 3 as the Preferred Implementation Scenario for this study.

Implementation Scenario 3 includes many of the improvements proposed by Scenarios 1 and 2, with a few substitutions or enhancements. Scenario 3 proposes a lower-cost but more geometrically divergent realignment concept for Clara Barton Parkway near the Glen Echo Access Ramp (the Major B option discussed previously).

This Preferred Implementation Scenario emphasizes three key recommendations: the improvement of traffic operations across the Cabin John Bridge using ITS technology, the enhancement of pedestrian and cyclist safety along the MacArthur Boulevard shared-use path near the Glen Echo Access Ramps, and the improvement of traffic operations on Clara Barton Parkway by rerouting through traffic over an existing unused, but still serviceable bridge.

Introduction

Project Overview

Glen Echo Park is a historic culture and arts center located along the Clara Barton Parkway and the Potomac River in Glen Echo, Maryland. The Park is owned by the National Park Service (NPS) and is managed by the Glen Echo Park Partnership for Arts and Culture, a nonprofit organization that oversees the Park's arts programs and maintains its historic facilities. With many of the buildings preserved from when the site was operated as an amusement park, its facilities include a dance pavilion, a carousel, children's theatres, and several buildings that now operate as classroom and office spaces. Nearly 400,000 visitors come to the Park each year to participate in arts programs, public festivals, and other interpretive events.

The Park is located along MacArthur Boulevard, a road that provides access to neighborhoods in the area and serves as a significant commuter route to and from the District of Columbia. Immediately to the south of the park, the Clara Barton Parkway provides access to Glen Echo while also connecting commuters from Maryland and Virginia to the District of Columbia. Motorists travelling on Clara Barton Parkway most commonly access Glen Echo Park via two exits, the Clara Barton Access Road located approximately one mile northwest of the Park in Cabin John (referred to in this report as the Cabin John Access Road), Maryland, and a set of parkway ramps located immediately southeast of the Park (referred to in this report as the Glen Echo Access Ramps). In addition to these major vehicular access points, Ride On, the local transit service provider, operates Route 32 which travels along MacArthur Boulevard, stopping at several locations near Glen Echo Park. A shared-use path also parallels MacArthur Boulevard and passes through a portion of Glen Echo Park. The MacArthur Boulevard shared-use path is used by community members, visitors, and commuters alike to walk and bike.

The Federal Highway Administration – Eastern Federal Lands Highway Division (FHWA-EFLHD) and NPS had observed safety concerns on facilities that provide access to Glen Echo Park. This Traffic and Pedestrian Safety Context Sensitive Solutions Assessment summarizes safety observations and recommends related improvements that pertain to vehicular access to the park via interchanges between Clara Barton Parkway and MacArthur Boulevard. The assessment also considers safety and accessibility observations and improvements for pedestrians and cyclists, specifically at locations along MacArthur Boulevard and along Cabin John Access Road. To conduct this analysis, the project team collected data to review existing conditions and planned improvements to the study area. The project team also met with park staff and community members to learn about their safety observations and improvement ideas. The project team supplemented available data with field observations to fully document existing conditions in the study area.

Safety Assessment Schedule

The safety assessment process involved regular project team meetings, one community stakeholder event, and several site visits to the study area to document existing conditions and gather new data. The effort began in October 2017 with a project kick-off call that involved representatives from FHWA-EFLHD, NPS units including the George Washington Memorial Parkway, Glen Echo Park, and the National Capital Regional Office, and the consultant team. A schedule of key project activities is included below:

October 25, 2017 – Project Kickoff Call: Project team discusses project study area, project goals, and overall project schedule.

December 12, 2017 – Project Kickoff Meeting: Project team meets at Glen Echo Park to review collected data regarding the study area, discuss ongoing efforts and projects that impact the study, and gather feedback from FHWA-EFLHD and NPS staff.

December 12, 2017 – Community Stakeholder Event: Project team hosts community members and advocacy group representatives so that they can learn about the project and can offer feedback in terms of observations and suggested safety improvements for the study area.

December 12-14, 2017 – Safety Field Review: Project team conducts a detailed safety review of the study area, documenting existing conditions and traffic observations.

January 30, 2018 – Initial Presentation of Recommendations: Project team presents initial safety recommendations to NPS and FHWA-EFLHD staff for their consideration.

March 2, 2018 – Stakeholder Review of Draft Recommendations: Following the incorporation of comments, the project team reviews formal draft safety recommendations with NPS and FHWA-EFLHD staff (including major reconfiguration options along Clara Barton Parkway).

March 9, 2018 – Montgomery County Review of Draft Recommendations: The project team reviews formal draft safety recommendations with Montgomery County Department of Transportation (MCDOT) staff to gather staff input about proposed safety improvements along MacArthur Boulevard.

May 2018 – Draft Safety Assessment Submitted: Project team submits draft safety assessment for internal review and public comment.

April 2019 – Final Safety Assessment Submitted: Project team submits final safety assessment to NPS and FHWA-EFLHD for acceptance.

Project and Community Stakeholders

Project Team

The Glen Echo Park Traffic and Pedestrian Safety Context Sensitive Solutions Assessment reflects a collaborative effort between representatives from NPS, FHWA-EFLHD, and the consultant team. The following people represented the agencies listed above in one or more instances over the course of the project:

Agency	Project Team Members
NPS – Glen Echo Park	• Brent O'Neill • Aaron Larocca
NPS – George Washington Memorial Parkway	• Jason Newman • Joshua Nadas • Maclean Eke • Tony Migliaccio • Simone Monteleone
NPS – National Capital Region	• Makayah Royal
NPS – United States Park Police	• John Dillon
FHWA-EFLHD	• Usman Ali • Isbel Ramos-Reyes
Kimley-Horn (Project Consultant)	• Kathy Falk • Tom Fowler • Danielle McCray • Dan Malsom

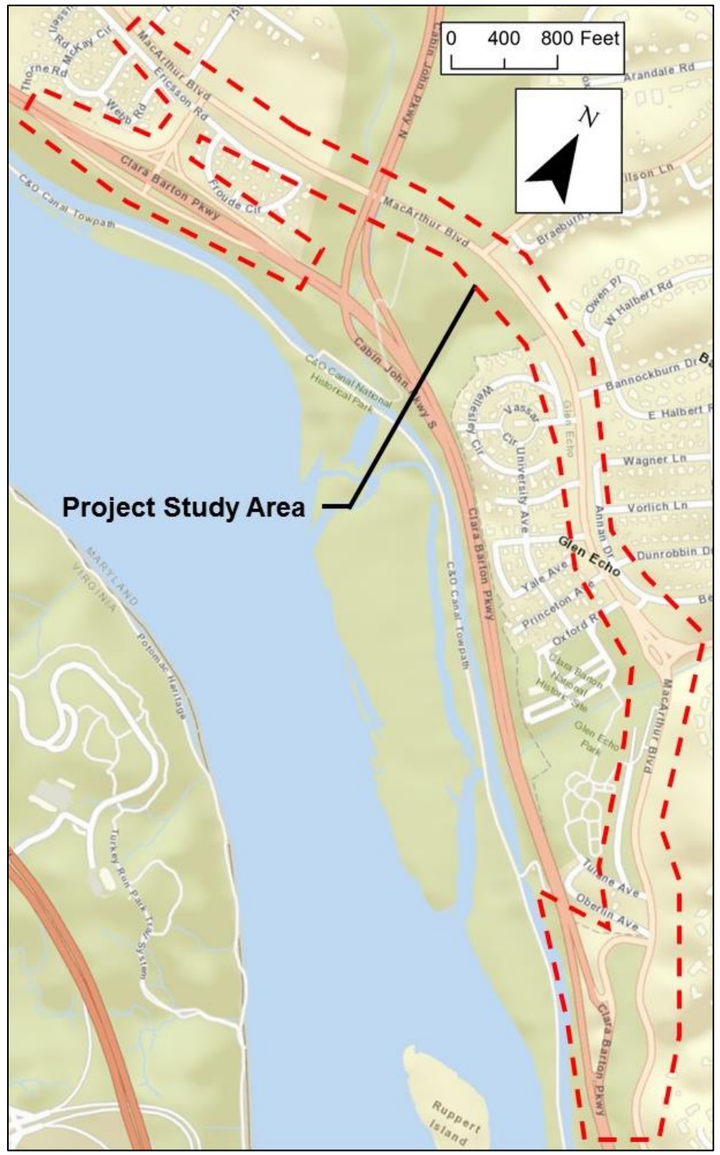
Community Stakeholders

At the December 12, 2017 community stakeholder event, several community members provided feedback regarding their observations of transportation conditions in and around the study area and their suggestions for related improvements. The following either participated in the event or provided input following the completion of the event:

Agency	Participated in Event
Joint Intelligence Community Campus –Bethesda Traffic Committee	Event Participant
Washington Area Bicyclist Association	Event Participant
Town of Glen Echo	Event Participant
Montgomery County Department of Transportation (MCDOT)	Provided Feedback After Event
The Irish Inn at Glen Echo	Event Participant
Glen Echo Park Partnership	Event Participant
Cabin John Citizens Association	Event Participant

In addition to the participating agencies listed above, the project team also invited representatives from the Brookmont Community Association, Montgomery Bicycle Advocates, Montgomery County Pedestrian Bicycle Traffic Safety Advisory Council, Maryland State Highway Administration District 3, and the Maryland District 8 Congressional Office.

Existing Conditions



Project study area

Site and Roadway Characteristics

MacArthur Boulevard and Clara Barton Parkway parallel each other along the north bank of the Potomac River in Montgomery County, Maryland. West from the District of Columbia, the roads pass through the communities of Brookmont, Glen Echo, Cabin John, and Carderock. Clara Barton Parkway ends in Carderock at MacArthur Boulevard, which continues farther west. This study analyzes the portions of MacArthur Boulevard and Clara Barton Parkway and associated access ramps near Glen Echo Park. A map of the project study area is included to the left.

MacArthur Boulevard is operated and maintained by Montgomery County, which classifies the road as an arterial. In the study area, MacArthur Boulevard is a two-lane road with one travel lane in each direction and narrow paved shoulders. The posted speed limit is 30 mph. A two-way shared-use path runs along the south side of the road. Near the west end of the study area, MacArthur Boulevard crosses Cabin John Parkway via the one-lane Cabin John Bridge, a historic structure completed in 1864. Currently, the only traffic signal along MacArthur Boulevard in the study area is at the one-lane bridge approaches, but the county plans to install a signal at the intersection of MacArthur Boulevard with Oberlin Avenue and the Glen Echo Access Ramp. The Washington Aqueduct, maintained by the Army Corps of Engineers, is buried beneath the road within the project area limits. The nature of the aqueduct requires that MacArthur Boulevard is weight-restricted and that any construction along the road be completed in close coordination with the Army Corps.

One-lane bridge and pedestrian path at Cabin John Aqueduct

Clara Barton Parkway is operated and maintained by the NPS. The road is classified as a parkway. Within the study area, Clara Barton Parkway is a divided four-lane limited-access freeway with a posted speed limit of 50 mph. The road does not have shoulders, and between the Cabin John Parkway and Glen Echo Access Ramp, the westbound travel lanes of Clara Barton Parkway are cantilevered over the eastbound travel lanes. Immediately to the southeast of the study area, Clara Barton Parkway becomes a two-lane undivided road that operates only in one direction during weekday peak travel periods. On weekday mornings from 6:15 am to 10:00 am, only eastbound traffic is permitted. On weekday afternoons from 2:45 pm to 7:15 pm, only westbound traffic is permitted, while all eastbound traffic is forced to make a U-turn at the Glen Echo Access Ramp. No commercial vehicles are permitted on the Clara Barton Parkway.

This study examines two points of access between MacArthur Boulevard and Clara Barton Parkway, in addition to the roads themselves. The first is the Cabin John Access Road. A full diamond interchange between Clara Barton Parkway and the Cabin John Access Road allows vehicles traveling in any direction on either road to enter and exit. The Cabin John Access Road intersects with Ericsson Road, a residential street maintained by the Cabin John Citizens' Association, and ends at an all-way stop-controlled intersection with MacArthur Boulevard approximately 90 feet further north.

Cabin John eastbound on-ramp to Clara Barton Parkway

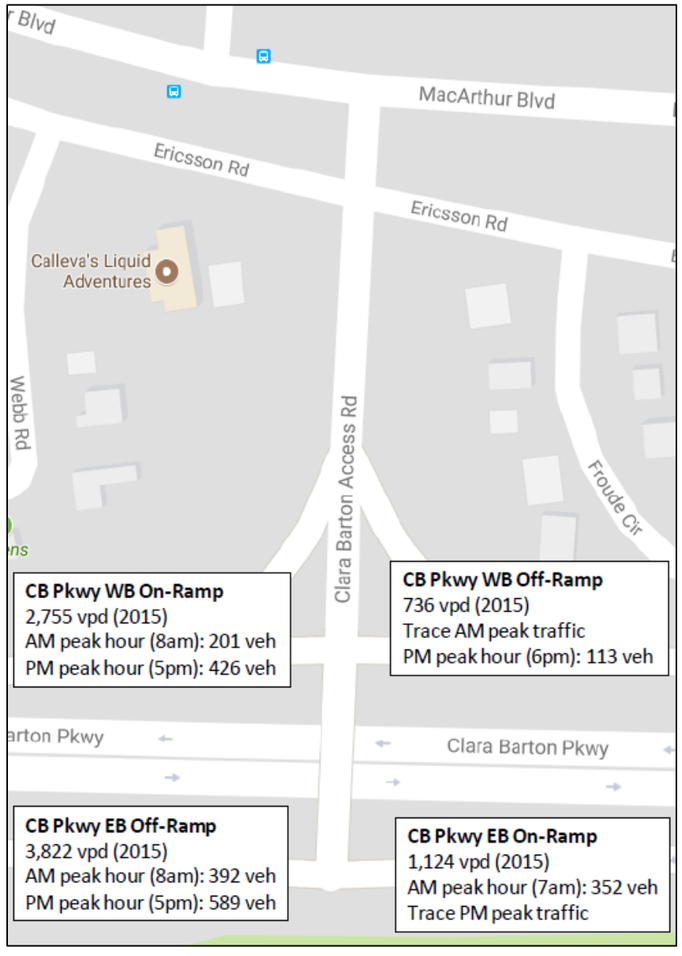
Southeast of the Cabin John Access Road, the Glen Echo Access Ramp provides partial access between Clara Barton Parkway and MacArthur Boulevard. The Glen Echo Access Ramp only directly accommodates westbound entering and exiting parkway traffic. Eastbound parkway traffic can exit to MacArthur Boulevard via an existing U-turn lane onto the westbound Clara Barton Parkway lanes. No entrance onto eastbound Clara Barton Parkway is currently possible via the Glen Echo Access Ramp. The Glen Echo Access Ramp currently ends at an all-way stop-controlled intersection with MacArthur Boulevard and Oberlin Avenue.

Westbound parkway on-ramp and off-ramp near Glen Echo

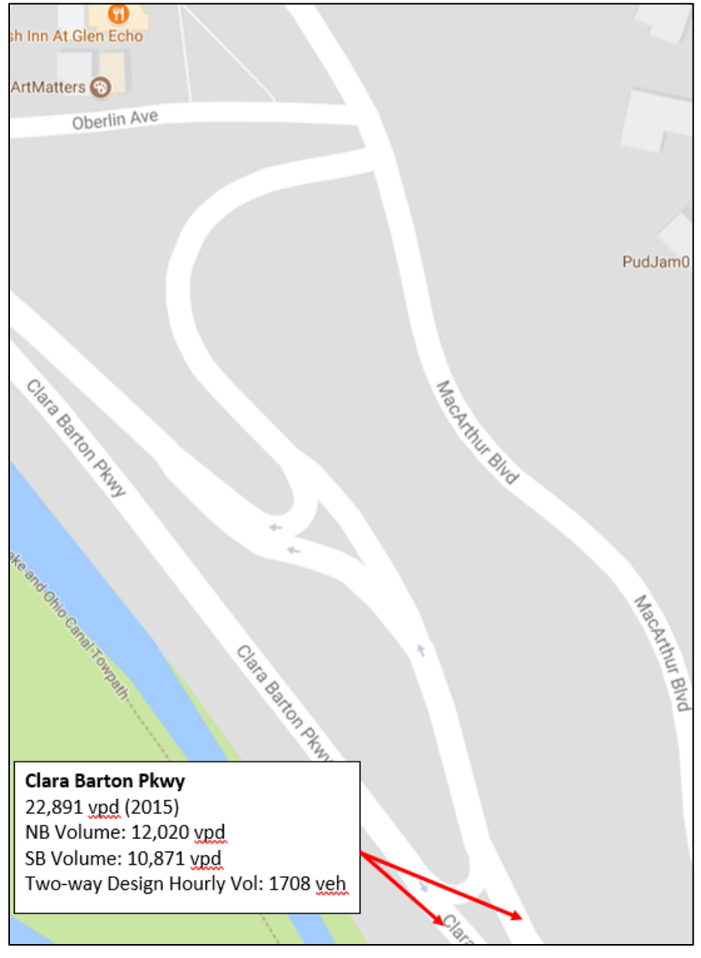
Glen Echo Park is accessible from several points along MacArthur Boulevard. A large parking lot for the park is accessible via Oxford Road. Other permit parking spaces are accessible via several driveways along MacArthur Boulevard and Tulane Avenue west of Goldsboro Road. Nearly all land within the study area (including Glen Echo Park) is zoned according to Montgomery County's R-60 zoning designation, which is reserved for single-family detached housing and recreational land. Small parcels along MacArthur Boulevard are also zoned for office or retail land uses.

Traffic Characteristics

NPS collected traffic volumes at the two Clara Barton Parkway access points within the study area. The most recent counts available at the time of report preparation were from 2015. These volumes are shown in the figures below. No traffic volume data was available for MacArthur Boulevard within the project study area.



Traffic volume information near the Cabin John Access Road



Traffic volume information near the Glen Echo Access Ramp

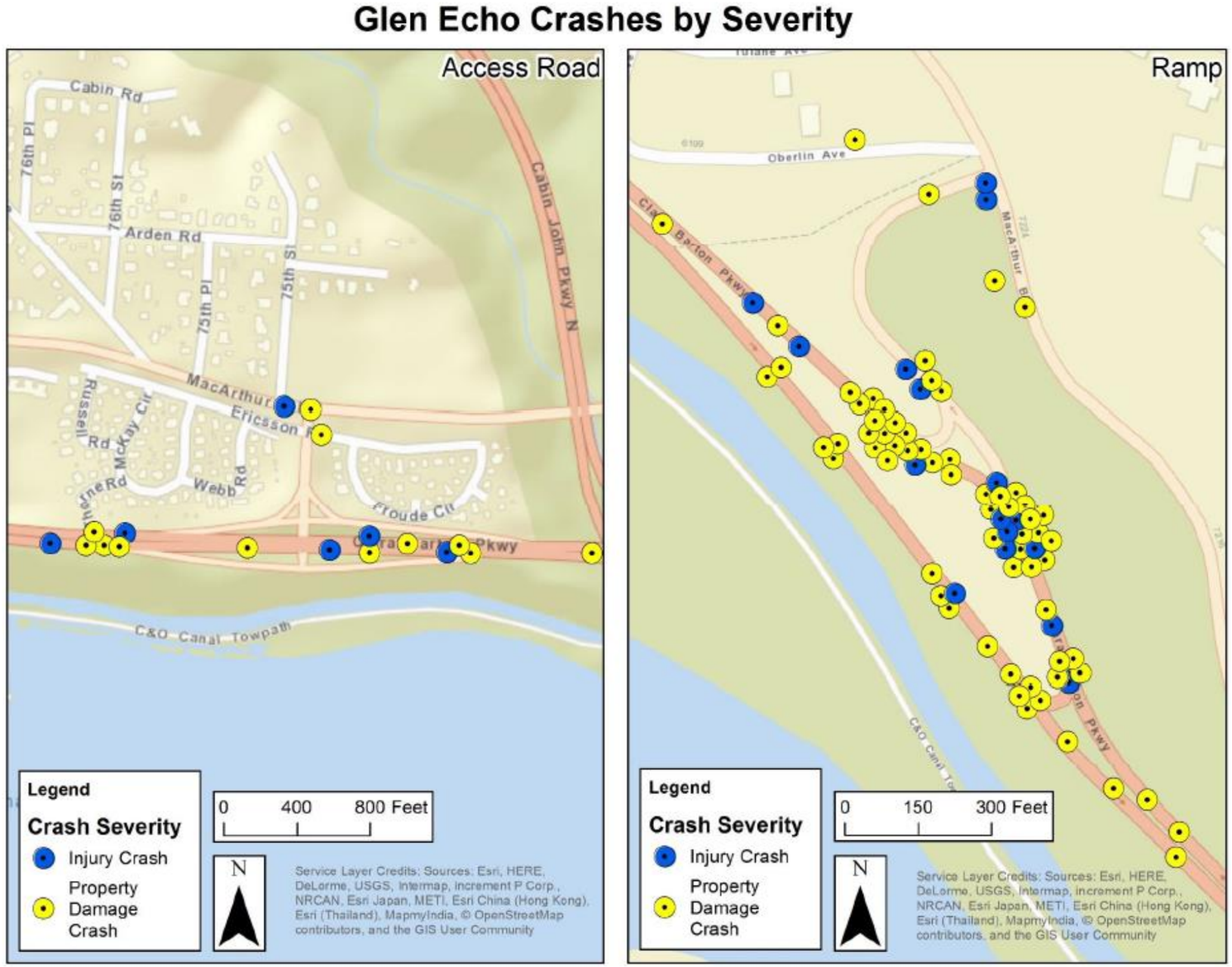
Crash Data Analysis

For the Glen Echo crash data analysis, NPS provided crash records for all reported crashes occurring on Clara Barton Parkway near the Clara Barton Parkway Ramps, and for the Cabin John Access Road from 2005 to 2017. The Montgomery County Department of Transportation (MCDOT) provided crash records for all reported crashes occurring on MacArthur Boulevard near the two parkway access locations, however the MCDOT data was only available from 2016 to 2017.

Overall, the largest number of crashes along Clara Barton Parkway within the study area occurred near the Glen Echo Access Ramp. Crashes occurred there most frequently in three locations: the eastbound U-turn, the westbound weaving section and diverge point, and the westbound merge area. Near the Cabin John Access Road, all Clara Barton parkway crashes occurred in the main travel lanes. None occurred on the parkway ramps.

Crashes by Severity

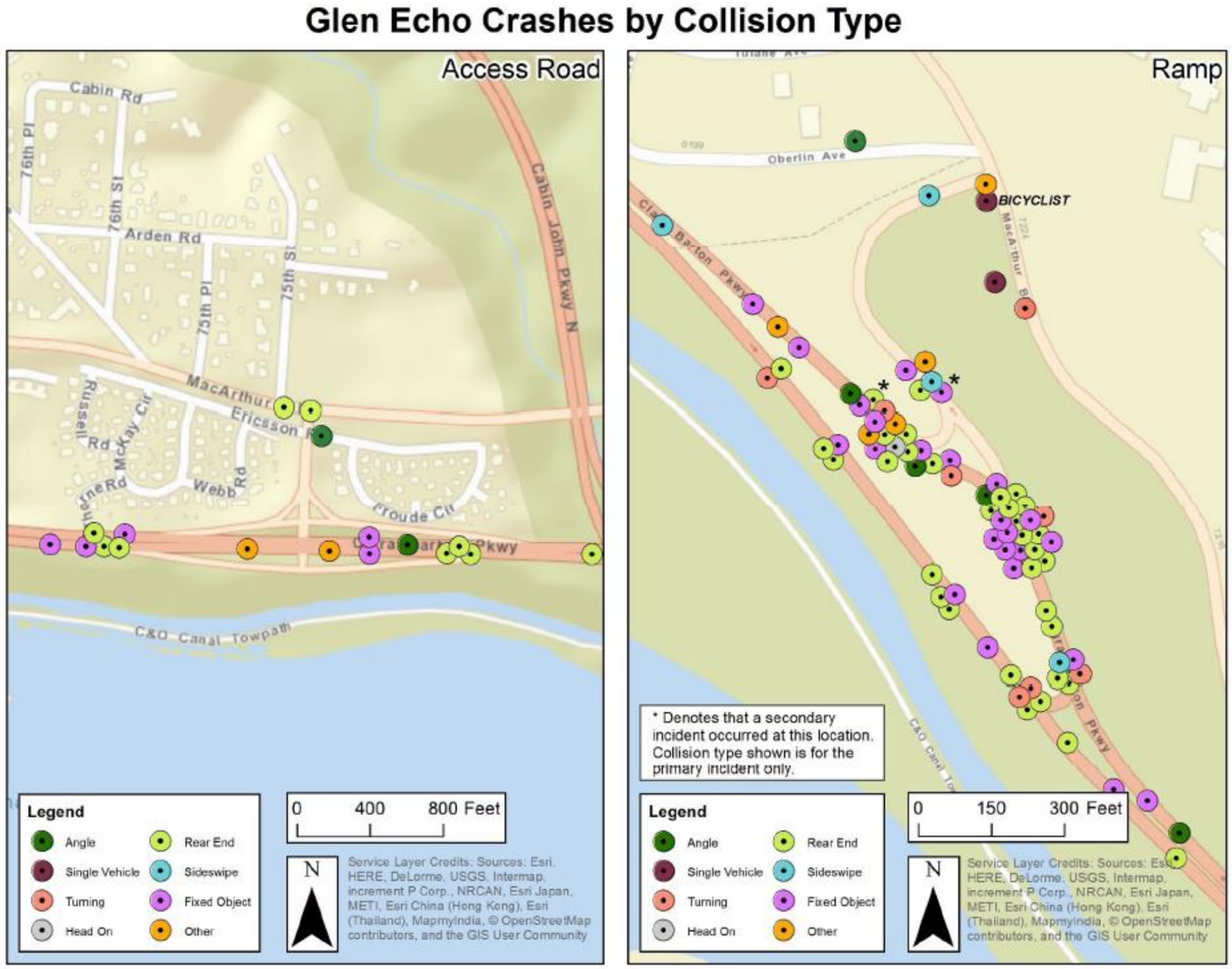
Events on the map at right could be classified as fatal crashes, injury crashes, or property damage only crashes. No fatal crashes were recorded near the Clara Barton Parkway Ramps within the study area. Of the recorded injury crashes, the highest number in one location occurred near the westbound diverge point along Clara Barton Parkway near the Glen Echo Access Ramp. Several injury crashes also occurred along MacArthur Boulevard at the intersections with Clara Barton Parkway access points.



Clara Barton Parkway and MacArthur Boulevard crashes by crash severity

Crashes by Collision Type

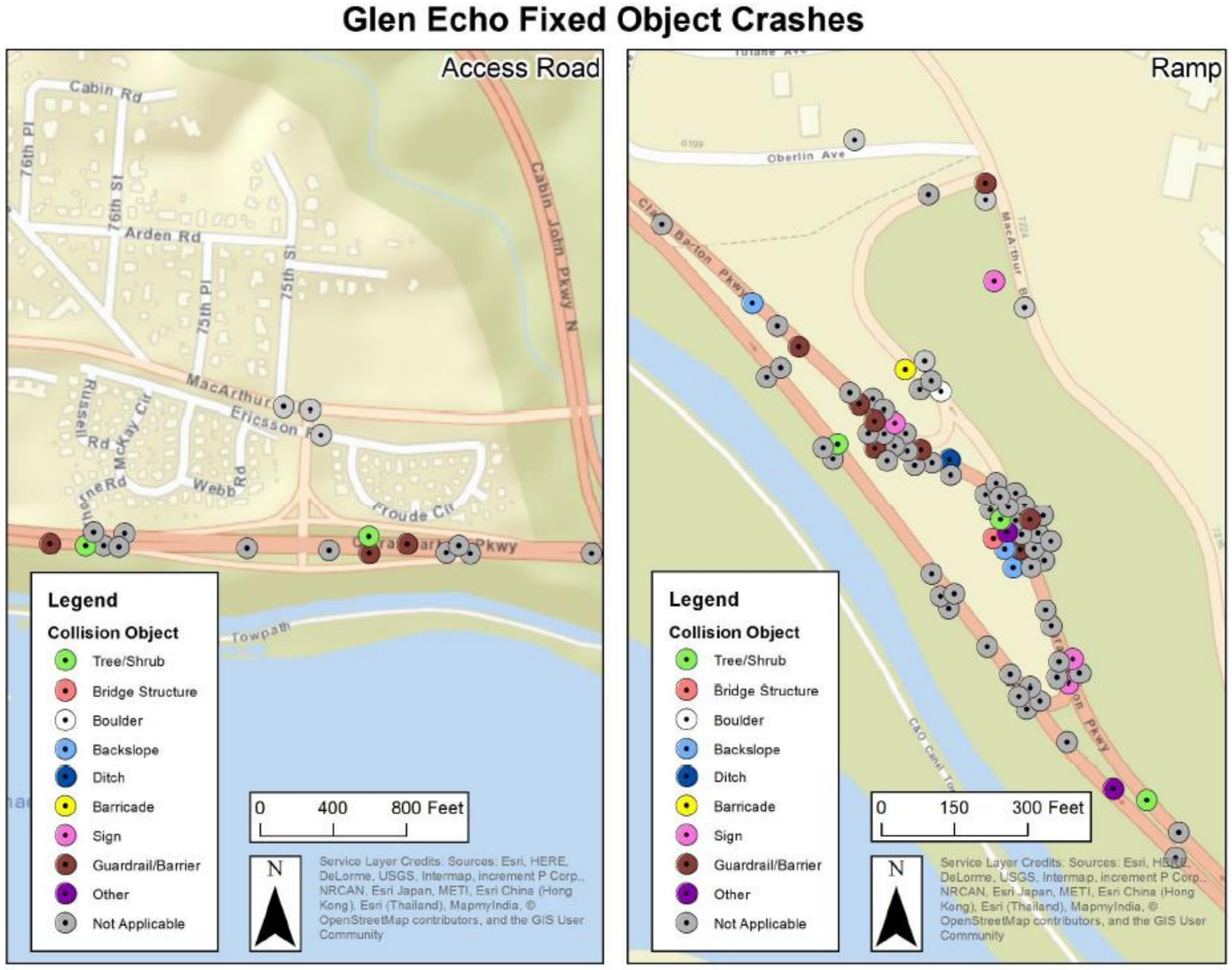
Near the Cabin John Access Road, rear end collisions were the most common collision type both along Clara Barton Parkway and along MacArthur Boulevard. Along Clara Barton Parkway near the Glen Echo Access Ramp, fixed object and rear end collision types were the most common in the westbound weave and diverge area, likely because of the short weaving length and the limited clear zone as the westbound lanes pass under the existing unused bridge. Along MacArthur Boulevard at the Glen Echo Access Ramp intersection, one of the reported single vehicle crashes involved a bicyclist.



Clara Barton Parkway and MacArthur Boulevard crashes by collision type

Fixed Object Crash Detail

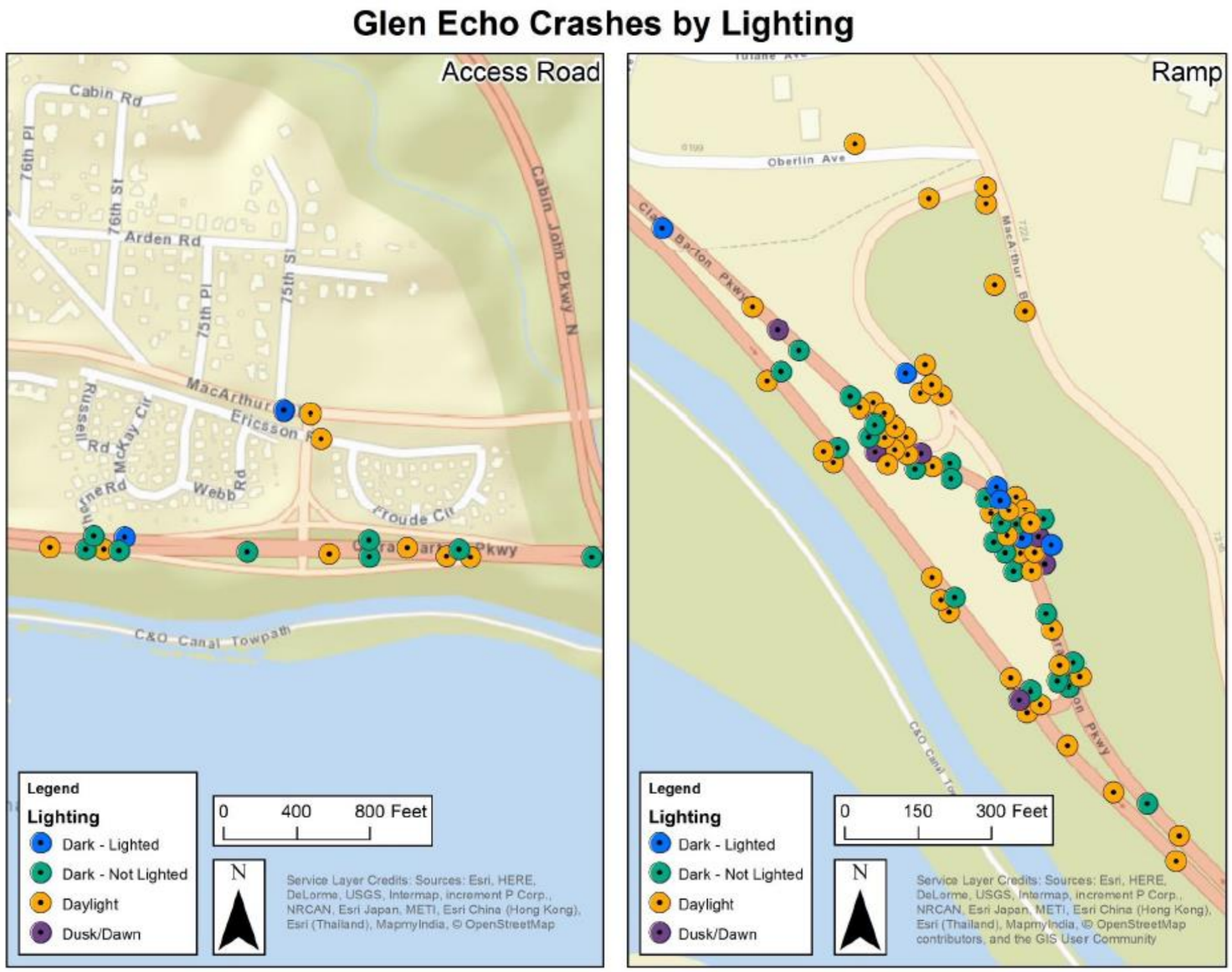
Depending on the data source, some of the crashes classified as 'Single Vehicle', 'Fixed Object', or 'Other' collision types included additional detail about the type of fixed object involved in the collision, if applicable. Collision objects are shown in the map at right. Grey icons denote that no fixed object was involved with the given crash. Guardrail and barriers were the most common fixed objects involved in reported crashes. Many of the Guardrail/Barrier crashes occurred at the westbound merge area on Clara Barton Parkway near the Glen Echo Access Ramp.



Clara Barton Parkway and MacArthur Boulevard crashes by collision object

Crashes by Lighting Condition

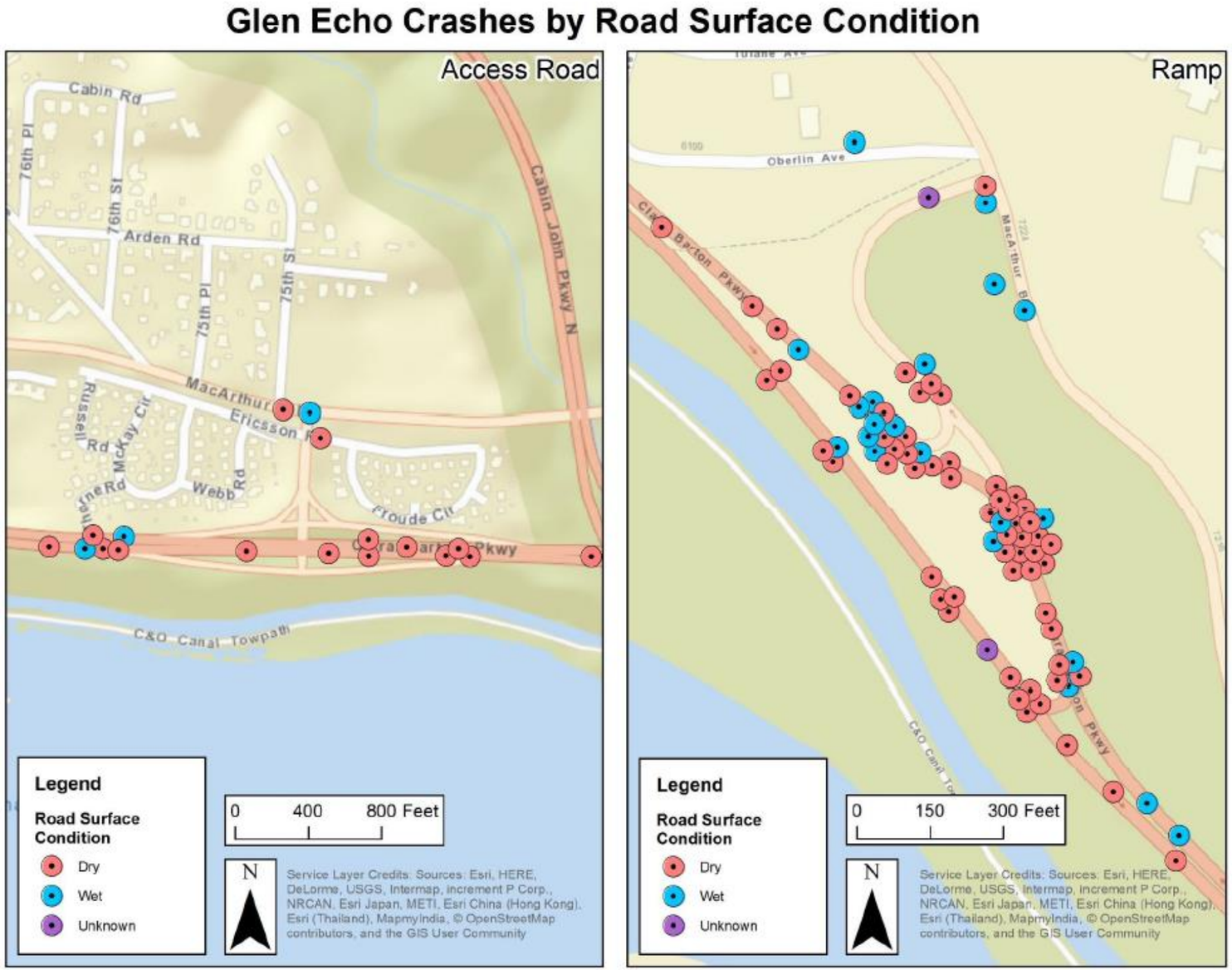
More than half of all reported crashes occurred in daylight, including all but one of the crashes reported on MacArthur Boulevard. While some of the crashes occurring at night along Clara Barton Parkway were classified as 'Dark – Lighted', no permanent road lighting exists along Clara Barton Parkway in the study area.



Clara Barton Parkway and MacArthur Boulevard crashes by collision object

Crashes by Road Surface Condition

Roughly three out of every four reported crashes in the study area occurred on a dry road surface. Two areas near the Glen Echo Access Ramp displayed a proportion of crashes on wet road surface clearly higher than the average for the study area. Along MacArthur Boulevard, three of the four reported crashes occurred on a wet road surface. In addition, most of the crashes that occurred immediately west of the westbound Clara Barton Parkway merge area were on a wet road surface.



Clara Barton Parkway and MacArthur Boulevard crashes by collision object

Past and Current Efforts

This study presents analysis and recommendations that build upon previous studies and ongoing or recently completed efforts near the park. Several of these studies and related efforts are described below.

2012 National Park Service Environmental Assessment/Assessment of Effect - MacArthur Boulevard Shared-Use Path at Glen Echo Park

NPS completed this report to quantify the impacts of a proposed relocation of 800 feet of the MacArthur Boulevard shared-use path from its former configuration along MacArthur Boulevard to a new alignment that makes use of NPS property, including adaptive reuse of an existing trolley bridge across Minnehaha Branch. This realignment project was completed following the 2012 study. When the project team reviewed conditions in the study area, the new shared-use path was open. The previous alignment along MacArthur Boulevard had also been maintained for use.

Realignment of MacArthur Boulevard shared-use path segment through Glen Echo Park

2017 Montgomery County Mobility Assessment Report

The MCDOT 2017 Mobility Assessment provides a summary of transportation mobility conditions in Montgomery County. The study looks at vehicle-based congestion metrics in completing corridor and intersection analysis, and it also considers the performance of other transportation modes such as bicycling and transit. While no roads in the study area are specifically noted in the plan, the region of the county containing the study area was found to have consistently decreasing average travel speeds from 2011-2015.

Planned FHWA Federal Lands Clara Barton Parkway Pavement Design Project

FWHA-EFLHD has prepared plans for the rehabilitation of pavement along Clara Barton Parkway, including main travel lanes and ramps at both access points in the project study area. Plans call for a full depth patch of pavement along the Cabin John Access Road south of the intersection with MacArthur Boulevard and for all the interchange ramps between the Cabin John Access Road and Clara Barton Parkway. On the Glen Echo Access Ramp, plans call for a full depth patch of all pavement from the eastbound U-turn, through the existing weave area, to the westbound merge area. The access ramp segment nearest MacArthur Boulevard would also receive a full depth pavement patch, and existing guardrail would be replaced. Work is planned to occur from 2019 to 2021.

Existing Clara Barton Parkway Glen Echo Access Ramp pavement condition

Existing Clara Barton Parkway - Cabin John interchange ramp pavement condition

Ongoing MacArthur Boulevard Bikeway Improvements

The MCDOT website and Montgomery County budget include funding for improvements to MacArthur Boulevard and the shared-use path along MacArthur Boulevard. The improvements would include widening the shared-use path to an eight-foot paved section with a five-foot grass buffer between the path and the roadway. MacArthur Boulevard itself would also be widened to a consistent 26-foot pavement width to provide shoulder space to on-road cyclists. Improvements have already been completed west of Oberlin Avenue. East of Oberlin Avenue, trail improvements would be ongoing through 2022.

Planned MCDOT Signal Installation at Glen Echo Access Ramp/MacArthur Boulevard/Oberlin Avenue

MCDOT has developed paving, striping, and signal design plans for the installation of a traffic signal at the existing stop-controlled intersection of MacArthur Boulevard with Oberlin Avenue and the Glen Echo Access Ramp. The paving plans include the widening of MacArthur Boulevard to include a northbound left turn bay onto the Glen Echo Access Road or Oberlin Avenue. The pavement widening will require the relocation of existing utility poles on the east side of the road. Pedestrian signal heads, push buttons, and countdown timers will be provided for users of the MacArthur Boulevard shared-use path on the west side of MacArthur Boulevard. As of April 2019, 90 percent plans had been completed.

Stakeholder Input

The project team presented an overview of the Glen Echo safety assessment at a kickoff stakeholder event held at the park on December 12, 2017. At this event, the project team asked attendees to share their observations of traffic conditions in the study area. Attendees were also encouraged to suggest potential safety improvements within the study area. Comments regarding the project from attendees at either of the events are summarized in meeting minutes provided in the report appendix.

Site Observations and Discussion

General Observations

Cabin John Access Road and Interchange

The Cabin John Access road runs from the eastbound Clara Barton Parkway interchange ramps north to MacArthur Boulevard. At the south end of the access road, four ramps are configured in a typical diamond interchange. The pavement on these ramps is generally in poor condition, with frequent potholes and pavement patches as well as some raveling of the curb. During the afternoon peak hour, the project team observed eastbound traffic exiting Clara Barton Parkway begin to queue from the stop-controlled intersection with Cabin John Access Road back toward the parkway main lanes.

North of the parkway ramps, the Cabin John Access Road intersects with Ericsson Road, a local street that provides access to residences in the Cabin John neighborhood. Brush growth at the intersection corners and a skip yellow centerline that moves diagonally through the intersection both can create uncertainty for vehicles moving through the intersection. During the afternoon peak, queues often extend from MacArthur Boulevard south beyond the Ericsson Road intersection, and residents have noted that queueing vehicles often block the Ericsson Road intersection and make it difficult for vehicles from Cabin John to exit the neighborhood. In some cases, vehicle queues propagate from the signalized eastbound approach to the Cabin John Bridge, along MacArthur Boulevard to the Cabin John Access Road intersection, and then both further along the eastbound MacArthur Boulevard and northbound Access Road approaches. In rare cases, momentary gridlock can form. Residents recounted occasionally walking out to the intersection to direct traffic in these instances.

Vehicle queue at stop-controlled eastbound parkway exit

Between the Ericsson Road intersection and the MacArthur Boulevard intersection, the Cabin John Access Road includes paved shoulders that are marked off by edge lines and flexible bollards placed at regular intervals. The width of the paved shoulder varies across the 90 feet between intersections, and both shoulders feature a single yellow paint stripe that acts as a centerline for pedestrians or cyclists that may use the shoulders as a path. These shoulder areas connect with the existing MacArthur Boulevard shared-use path to the north, but do not connect with any off-street pedestrian or bicycle infrastructure along Ericsson Road. During its field review, the project team observed pedestrians crossing Cabin John Access Road at Ericsson Road, walking between queued cars, instead of using the shoulder paths and the crosswalk provided at the MacArthur Boulevard intersection.

Glen Echo Access Ramp and Interchange

The Glen Echo Access Ramp connects the westbound Clara Barton Parkway with MacArthur Boulevard immediately to the southeast of Glen Echo Park. The ramp is generally characterized by faded striping and poor pavement conditions, with potholes and pavement patching most common near the MacArthur Boulevard intersection. Guardrail and chevron signs posted along the outside of the ramp curves also show evidence of damage either from vehicle scrapes or other weathering.

The Clara Barton Parkway interchange at Glen Echo exhibits similar signs of wear. Pavement has begun to crack and ravel in places, especially on the inside edges of sharp curves. Some signs have been damaged, and others are improperly placed either too close to decision points or too far away from the road to be easily perceived. To allow for contraflow operations closer to the District of Columbia, the United States Park Police use flip board signs and manually block eastbound travel lanes and channel traffic to U-turn onto the westbound lanes using wooden barricades with regulatory signs and chevrons fastened to them. While the project team did not observe vehicles passing around barricades while the road was closed, the project team did observe barricades that were not fully removed from traveled way when the eastbound through lane was open.

When not in use, through lane barricade was moved to side of the lane and leaned against another barricade

In the westbound direction on Clara Barton Parkway, through vehicles must weave with eastbound U-turning vehicles within a 300-foot weaving segment where virtually all U-turn vehicles must change lanes in order to exit to MacArthur Boulevard, and the majority of outbound through vehicles must change lanes in the opposing manner to continue west on the parkway towards Cabin John and Interstate 495. This weaving motion, combined with a lack of gaps in traffic flow during the afternoon peak, leads to the queuing of eastbound U-turning vehicles along the parkway on a daily basis. Furthermore, the presence of the bridge overpass roughly halfway along the westbound weaving area limits sight of the diverge point where vehicles must either exit to the right to MacArthur Boulevard, or to the left to continue on the parkway. The project team observed several instances of vehicles that mistakenly took the exit lane and then made a U-turn onto the westbound entrance lanes once the two lanes converged at the Glen Echo Access Ramp. Traffic entering westbound onto MacArthur Boulevard must navigate a sharp curve and then quickly accelerate to match the speeds of westbound through traffic in the adjacent lane.

MacArthur Boulevard

MacArthur Boulevard typical cross-section

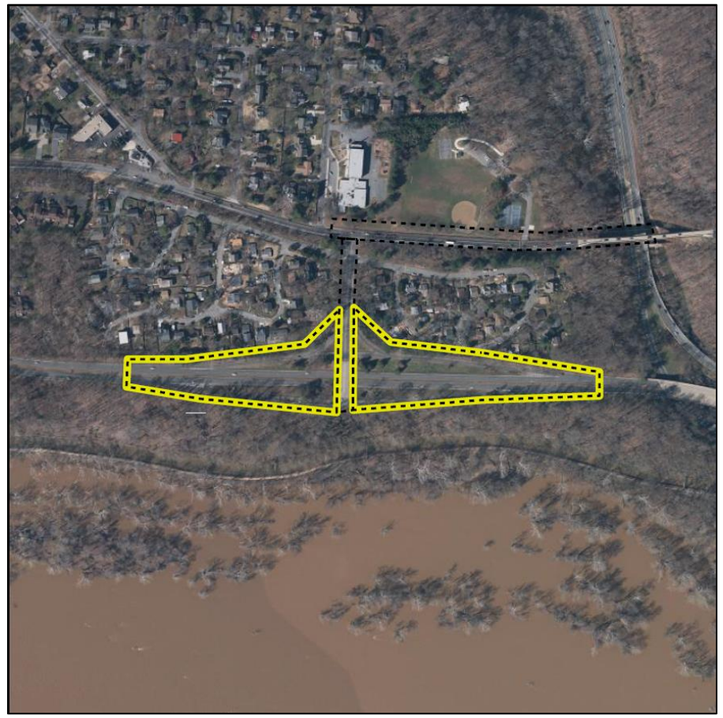
Within the study area, MacArthur Boulevard contains directional signage guiding vehicles to Clara Barton Parkway, Glen Echo Park, Clara Barton National Historical Site (which was closed for renovations at the time of the field review), and associated parking areas. Much of this directional signage is cluttered among other posted signs or is posted on the left side of the road in the direction of travel, where drivers are not expecting to look for guidance. In two locations along the road, existing guardrail segments feature ‘Texas Twist’ style end treatments which do not meet federal standards.

During both morning and afternoon peak hours, long queues form along MacArthur Boulevard at the stop-controlled approaches to both the Glen Echo Access Ramp intersection and the Cabin John Access Road intersection. One of the key bottlenecks within the study area, in addition to the two study intersections, is the Cabin John Bridge. The bridge contains one lane and is signalized to allow only one direction of travel to cross at a time. In rare cases, westbound vehicle queues can block the bridge and block traffic attempting to move in the opposing direction. No extra road or shoulder space is provided west of the bridge for vehicles to clear the bridge exit if queues from the Access Road extend east to the bridge.

The MacArthur Boulevard shared-use path runs along the southwest side of MacArthur Boulevard throughout the study area. Ladder-style crosswalks are provided at the two study intersections, and crosswalks are also provided at some of the smaller residential street intersections near Glen Echo Park. The existing crosswalk length at the Glen Echo Access Ramp and Oberlin Avenue intersection is approximately 100 feet. Once this intersection is signalized as planned, the signal timing will need to provide at least 35 seconds of crossing time for shared-use path users unless refuge space is provided between the two intersection approaches.

Site 1 Potential Improvements – Cabin John Access Road Ramps

Site Map



Site Description

Four ramps (two eastbound and two westbound) provide access between the Clara Barton Parkway and Cabin John Access Road. According to community members, use of these ramps often increases when ramps along the parkway southeast of Glen Echo Park become congested, especially during the afternoon. The eastbound exit ramp is stop-controlled, while the westbound exit ramp branches into a yield-controlled channelized right for northbound traffic and a STOP-controlled ramp for through or U-Turn traffic.

Site Observations

Off-Ramp Queueing

Especially during the afternoon, traffic exiting Clara Barton Parkway begins to queue back from MacArthur Boulevard. Project team members participating in the site review observed that at times, this queue extends onto the eastbound off-ramp. The team never observed that the queue extended far enough that it impacted traffic flow on Clara Barton Parkway, but such a situation might be possible if traffic in the area worsens.

Poor Ramp Pavement Quality

Pavement on the ramps in this location shows evidence of rutting, alligator cracking, and raveling. Previous pavement patching attempts are evident, and pavement quality appears to be the worst along the eastbound ramps. On the eastbound parkway ramps, the left-hand curb also has disintegrated in places.

Limited Wrong-Way Driver Warning

While regulatory one-way arrow signs are posted at eastbound and westbound ramp intersection locations along the Cabin John Access Road, no Wrong Way signage is used along any of the ramps.

Cabin John Access Road at Clara Barton Parkway

Poor pavement quality at parkway ramps to Cabin John Access Road

Posted One Way signage north of bridge over parkway

Potential Improvement Options

1A – Resurface Ramps (Planned)

Resurface ramps between Clara Barton Parkway and Cabin John Access Road as a part of the planned FHWA-EFLHD pavement improvements

Partner Agencies: NPS

Opinion of Probable Cost: N/A (Planned)

Detailed Description of Improvements:

- Mill and overlay pavement on Cabin John Access Road ramps.
- Reconstruct concrete curb segments along ramps in locations where the existing curb has begun to disintegrate.

Pavement rutting on parkway entrance ramp

1B – Install Wrong Way Signs

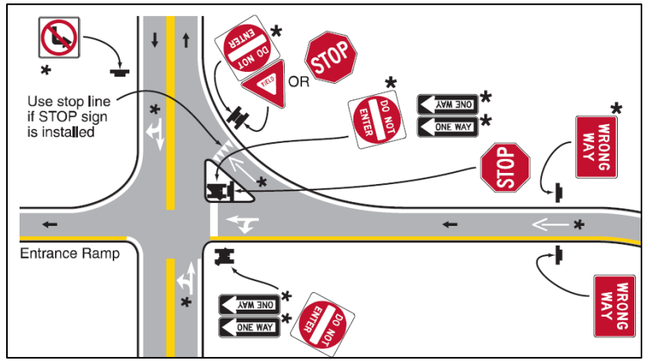
Install signage along Cabin John Access Road ramps to deter wrong-way drivers.

Partner Agencies: NPS

Opinion of Probable Cost: $2,800

Detailed Description of Improvements:

- Install Do Not Enter (MUTCD R5-1) and Wrong Way signs (MUTCD R5-1a) facing toward the Cabin John Access Road on both sides of the eastbound parkway exit ramp and the westbound parkway exit ramp.



MUTCD guidance diagram for Wrong Way and Do Not Enter sign placement

General guide to sign placement on parkway ramps

Site 2 Potential Improvements – Cabin John Access Road

Site Map

Site Description

The Cabin John Access Road connects the Clara Barton Parkway to both MacArthur Boulevard and the Cabin John neighborhood located between the two parallel routes. From the south, the access road crosses the parkway via a concrete bridge and continues north to an intersection with Ericsson Road, which provides access to Cabin John residences. This intersection is a two-way stop-controlled intersection, with stop signs posted at the Ericsson Road approaches. Cabin John residents complained that queued vehicles often block the intersection, making it difficult for vehicles turning onto the access road from Ericsson Road. About 90 feet north of the Ericsson Road intersection, Cabin John Access Road ends at an all-way stop-controlled intersection with MacArthur Boulevard.

Site Observations

Faded Centerline Striping

The yellow centerline striping along Cabin John Access Road is faded across the parkway bridge and elsewhere south of the Ericsson Road intersection.

Queueing from MacArthur Boulevard

Especially during the afternoon, traffic exiting Clara Barton Parkway begins to queue back from MacArthur Boulevard. While the approach to MacArthur Boulevard north of Ericsson Road is striped to include two lanes, traffic often queues to a point south of Ericsson Road where access to the second lane becomes blocked. Queues at times will “Block the Box” at the intersection of Cabin John Access Road and Ericsson Road.

Brush Growth Limits Sight Distance

Roadside brush growing at the corners of the Cabin John Access Road and Ericsson Road intersection limits sight distance for vehicles trying to turn onto the access road.

Nonstandard Use of Road Shoulder

The Cabin John Access Road shoulders between MacArthur Boulevard and Ericsson Road have widths that vary from 4 to 6 feet. These shoulders have been painted with a yellow center stripe parallel to the white edge line, likely to imitate typical striping for a shared-use path. Plastic flexible bollards had been installed to the outside of these edge lines for the consideration of a resident who uses a scooter to travel the access road shoulder between the residential area and the shared-use path along MacArthur Boulevard.

Cabin John Access Road
From Clara Barton Parkway to MacArthur Boulevard

Ericsson Road intersection box and centerline skip striping

Brush growth at corners of Ericsson Road intersection

Potential Improvement Options

2A – Brush Intersection Corners

Brush intersection corners at the intersection of Ericsson Road and Cabin John Access Road to improve sight distance.

Partner Agencies: NPS, Cabin John

Opinion of Probable Cost: $500

Detailed Description of Improvements:

- Remove brush that is growing on the southeast and southwest corners of the intersection of the Cabin John Access Road and Ericsson Road so that the westbound parkway exit ramp is visible from the stop bars at both Ericsson Road intersection approaches.

Intersection sight distance limited by brush growth

2B – Restripe Cabin John Access Road

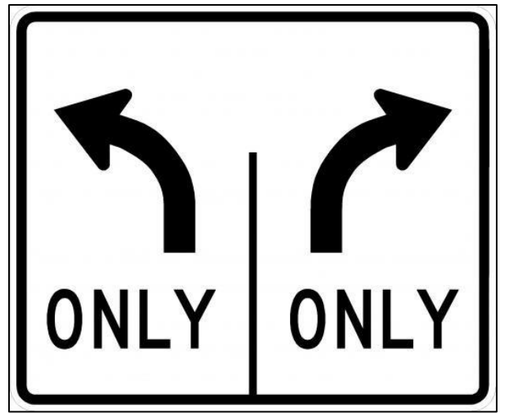
Complete comprehensive restriping and signing improvements along the Cabin John Access Road to increase capacity in the northbound direction.

Partner Agencies: NPS

Opinion of Probable Cost: $9,000

Detailed Description of Improvements:

- Remove existing faded yellow median striping along the Cabin John Access Road south of Ericsson Road (including striping on bridge).
- Remove existing yellow skip striping through the Cabin John Access Road and Ericsson Road intersection.
- Stripe Cabin John Access Road according to the following specifications:
  - Restripe the 4-foot median across parkway bridge in same location as before, allowing for one 16-foot lane in each travel direction.
  - North of the bridge, stripe a double yellow centerline that begins aligned with the western edge of the striped median on the bridge and tapers to allow for two 11-foot northbound lanes and one 11-foot southbound lane.
  - Skip stripe the yellow centerlines and white lane line through the Ericsson Road intersection.
  - Extend the existing white lane line south of the Cabin John Access Road and Ericsson Road intersection so that it begins at the end of the new centerline taper.
  - Post regulatory lane assignment signs (MUTCD R3-8 series) ahead of the MacArthur Boulevard intersection.



MUTCD R3-8 sample lane assignment signage

Queueing along Cabin John Access Road at the Ericsson Road intersection

2C – Widen Shoulders to Accommodate Pedestrians and Cyclists

Modify the existing road shoulders between Ericsson Road and MacArthur Boulevard to make the space more usable for pedestrians and cyclists.

Partner Agencies: NPS, Cabin John, Montgomery County

Opinion of Probable Cost: $8,600

Detailed Description of Improvements:

- Widen both Cabin John Access road shoulders between MacArthur Boulevard and Ericsson Road by 4 feet each.
- Remove existing yellow centerline stripe and restripe at new center of shoulder.
- Relocate existing road signage impacted by shoulder widening.
- Add directional signage and path intersection warning signage (MUTCD W2-2) along MacArthur Boulevard shared-use path ahead of Cabin John Access Road shoulders.

Existing end of shared-use path striping in road shoulder

2D – Construct Trail Access Path East of Cabin John Access Road

Construct a new access path from the MacArthur Boulevard shared-use path to Ericsson Road to remove pedestrian and cyclist traffic from the road shoulder entirely.

Partner Agencies: NPS, Cabin John, Montgomery County, Army Corps of Engineers

Opinion of Probable Cost: $15,300

Detailed Description of Improvements:

- Remove flexible bollards and yellow line striping in shoulders along Cabin John Access Road between MacArthur Boulevard and Ericsson Road.
- Remove existing pavement outside of white edge lines (and extend shared-use path approaches) to reduce required crossing distance for shared-use path users.
- Construct one new shared-use path spur connecting the MacArthur Boulevard shared-use path to Ericsson Road to the east of the Cabin John Access Road. This spur should be set back by at least 30 feet from the Cabin John Access Road edge of pavement.
- Install stop signs along the new shared-use path spur at its intersection with Ericsson Road and the existing MacArthur Boulevard shared-use path.

Existing transition from shared-use path to road shoulder and crosswalk

Existing sidewalk connection to Ericsson Road

Graphic overview of potential improvement options along Cabin John Access Road

Site 3 Potential Improvements – MacArthur Boulevard near Cabin John Access Road

MacArthur Boulevard from Cabin John Access Road to Cabin John Parkway

Site Map

Site Description

The Cabin John Access Road ends at MacArthur Boulevard. The northbound approach to this intersection is striped to include one left turn only lane and one right turn only lane. Both MacArthur Boulevard approaches to the intersection contain one lane. The MacArthur Boulevard shared-use path crosses the northbound approach to the intersection, while a second crosswalk at the eastbound approach provides access from the shared-use path to a nearby day school and neighborhood to the north. Queues form in all directions at this intersection during the PM peak hour, and if queues are severe enough, operations at the ramps to the Clara Barton Parkway and operations at the MacArthur Boulevard signalized one-lane bridge east of the intersection may both be impacted.

Site Observations

Queueing and Box Blocking

At times, queueing at the one-lane bridge along MacArthur Boulevard spills back through the Cabin John Access Road intersection. The project team observed that eastbound vehicles would stop in the intersection, making it difficult or impossible for other turning vehicles to complete their movements. As a result of this, new queues would form and propagate at the other intersection approaches.

One-Lane Bridge Congestion

When queues extend back to the one-lane bridge from the westbound approach to the MacArthur Boulevard intersection, it is possible that these queues will occasionally fail to clear the one-lane bridge, thereby blocking the eastbound movement across the bridge. Residents described having to direct traffic at the MacArthur Boulevard and Cabin John Access Road intersection when conditions like these would arise.

MacArthur Boulevard eastbound approach to Cabin John Access Road

Existing signal and loop detectors at MacArthur Boulevard one-lane bridge

Potential Improvement Options

3A – Construct Bridge Pullout for Use by Queued Vehicles

Add a pullout west of the single lane Cabin John Bridge to provide extra space for queueing vehicles and reduce the tendency for queues to block the bridge.

Partner Agencies: Montgomery County, Army Corps of Engineers

Opinion of Probable Cost: $53,500

Detailed Description of Improvements:

- Construct a pullout area at least 8 feet in width and 40 feet in length immediately west of the one-lane bridge along the north side of MacArthur Boulevard. Replace guardrail so that it continues along the outside of pavement through the length of the pullout. A pullout will allow for one or two vehicles that queue back onto the one lane bridge to keep the bridge clear.

- Add signage in the westbound travel direction near the bridge exit that advises vehicles to use pullout if they are blocking the bridge.

North side shoulder and ditch at eastbound bridge approach

3B – Add Queue Detection Along MacArthur Boulevard

Install queue detection to improve signal operations and reduce the likelihood of queues blocking the one-lane Cabin John Bridge.

Partner Agencies: Montgomery County, Army Corps of Engineers

Opinion of Probable Cost: $86,600

Detailed Description of Improvements:

- Install queue detection equipment at the westbound exit from the one-lane bridge, between the bridge and the Cabin John Access Road.

- Queue detection equipment should alert the one-lane bridge signal when queues threaten to impact bridge operations. The westbound signal will not provide a green if traffic on the westbound exit has not cleared.

Vehicles entering one-lane bridge across Cabin John Parkway

Improvement Options Deemed Infeasible

"Don't Block the Box" Signing and Striping

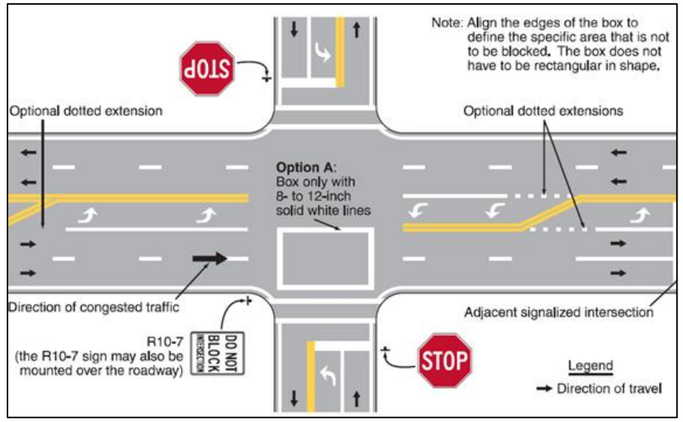
Install signing and striping to deter queueing through the MacArthur Boulevard and Cabin John Access Road intersection in the eastbound direction.

Detailed Description of Improvements:

- Add "Don't Block the Box" styled striping to the inside of the intersection of MacArthur Boulevard and Cabin John Access Road.

- Post a regulatory Do Not Block Intersection sign (MUTCD R10-7) at the eastbound approach to the intersection.

This option was not considered because MCDOT noted that MacArthur Boulevard was classified as an arterial roadway, and currently no arterial roadways in the county use this type of striping. MCDOT noted that this treatment is often ignored by drivers, and installing it here could set a precedent for installation on many similar arterial intersections.



MUTCD guidance for "Don't Block the Box" signing and striping

Site 4 Potential Improvements – MacArthur Boulevard at Glen Echo Access Ramp

Site Map

Site Description

Southeast of Glen Echo Park, ramps providing access to the Clara Barton Parkway intersect with MacArthur Boulevard. A fourth approach at Oberlin Avenue intersects with MacArthur Boulevard immediately north of the ramps. While the existing intersection operates with stop control at all four approaches, Montgomery County plans to install a traffic signal at this location. The county also plans to add a northbound left turn lane along MacArthur Boulevard. The MacArthur Boulevard shared-use path crosses both the Oberlin Avenue and Glen Echo Access Ramp approaches at this intersection.

Site Observations

Challenging Intersection Operations

The approaches from the Glen Echo Access Ramps and Oberlin Avenue are adjacent to one another, and the two road centerlines are separated by 50 feet. The existing all-way stop-control in such a geometric configuration leads to vehicle movements that can surprise or confuse drivers. The project team members participating in the field review observed several instances where turning vehicles were cut off by other vehicles passing through the intersection.

Intersection Signage

Some signs at the intersection approaches are posted in locations where they are obstructed by brush or other signs. Others are posted below stop signs, against MUTCD standards. Four sign assemblies are placed on the east side of the intersection, exceeding the amount of information that could reasonably be processed at one time by a typical road user.

Faded Striping at Ramp Approach

Centerline and other white line striping on the parkway ramp approach has faded.

Poor Pavement Condition at Ramp Approach

Pavement along the access ramps for the 100 feet south of MacArthur Boulevard shows signs of cracking, rutting, and potholing, especially in the wheel path areas of vehicles turning onto and off of these ramps from MacArthur Boulevard.

Shared-Use Path User Exposure

Path users must cross 100 feet of pavement between the approaches to Oberlin Avenue and the Glen Echo Access Ramps, exposing users to the risk of being struck by vehicles. South of the parkway ramps, the path continues, but no separation exists between the road pavement and shared-use path pavement. Even though flexible bollards (several of which were damaged at the time of the field review) are in place to prevent vehicles from turning into the shared-use path, the project team observed vehicles parking in the path space and law enforcement vehicles using the path space as a staging area for targeted commercial vehicle enforcement.

MacArthur Boulevard
from Tulane Avenue to near Mohican Road

Faded striping and damaged pavement on ramp

Law enforcement vehicle parked in shared-use path space

Improvements Already Planned

As of April 2019, MCDOT had completed 90 percent design plans for intersection improvements at MacArthur Boulevard and the Glen Echo Access Ramps. Planned improvements relevant to this study include converting the intersection to traffic signal control, the addition of a northbound left turn bay along MacArthur Boulevard, related signing and striping improvements, and the installation of an actuated pedestrian signal along the MacArthur Boulevard shared-use path crossing at the intersection. A grass buffer will also be installed between the shared-use path and MacArthur Boulevard to the south of the intersection.

MCDOT expects these improvements to eventually be approved for construction, pending review by US Army Corps of Engineers and Montgomery County Department of Permitting Services.

Potential Improvement Options

4A – New Traffic Signal and Turn Lane (Planned)

Complete planned signal installation and road widening at intersection of Glen Echo Access Ramps, MacArthur Boulevard, and Oberlin Avenue.

Partner Agencies: NPS, Montgomery County, Army Corps of Engineers

Opinion of Probable Cost: N/A (already planned)

Detailed Description of Improvements:

- Install a traffic signal at the intersection of MacArthur Boulevard, Glen Echo Access Ramp, and Oberlin Avenue. Construct according to MCDOT signal plans.
- Reconfigure the northbound approach on MacArthur Boulevard to include a left turn lane. Construct according to MCDOT striping plans.
- Update striping and signage as needed at the intersection to support planned changes. Updates would include removal of stop signs and posting of new lane assignment signage at intersection approaches.

Existing stop-controlled intersection at MacArthur Boulevard, Oberlin Avenue, and Glen Echo Access Ramps

Regulatory sign posted to stop sign and brush growth in front of Interstate route shield

4B – Restripe and Repave Ramp Approach (Planned)

Complete planned pavement improvements and associated restriping improvements at the Glen Echo Access Ramp approach to the intersection.

Partner Agencies: NPS

Opinion of Probable Cost: N/A (already planned)

Detailed Description of Improvements:

- Repave the Glen Echo Access Ramp approach to the intersection for the 100 linear feet of pavement west of the existing MacArthur Boulevard centerline. (Work planned by FHWA.)
- Restripe elements affected by repaving efforts, including double yellow centerline, white turn lane separation line, and white edge lines for up to 100 linear feet west of the existing stop bar along the parkway ramp approach to the intersection. (Work planned by MCDOT.)

Potholes and pavement patching along Glen Echo Access Ramp

4C – Reconfigure Signing at Intersection

Adjust guide signs, route shields, and regulatory signs to reduce sign clutter and better meet driver expectations for sign placement and location.

Partner Agencies: NPS, Montgomery County

Opinion of Probable Cost: $900 (cost does not include some work that is already planned)

Detailed Description of Improvements:

- Remove all signs posted beneath stop signs and relocate them on separate posts at intersection approaches. (Work planned by MCDOT.)
- Brush in front of signs on the east side of the intersection, including the MacArthur Boulevard commercial vehicle restriction sign assembly and the northbound Interstate 495 shield and directional arrow. (Work planned by MCDOT.)
- Install an Interstate 495 shield and directional arrow along MacArthur Boulevard in the southbound direction prior to the intersection.
- Repost the existing Dismount and Walk Your Bike sign at the southwest corner of the intersection so that the sign faces northbound shared-use path traffic.
- Relocate the existing brown directional sign assembly to the north of the intersection that faces Glen Echo Access Ramp traffic so that it is located along the parkway exit ramp approach to the intersection.

Existing sign assemblies on east side of intersection, facing ramp exit

4D – Separate Shared-Use Path from Roadway (Planned)

Complete planned separation of MacArthur Boulevard shared-use path from the MacArthur Boulevard vehicular travelled way through the use of an unpaved buffer.

Partner Agencies: Montgomery County, Army Corps of Engineers

Opinion of Probable Cost: N/A (already planned)

Detailed Description of Improvements:

- Remove existing pavement located between the shared-use path and MacArthur Boulevard for the 350 linear feet south of the intersection. Incorporate these changes into MCDOT paving plans.
- Restripe the newly separated shared-use path with a yellow centerline, and the newly separated MacArthur Boulevard with necessary edge line striping. Incorporate these changes into MCDOT paving plans.

Crossing and shared-use path section south of intersection

Improvement Options Deemed Unnecessary

Improve Delineation of Shared-Use Path

Better distinguish the MacArthur Boulevard shared-use path from the MacArthur Boulevard vehicular travelled way through enhanced signing, striping, and flexible bollard placement.

Detailed Description of Improvements:

- Repair damaged flexible delineators between MacArthur Boulevard and shared-use path.
- Extend the use of flexible delineators further to the south along the west side of MacArthur Boulevard.
- Supplement existing no parking symbol signage with No Stopping on Pavement (MUTCD R8-5) signs posted at points halfway between existing no parking symbol signage.

After review of MCDOT plans, this option was removed from consideration. MCDOT plans to separate the existing MacArthur Boulevard shared-use path from the travelled way to the south of the intersection. This improvement would make unnecessary the implementation of the improvements described above.

Damaged flexible delineators along MacArthur Boulevard south of Glen Echo Access Ramp

Create Pedestrian Crossing Refuge at Intersection

Create pedestrian refuge for users of the MacArthur Boulevard shared-use path between the Glen Echo Access Ramp and Oberlin Avenue approaches.

Detailed Description of Improvements:

- Extend the existing grass intersection corner between Oberlin Avenue and the Clara Barton Parkway ramp further to the east so that it intersects the existing crosswalk location for the MacArthur Boulevard shared-use path. Incorporate these changes into MCDOT paving plans.
- Create a paved refuge area for pedestrians within the extended intersection corner. Incorporate these changes into MCDOT paving plans.
- Install pedestrian countdown signal heads and push buttons in both directions at the refuge area. Incorporate these changes into MCDOT paving plans.

After review of MCDOT plans, this option was removed from consideration. As a part of the planned intersection signalization, MCDOT will install pedestrian countdown signal heads and push buttons in both directions at the existing shared-use path approaches to Oberlin Avenue and the Glen Echo Access Ramps. MCDOT confirmed that signal phasing will be designed to allow for adequate pedestrian crossing time without the proposed crossing refuge space.

Proposed location of median refuge area

Graphic overview of potential improvement options along MacArthur Boulevard at Glen Echo Access Ramps and Oberlin Avenue

Site 5 Potential Improvements – Clara Barton Parkway near U-Turn

Site Map

Site Description

Those travelling eastbound on Clara Barton Parkway passing through the Glen Echo interchange continue to the District of Columbia and Virginia via the right lane. Those using the left lane make a U-turn into a 300-foot long westbound weaving segment that passes beneath an unused bridge before splitting at the diverge point described in the Site 6 Description on page 26.

Site Observations

PM Peak Queueing and Congestion

During the PM peak, the right lane into the District of Columbia is closed and all eastbound vehicles must use the U-turn into the westbound weave segment. Due to the high vehicle volumes exiting Washington via Clara Barton Parkway, available gaps for U-turning vehicles are limited. The project team members participating in the field review observed vehicles accelerating hard to enter the weave segment ahead of approaching westbound vehicles. At other times, westbound vehicles would intentionally slow down to let U-turning vehicles into the weave segment. Even relatively short vehicle queues would take minutes to clear due to a lack of gaps in oncoming traffic.

Flip Board Signs and Barricade Use

The project team observed the measures taken during the right eastbound lane closure during the PM peak, which included the use of wooden barricades and flip board lane assignment signs at the approach to the closure. The project team noted that vehicles would stop at times in front of the barricade closure, unsure of how to proceed. On one of the observation days, several signs were found to have not been flipped to reflect current lane assignment conditions.

Misleading Left Turn Signing and Striping

The righthand eastbound lane that completes a U-turn into the westbound weave segment is signed and striped as a left turn lane, not a U-turn lane.

Lack of Warning Signage and Object Markers

Few object markers are present in the weave segment as it passes beneath the existing bridge. Several fixed object crashes and numerous other crashes had been reported in this location. Additionally, no advance warning signage in the weave segment alerts users to the upcoming lane diverge point.

Poor Pavement Quality

Pavement has raveled in some locations in the U-turn segment and the westbound weave segment. Pavement striping has faded in the westbound weave segment.

Parkway Eastbound Approach, Eastbound U-Turn, and Westbound Weaving Area

PM peak period directional closure with stopped truck

Existing flip board sign ahead of westbound U-turn

Short westbound weave area and brown guide sign

Potential Improvement Options

5A – Pavement Improvements (Planned)

Complete planned pavement improvements at the eastbound approach, U-turn, and westbound weave area.

Partner Agencies: NPS

Opinion of Probable Cost: N/A (Planned)

Detailed Description of Improvements:

- Repair damaged or cracked pavement within weave segment and U-turn lane, and reapply lane line skip striping and edge lines.

Pavement damage in eastbound parkway U-turn lane

Note: Following the finalization of the report, NPS-George Washington Memorial Parkway suggested that the existing wooden barricades in place to channelize the U-turn area be replaced with guardrail. While existing crash data does not show past evidence of collisions involving the wooden barricades, the safety team agreed that replacing these barricades with guardrail would be an appropriate proactive safety countermeasure to consider in conjunction with other potential improvements in this area. Guardrail along the outside of the U-turn curve should be considered in this location, even though it has not been included as a formal recommendation in the report.

5B – Signing and Pavement Marking Updates

Improve clarity of signing and striping at eastbound U-turn area and westbound weave area.

Partner Agencies: NPS

Opinion of Probable Cost: $7,000

Detailed Description of Improvements:

- Remove and replace signing and pavement marking that denotes a left turn lane in the eastbound left lane so that it instead denotes a U-turn lane in that location. Post signage directing users who want to exit Clara Barton Parkway to use the left lane and then keep right after the U-turn.
- Post Right Lane Exit Only Ahead warning sign (MUTCD W9-7) in weave area. Relocate existing brown guide sign south of bridge so that it is placed facing westbound traffic prior to the beginning of the weaving segment.
- Place object markers in front of all bridge piers at the bridge underpass location.
- Improve clarity of guide signage leading to and at the westbound diverge point. *(This project element may already be considered as part of a signing project already underway.)*

Faded pavement striping beneath bridge

Existing signage at westbound diverge point

5C – Automated Lane Closure Management

Install an automated lane closure management system to replace the existing manual placement of barricades during lane closures.

Partner Agencies: NPS

Opinion of Probable Cost: $147,000

Detailed Description of Improvements:

- Replace existing flip board signs with static blank out message signs communicating lane assignment information.
- Replace use of wooden barricades with a remotely controlled raiseable arm barricade that can control access to the eastbound through lane.

Example: blank out lane control signs used on Canal Road NW in the District of Columbia

Site 6 Potential Improvements – Clara Barton Parkway East of Ramps

Eastbound and Westbound Parkway, East of U-Turn

Site Map

Site Description

The Clara Barton Parkway continues east of Glen Echo into Washington. Immediately east of the ramps, the parkway becomes a two-lane road. A partially striped pavement and raised concrete median is present immediately east of the ramps, but the median tapers away to a double yellow centerline stripe over the course of 800 feet. This portion of Clara Barton Parkway is open only in the eastbound direction during the weekday AM peak, only in the westbound direction during the weekday PM peak, and in both directions at other times.

Site Observations

Westbound Approach Warning Signage

Westbound traffic approaching the Glen Echo ramps encounters a merge warning sign (MUTCD W4-1) with a 20 mph advisory speed plaque posted on the left side of the travel lane. Review of the approach using historical imagery shows that portable speed enforcement trailers have been used at this location in the past to control approach speeds.

Eastbound Lane Diverge Leads to AM Slowdown

The lane diverge location in the eastbound direction on Clara Barton Parkway creates a significant slowdown during morning peak periods as vehicles try to merge between lanes. Queues from this slowdown were observed to extend back to the Clara Barton Parkway entrance ramp from Cabin John Parkway.

Eastbound Clara Barton Parkway, east of U-turn

6A – Post Additional Westbound Approach Warning Signage

Increase visibility of westbound merge and weave area.

Partner Agencies: NPS

Opinion of Probable Cost: $400

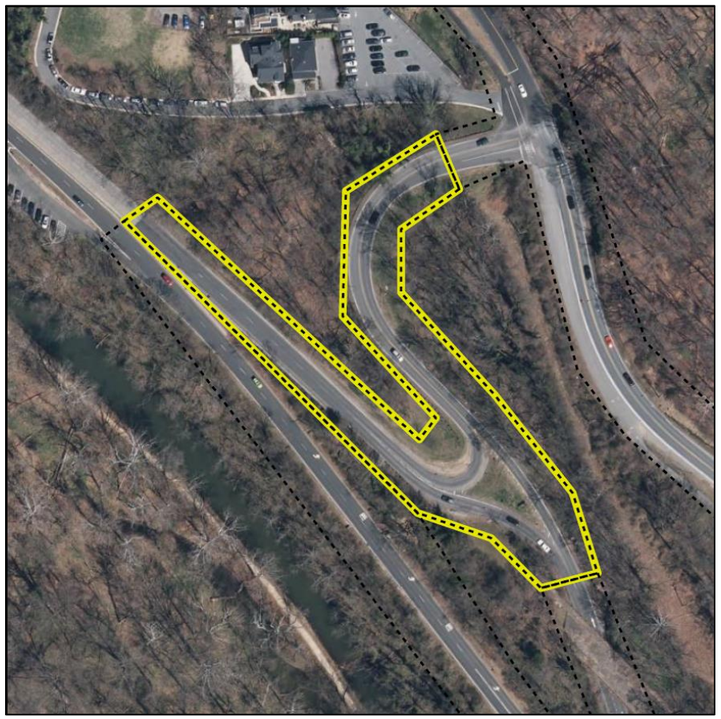
Detailed Description of Improvements:

- Post an additional MUTCD W4-1 merge warning sign with a 20-mph advisory speed plaque in line with the existing identical sign.

Existing westbound merge area warning signage

Site 7 Potential Improvements – Clara Barton Parkway Westbound and Access Ramp

Site Map



Site Description

Access is provided only to westbound Clara Barton Parkway from MacArthur Boulevard. Entering vehicles pass through two curves before emerging onto the righthand westbound lane of the parkway. The westbound travel lanes of Clara Barton Parkway also diverge in this area: the lane that diverges to the right allows eastbound and westbound Clara Barton Parkway vehicles to exit onto MacArthur Boulevard, while the lane that diverges to the left serves vehicles that are continuing west to Cabin John or Interstate 495. The latter of these two lanes joins to the left of the westbound entrance lane at the western end of the ramp area.

Site Observations

Chevron Placement on Curves

Chevron warning signs are posted along the outside edges of the curves that make up the westbound entrance ramp onto Clara Barton Parkway. Some of these signs exhibit poor reflectivity or show other signs of damage. At the large ramp curve nearest MacArthur Boulevard and the smaller hairpin curve onto westbound Clara Barton Parkway, chevrons are not posted for the full length of the curve.

Pavement and Curb Damage

The curb along the inside of the small hairpin curve onto westbound Clara Barton Parkway has disintegrated, and pavement along the inside of the curve shows evidence of damage from water ponding in that location. Pavement in other locations shows evidence of cracking, especially near the edges of the roadway.

Sign Placement and Condition on Island

A grass island is located at the westbound diverge point. Chevrons posted for westbound through traffic diverging to the left at the island are posted on the far side of the island, on the back side of chevrons posted for the westbound entrance ramp curve. These chevrons and another warning sign both show evidence of damage.

Debris on Roadway

Debris accumulates at the outside edge of the small hairpin curve of the westbound parkway entrance ramp.

Little Separation Between Westbound Movements

Numerous crashes have been reported in the area where entering westbound traffic on the Clara Barton Parkway continues beside westbound through traffic. While each movement has its own lane, the white skip striping designating the two lanes has faded. Furthermore, the westbound through lane is bounded by timber-backed guardrail that reduces the available lane width. Several flexible bollards are placed at 20-foot intervals in the merge gore.

Parkway Westbound Diverge and Merge, and Glen Echo Access Ramp Entrance and Exit

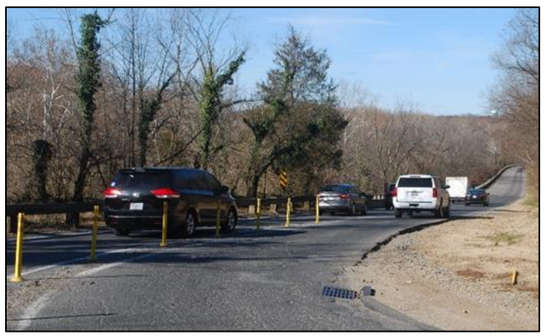
Vehicles Making Illegal U-Turns

The project team members participating in the field review observed several vehicles making a U-turn from the MacArthur Boulevard exit lane onto the westbound Clara Barton Parkway entrance lane. While a regulatory sign is posted prohibiting U-turns in this location, no physical barrier exists preventing the movement.

Damaged Guardrail

The guardrail posted along the outside of the largest ramp curve (nearest to MacArthur Boulevard) shows evidence of several vehicle hits.

Faded chevron at Glen Echo Access Ramp curve



Westbound merge area west of Glen Echo Access Ramp

Potential Improvement Options

7A – Entrance and Exit Ramp Control

Install roadway features to deter drivers from making illegal U-turns.

Partner Agencies: NPS

Opinion of Probable Cost: $2,100

Detailed Description of Improvements:

- Install transverse rumble strips along the downhill segment of the westbound entrance ramp prior to the hairpin curve to control speeds entering the curve segment.
- Install flexible bollards at 10-foot intervals along the first 50 feet, where the exit and westbound entrance ramps to the parkway first come together, to deter attempted U-turn movements.

Exit and entrance movements along Glen Echo Access Ramp

Existing U-turn restriction sign at Glen Echo Access Ramp

7B – Improve Chevron and Guardrail Use Along Ramp Curves

Repair or replace select signage and guardrail portions along the horizontal curves of the Glen Echo Access Ramp.

Partner Agencies: NPS

Opinion of Probable Cost: $5,700 (excluding planned guardrail improvement)

Detailed Description of Improvements:

- Replace chevrons (MUTCD W1-8) so that they are spaced at regular intervals along the full length of the outsides of curves for the westbound entrance ramp to Clara Barton Parkway. For recommended interval spacing, consult MUTCD.
- Remove chevrons posted to the back side of signposts along the hairpin curve. Place new chevrons at regular intervals along the full length of the outside curve edge for westbound through traffic.
- Replace damaged joining lane Keep Left warning sign (see picture at right) for westbound through traffic.
- Repair damaged guardrail along the ramp curve nearest MacArthur Boulevard and install delineators along the length of the guardrail segment. *(This project element is already part of planned repaving efforts.)*

Table 2C-6. Typical Spacing of Chevron Alignment Signs on Horizontal Curves

Advisory Speed	Curve Radius	Sign Spacing
15 mph or less	Less than 200 feet	40 feet
20 to 30 mph	200 to 400 feet	80 feet
35 to 45 mph	401 to 700 feet	120 feet
50 to 60 mph	701 to 1,250 feet	160 feet
More than 60 mph	More than 1,250 feet	200 feet

MUTCD guidelines for chevron spacing

Damaged chevron and guardrail

Chevrons posted to back side of posts, set back from westbound through lane

Consistent westbound through traffic and scraped warning sign

7C – Improve Drainage and Repair Damaged Pavement and Curb

Rehabilitate pavement at the westbound entrance curve that shows signs of raveling and potholing.

Partner Agencies: NPS

Opinion of Probable Cost: at least $7,500, pending study (excluding planned repaving improvements)

Detailed Description of Improvements:

- Conduct a study to better understand drainage conditions that are leading to pavement damage and debris deposits at the westbound Clara Barton Parkway entrance ramp hairpin curve.
- Repair the damaged asphalt curb and pavement segments on the inside edge of the ramp hairpin curve. *(This project element is already part of planned repaving efforts.)*
- Clear debris deposits from the hairpin curve. *(This project element is already part of planned repaving efforts.)*
- Repair cracked pavement and deteriorating pavement edges elsewhere at the site. *(This project element is already part of planned repaving efforts.)*

Damaged pavement edge at hairpin curve

7D – Enhanced Separation of Westbound Movements

Install improvements that provide additional roadway width and greater separation of movements in the westbound merge area immediately to the west of the Glen Echo Access Ramp.

Partner Agencies: NPS

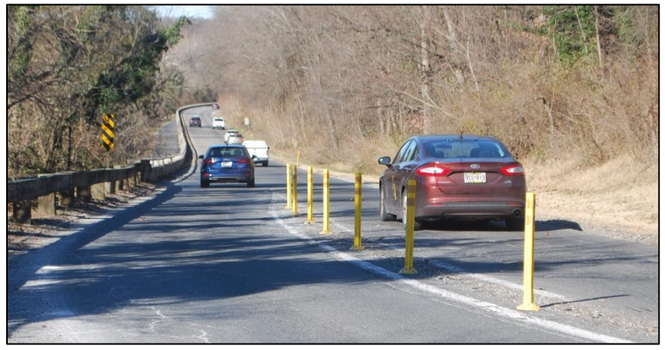
Opinion of Probable Cost: $56,800

Detailed Description of Improvements:

- Restripe the faded skip striping lane lines along the cantilevered concrete westbound road segment, west of the westbound lane merge.
- Post flexible bollards at 10-foot intervals for the full length of the merge area gore to prevent errant merging between lanes.
- Relocate the existing timber backed guardrail on the right side of the westbound through lane, 2 feet back from the existing guardrail position. Construct additional pavement between the beginning of guardrail and the beginning of the cantilevered concrete structure to provide additional room for through vehicles and to discourage drifting into the other lane.

Existing timber guardrail along westbound through lane edge

Existing bollards separating lanes at westbound merge area



Through vehicles and entering vehicles merging on Clara Barton Parkway

General Potential Improvements – Park Access from Along MacArthur Boulevard

Description

Access to and from Glen Echo Park via MacArthur Boulevard is provided at four points: Oberlin Avenue and Tulane Avenue on the southern end of the park, a permit-only parking lot entrance south of Goldsboro Road, and Oxford Road at the northwest end of the park. While all access points are used, nearly all visitors use the general parking facilities at the northwest end of the park, which are accessible only via Oxford Road.

Observations

Inconsistent Signing and Striping

Stop signs and regulatory signs for trucks are posted inconsistently at the various park access points. At the location south of Goldsboro Road, a regulatory sign for trucks is posted without the necessary accompanying pavement striping, and the stop sign is posted too low to the ground.

No Shared-Use Path Wayfinding

The MacArthur Boulevard shared-use path features a relatively new bypass trail that cuts through the Glen Echo Park permit parking lot along MacArthur Road and away from the road through park property before rejoining the existing shared-use path at Oxford Road. No wayfinding signage is provided at either junction. The project team observed user behavior at these sites and noted that none of the users made use of the bypass trail.

Inconsistent Roadside Wayfinding

Brown NPS wayfinding signs are used inconsistently along MacArthur Boulevard. Many signs are posted on the left side of the roadway (especially for vehicle traffic in the northwest direction) at angles that do not face oncoming traffic. Sign lettering size is inconsistent from sign to sign, and signs for the Clara Barton House are posted separately from signs for Glen Echo Park, even though both sites are accessed via identical routes.

Inconsistent wayfinding sign formatting

Shared-use path warning signage (but no guide signage)

Potential Improvement Options

8A – Improve Signage at Permit Lot Access

Partner Agencies: NPS, Montgomery County

Opinion of Probable Cost: $400

Detailed Description of Improvements:

- Remove existing Truck Crossing Permitted Between White Lines sign.
- Repost stop sign so that the bottom of the sign is 7 feet above the ground.

Existing signage at permit lot access

8B – Improve Signage at Public Parking Lot Access (Oxford Road)

Partner Agencies: NPS, Montgomery County

Opinion of Probable Cost: $900

Detailed Description of Improvements:

- Add signing for the parking lot to the right side for westbound traffic on MacArthur Boulevard.
- Relocate signing for eastbound traffic so that it is located at the approach to the Oxford Road intersection. Current signage appears to direct traffic onto the newly constructed shared-use path.

Existing signage for Glen Echo Park at the Oxford Road intersection

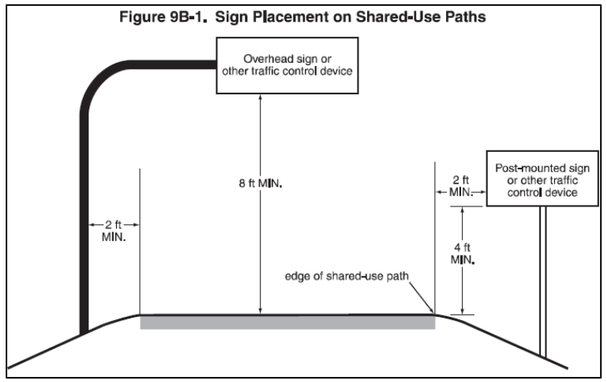
8C – Install Shared-Use Path Wayfinding Signage

Partner Agencies: NPS, Montgomery County

Opinion of Probable Cost: $900

Detailed Description of Improvements:

- Post wayfinding signage for MacArthur Boulevard shared-use path users at junction locations with the newly constructed bypass trail (near the Oxford Road intersection for eastbound travelers, and prior to the trail split through the Glen Echo permit parking lot for westbound travelers).



MUTCD guidance for post-mounted, cyclist and pedestrian-oriented sign placement

Westbound diverge point for MacArthur Boulevard shared-use path (no guide signage present)

8D – Standardize NPS Wayfinding on MacArthur Boulevard

Partner Agencies: NPS, Montgomery County

Opinion of Probable Cost: $4,100

Detailed Description of Improvements:

- Remove any signs that are placed along the left side of the road in the direction of travel and repost these signs on the right side of the road.
- Standardize the size and font use of signs directing users to Glen Echo Park and the Clara Barton Parkway.
- Post wayfinding signage in a way that clearly defines which parking lots on the Glen Echo site are used for which purposes.

Existing parking wayfinding signage on left side of road

Multiple, inconsistent NPS signs posted at MacArthur Boulevard intersection at Glen Echo Access Ramp

General Potential Improvements – Other Considerations

Observations

Inconsistent Shared-Use Path Width

The existing shared-use path along MacArthur Boulevard narrows to a minimum width of 3 feet as it passes the traffic circle at Goldsboro Road. A Montgomery County Ride On bus stop is in the middle of the path in this traffic circle.

Improper Guardrail End Treatments

Several guardrail segments along MacArthur Boulevard feature 'Texas Twist' end treatments that are no longer FHWA-compliant because they pose a collision risk if errant vehicles were to strike them.

Narrow path segment at Ride On bus stop

Existing 'Texas Twist' guardrail end terminal

Potential Improvement Options

9A – Limit Risk to Users at Narrow Path Segment

Partner Agencies: Montgomery County

Opinion of Probable Cost: $700

Detailed Description of Improvements:

- Post warning signage ahead of narrow shared-use path segment in both directions advising users to proceed with caution and to dismount and walk bikes around traffic circle.

Existing Dismount and Walk Your Bike warning sign at Cabin John Bridge

9B – Replace Nonstandard Guardrail End Treatments

Partner Agencies: Montgomery County

Opinion of Probable Cost: $9,300

Detailed Description of Improvements:

- Replace 'Texas Twist' guardrail end treatments with FHWA-approved crashworthy end treatments. 'Texas Twist' guardrail end treatments were observed along MacArthur Boulevard in the following locations:
  - The south side of MacArthur Boulevard to the east of the Oxford Road intersection, and
  - The north side of MacArthur Boulevard to the east of the Goldsboro Road intersection.

Existing crashworthy end treatment on MacArthur Boulevard

Major Reconfiguration Options – Glen Echo Ramps

Description

For the ramps connecting MacArthur Boulevard to Clara Barton Parkway near Glen Echo, several major reconfiguration options exist to address the most difficult transportation safety challenges observed. These options involve reconfiguring parkway ramps and through lanes. Field review observations relevant to one or more of these major reconfiguration options are listed below.

Site Observations

Little Separation Between Westbound Movements

Numerous crashes have been reported in the area where entering westbound traffic on the Clara Barton Parkway continues beside westbound through traffic. While each movement has its own lane, the white skip striping designating the two lanes has faded. Furthermore, the westbound through lane is bounded by timber-backed guardrail that reduces the available lane width. Several flexible bollards are placed at 20-foot intervals in the merge gore.

Vehicles Making Illegal U-Turns

The project team members participating in the field review observed several vehicles making a U-turn from the MacArthur Boulevard exit lane onto the westbound Clara Barton Parkway entrance lane. While a regulatory sign is posted prohibiting U-turns in this location, no physical barrier exists preventing the movement.

PM Peak Queueing and Congestion

During the PM peak, the right lane into the District of Columbia is closed and all eastbound vehicles must use the U-turn into the westbound weave segment. Due to the high vehicle volumes exiting the District via Clara Barton Parkway, available gaps for U-turning vehicles are limited. The project team observed vehicles accelerating hard to enter the weave segment ahead of approaching westbound vehicles. At other times, westbound vehicles would intentionally slow down to let U-turning vehicles into the weave segment. Even relatively short vehicle queues would take minutes to clear due to a lack of gaps in oncoming traffic.

Short Westbound Weave Area

The existing westbound weave area is only 300 feet long, and the dominant weaving movements cross one another, causing driver indecision and increasing crash risk.

Potential Improvement Options

Major A – Lengthened Westbound Weave Area and Relocated U-Turn Lane

Partner Agencies: NPS

Opinion of Probable Cost: $10.6 million

Detailed Description of Improvements:

- Realign the existing westbound through lane further to the north and extend the eastbound U-turn lane further to the east. This would lengthen the westbound weaving area so that vehicle speeds among weaving movements would become similar, and drivers would have more time to make necessary weaving maneuvers. Remove the existing yield sign at the eastbound U-turn lane.

A detailed schematic of this improvement is provided on page 34.

Major B – Westbound Through Traffic Flyover via Existing Unused Bridge

Partner Agencies: NPS

Opinion of Probable Cost: $10.1 million

Detailed Description of Improvements:

- Realign the westbound through lane so that it climbs the north side of the Potomac River Valley until it is level with the existing bridge crossing over the westbound weaving segment. Route the new westbound through lane across the existing bridge and rejoin with the existing alignment at the convergence point with the existing westbound Glen Echo Access Ramp.

- Designate the existing westbound through lane west of the realigned lane as a left-hand exit-only lane to MacArthur Boulevard and Glen Echo. Remove pavement to the left of the existing westbound diverge point so that all traffic from the westbound exit lane and eastbound U-Turn lane must exit to MacArthur Boulevard.

- Restripe the existing westbound weave area as a merge area, providing the eastbound U-turn lane with acceleration space before merging into the exit lane.

A detailed schematic of this improvement is provided on page 35.

Improvement Options Deemed Infeasible

Construct New Bridge and Diamond Interchange

Install signing and striping to deter queueing through the MacArthur Boulevard and Cabin John Access Road intersection in the eastbound direction.

Detailed Description of Improvements:

- Demolish the existing bridge over the existing westbound weaving segment.

- Construct a left exit ramp in the eastbound direction that begins at the end of the cantilevered westbound section and climbs the grade in the forested area between the eastbound and westbound parkway through lanes. End this ramp at a new access road that crosses the existing westbound weaving segment perpendicular to the existing bridge in the same location. Opposite the left exit ramp at the southwest end of this access road, construct an eastbound entrance ramp that merges onto the eastbound through lane from the left.

- On the opposite side of the new bridge (northeast of the existing westbound through lanes), construct westbound entrance and exit ramps from the access road onto the parkway.

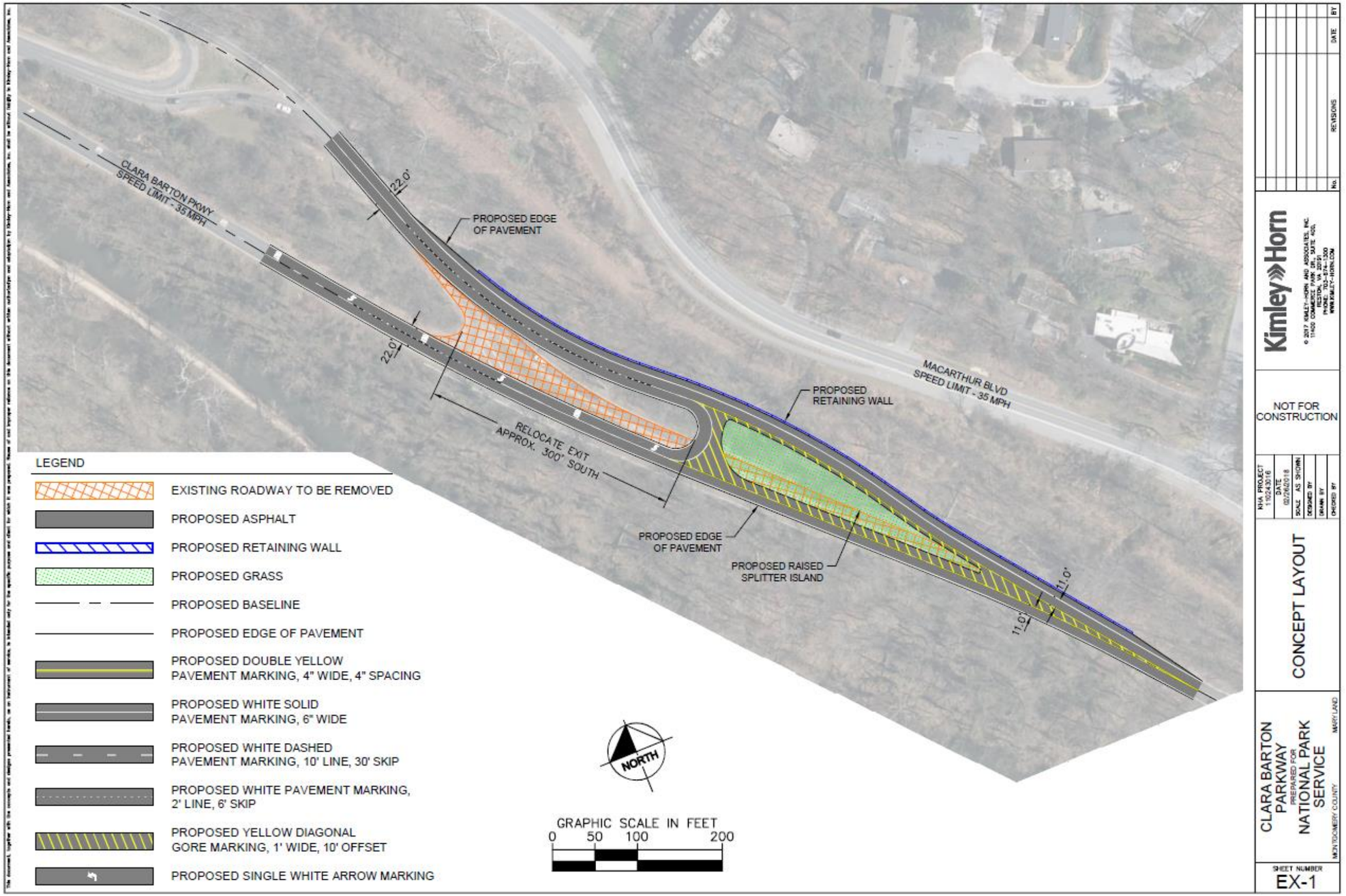
- Northeast of the newly constructed ramps, curve the access road to the north and tie it into the existing entrance and exit ramp alignment north of the existing hairpin curve at the westbound entrance ramp.

- Realign the westbound through lane to smooth the horizontal curvature near the existing bridge.

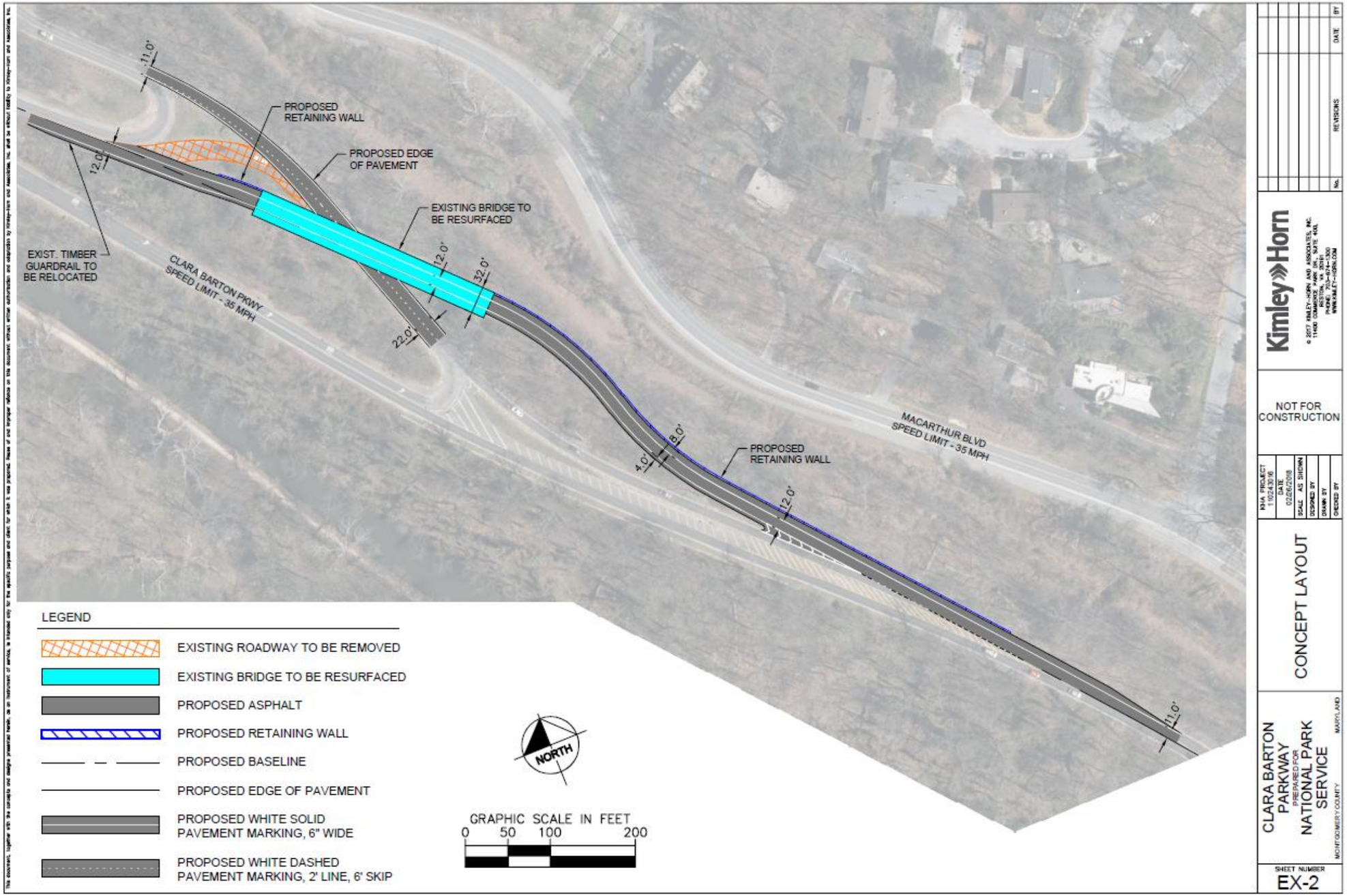
- Remove the existing eastbound U-turn lane east of the proposed left exit ramp.

- Remove the existing westbound weaving section and the segments of the westbound entrance and exit ramps south of the point where the two ramps separate.

This option was not considered because initial estimates gauged this improvement to be approximately twice as expensive as potential improvements ‘Major A’ and ‘Major B’. The project would include the demolition of an existing bridge and the construction of a new bridge in its place. The project would also require large amounts of earthwork to achieve an acceptable geometric alignment.



Concept layout for realignment option Major A – Lengthened Westbound Weave Area and Relocated U-Turn Lane



Concept layout for realignment option Major B – Westbound Through Traffic Flyover via Existing Unused Bridge

Implementation Scenarios

Potential Implementation Scenarios

The potential improvement options described in this document have been included in one or more implementation scenarios, described below. These three implementation scenarios vary in level of ambition and cost of implementation. The first scenario identifies relatively low-cost improvements that begin to address some of the observed safety concerns within the project study area. The second and third scenarios are more aspirational in nature and include improvement options that are higher in cost and would require a greater level of coordination and public support than the improvement options featured only in the first scenario.

A schematic map of each implementation scenario described below is included on pages 37-39. In addition, the table on page 40 provides a comparison among the three proposed implementation scenarios and includes costs and implementation timeframes for the component potential improvements in each scenario. Total costs for each scenario are provided in the table below. Unit cost breakdowns are provided in the report appendix for each potential improvement.

Scenario	Opinion of Probable Total Cost
Scenario 1	$51,800
Scenario 2	$10,924,800
Scenario 3 *(Preferred)*	**$10,511,400**

Implementation Scenario 1

Implementation Scenario 1 generally identifies already planned or low-cost improvements at each site within the study area. Nearly all these improvements feasibly could be implemented in the short-term, with a minimum of design and approvals required. Major reconstruction or geometric realignment options are not included in this scenario.

Implementation Scenario 1 improvements include:

- **1A – Resurface Ramps (Planned)**
- **1B – Install Wrong Way Signs**
- **2A – Brush Intersection Corners**
- **2C – Widen Shoulders to Accommodate Pedestrians and Cyclists**
- **4A – New Traffic Signal and Turn Lane (Planned)**
- **4B – Restripe and Repave Ramp Approach (Planned)**
- **4C – Reconfigure Signing at Intersection (Some Elements Already Planned)**
- **4D – Separate Shared-Use Path from Roadway (Planned)**
- **5A – Pavement Improvements (Planned)**
- **5B – Signing and Pavement Marking Updates**
- **6A – Post Additional Westbound Warning Signage**
- **7A – Entrance and Exit Ramp Control**
- **7B – Improve Chevron and Guardrail Use Along Ramp Curves (Some Elements Already Planned)**
- **7C – Improve Drainage and Repair Damaged Pavement and Curb (Some Elements Already Planned)**
- **8A – Improve Signage at Permit Lot Access**
- **8B – Improve Signage and Public Parking Lot Access (Oxford Road)**
- **8C – Install Shared-Use Path Wayfinding Signage**
- **8D – Standardize NPS Wayfinding on MacArthur Boulevard**
- **9A – Limit Risk to Users at Narrow Path Segment**
- **9B – Replace Nonstandard Guardrail End Treatments**

Most of these updates pertain to the installation or replacement of signage and pavement markings, both generally low-cost types of improvement. A schematic map of the improvements in this implementation scenario is on page 37. Total implementation costs for Implementation Scenario 1 can be found in the implementation scenario comparison table on page 40.

Implementation Scenario 2

Implementation Scenario 2 builds upon the recommendations of Implementation Scenario 1, adding several general short-term recommendations with higher implementation costs. Implementation Scenario 2 also includes several aspirational long-term improvement options that more completely address the safety and wayfinding concerns identified in this study, including one major improvement along Clara Barton Parkway with a cost several orders of magnitude higher than all other proposed improvements. In addition to the short-term potential improvements listed in Implementation Scenario 1, the following potential improvements are included in Implementation Scenario 2:

- **2B – Restripe Cabin John Access Road**
- **2D – Construct Trail Access Path East of Cabin John Access Road**
  - Completed *instead* of Improvement 2C.
- **3A – Construct Bridge Pullout for Use by Queued Vehicles**
- **5C – Automated Lane Closure Management**
- **7D – Enhanced Separation of Westbound Movements**
- **Major A – Lengthened Westbound Weave Area and Relocated U-Turn Lane**

In addition to the major realignment of Clara Barton Parkway, this scenario includes several higher-cost improvements that involve the construction of new pavement or the implementation of intelligent transportation system (ITS) devices to improve traffic operations. A schematic map of the improvements in this implementation scenario is on page 38. Total implementation costs for Implementation Scenario 2 can be found in the implementation scenario comparison table on page 40.

Implementation Scenario 3

Implementation Scenario 3 substitutes enhances an element of Implementation Scenario 2 along MacArthur Boulevard, and proposes a lower-cost but more geometrically divergent realignment concept for Clara Barton Parkway near the Glen Echo Access Ramp. In addition to the potential improvements listed in Implementation Scenario 1 and Implementation Scenario 2, the following potential improvements are included in Implementation Scenario 3:

- **3B – Add Queue Detection along MacArthur Boulevard**
- **Major B – Westbound Through Traffic Flyover via Existing Unused Bridge**
  - Completed *instead* of Improvement Major A.

Improvements in Implementation Scenario 3 focus on two areas: the improvement of traffic operations across the Cabin John Bridge through ITS technology and the improvement of traffic operations on Clara Barton Parkway by rerouting through traffic over an existing unused, but still serviceable bridge.

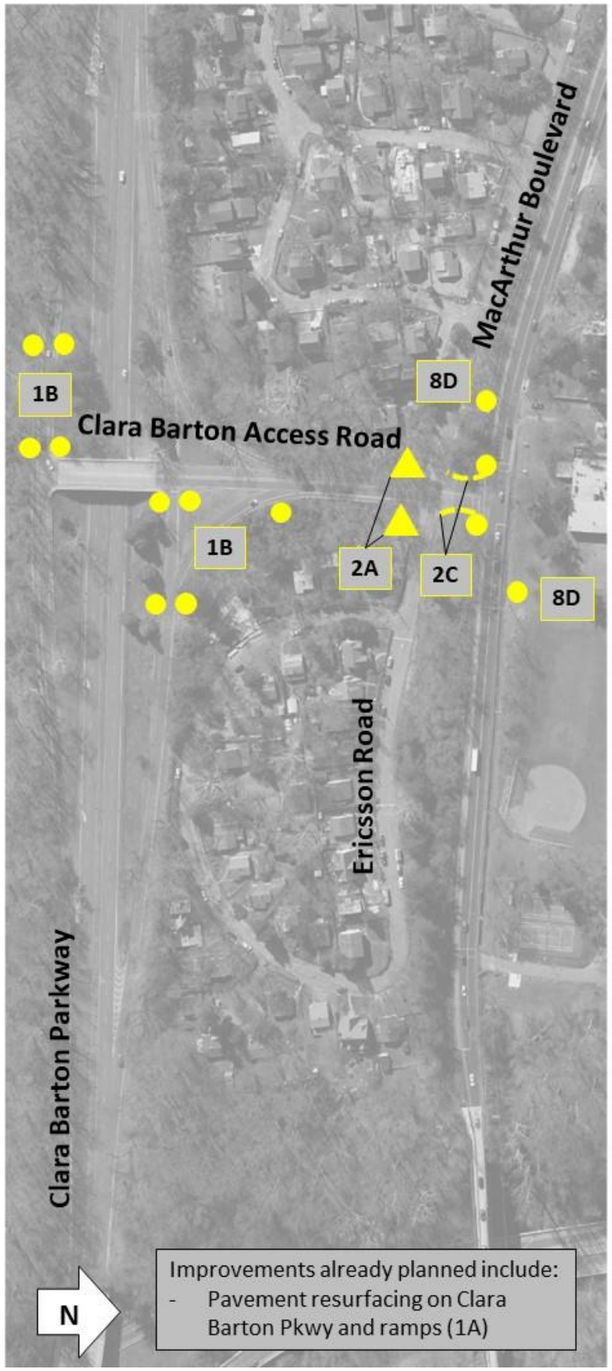
A schematic map of the improvements in this implementation scenario is on page 39. Total implementation costs for Implementation Scenario 3 can be found in the implementation scenario comparison table on page 40.

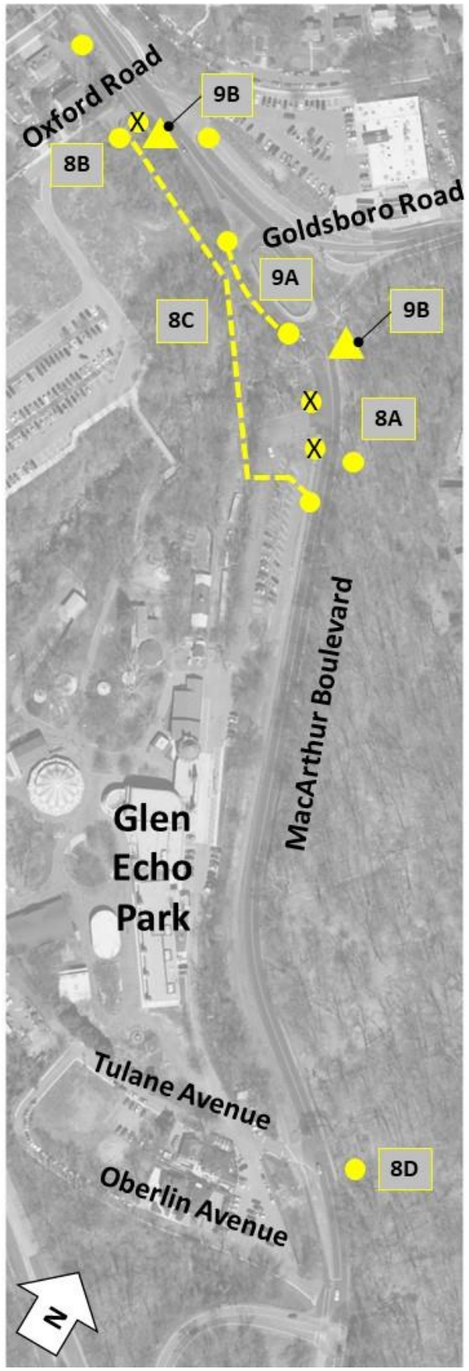
Preferred Implementation Scenario

The project team identified Implementation Scenario 3 as the preferred implementation scenario for this study.

Implementation Scenario 3 was selected as the preferred implementation scenario because it most comprehensively addresses the concerns of motorists traveling along Clara Barton Parkway, as well as motorists, pedestrians, and cyclists travelling along MacArthur Boulevard. The major reconfiguration of Clara Barton Parkway that routes the westbound through lane over an existing unused bridge addresses many of the operational challenges that currently plague the parkway. Redirecting westbound through traffic away from the existing weave area under the bridge significantly increases the number of available gaps in traffic for eastbound U-turning vehicles. The realignment also allows for the elimination of the westbound weave area altogether, instead channeling all traffic in the travel lanes under the bridge to the Glen Echo Access Ramp exit. Furthermore, this improvement can be constructed at a slightly lower estimated cost than the other major improvement option, which would only lengthen the existing weave area rather than diverting traffic from those lanes and eliminating the need for a weave area altogether.

On MacArthur Boulevard, Implementation Scenario 3 provides for a full separation of the MacArthur Boulevard shared-use path from the adjacent roadway, making it more difficult for vehicles to pull away from the road and obstruct the path. At the MacArthur Boulevard intersection with the Glen Echo Access Ramps and Oberlin Avenue, the adjustment of intersection geometry could allow for a pedestrian refuge space between the ramp and Oberlin Avenue approaches, significantly reducing the crossing distance and allowing for more flexibility in timing the planned signal at the intersection. Both improvements could potentially be incorporated into MCDOT's upcoming pavement widening and signal installation efforts at the intersection. To the northwest, the installation of queue detection equipment in addition to the proposed bridge pullout would offer additional, creative ways to prevent vehicle queues from impacting traffic operations across the Cabin John Bridge.


MacArthur Boulevard
1B
Clara Barton Access Road
8D
1B
2A
2C
8D
Ericsson Road
Clara Barton Parkway
N
Improvements already planned include:
- Pavement resurfacing on Clara Barton Pkwy and ramps (1A)


Oxford Road
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Goldsboro Road
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MacArthur Boulevard
Glen Echo Park
Tulane Avenue
Oberlin Avenue
8D
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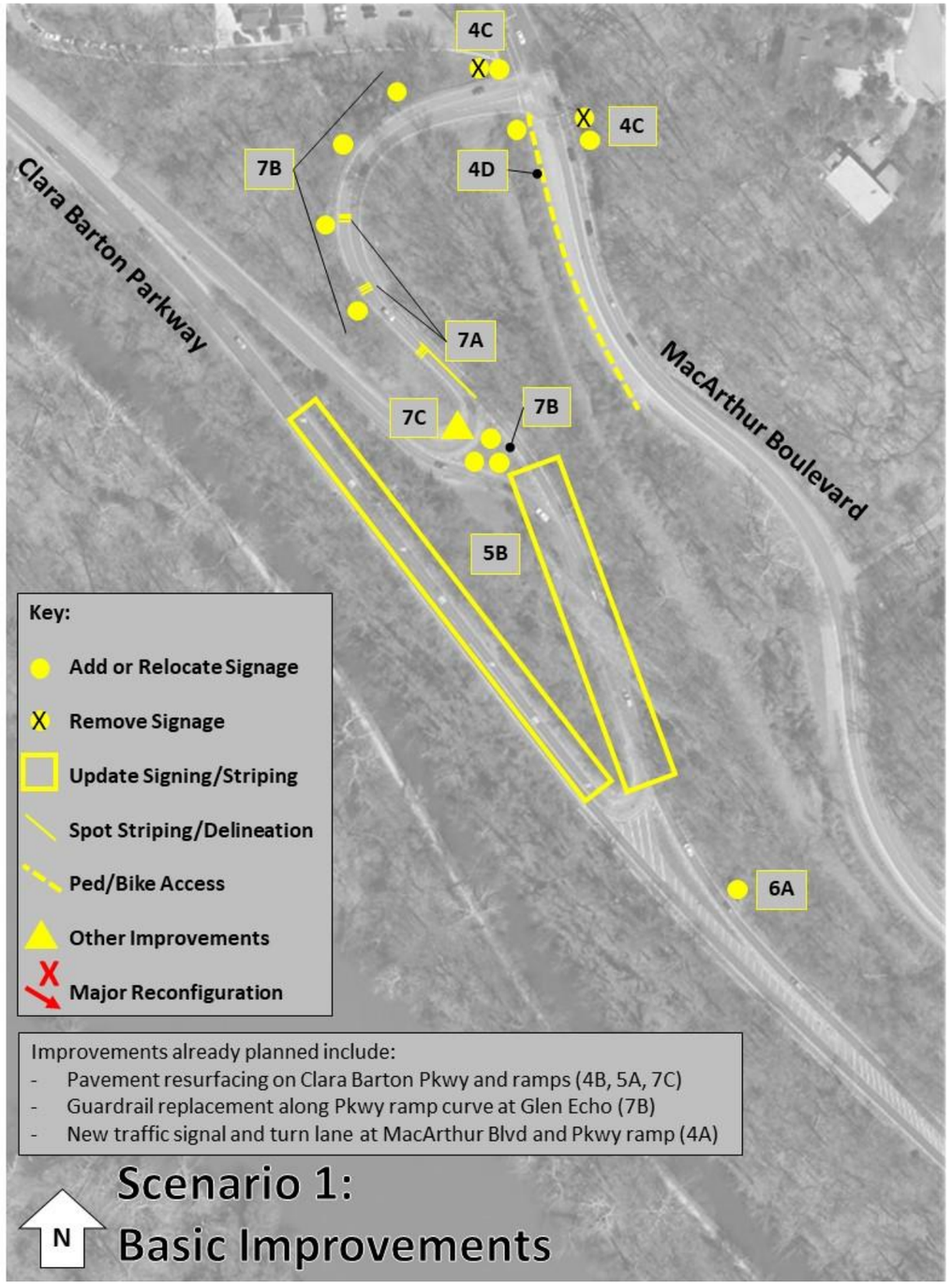
4C
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Clara Barton Parkway
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MacArthur Boulevard
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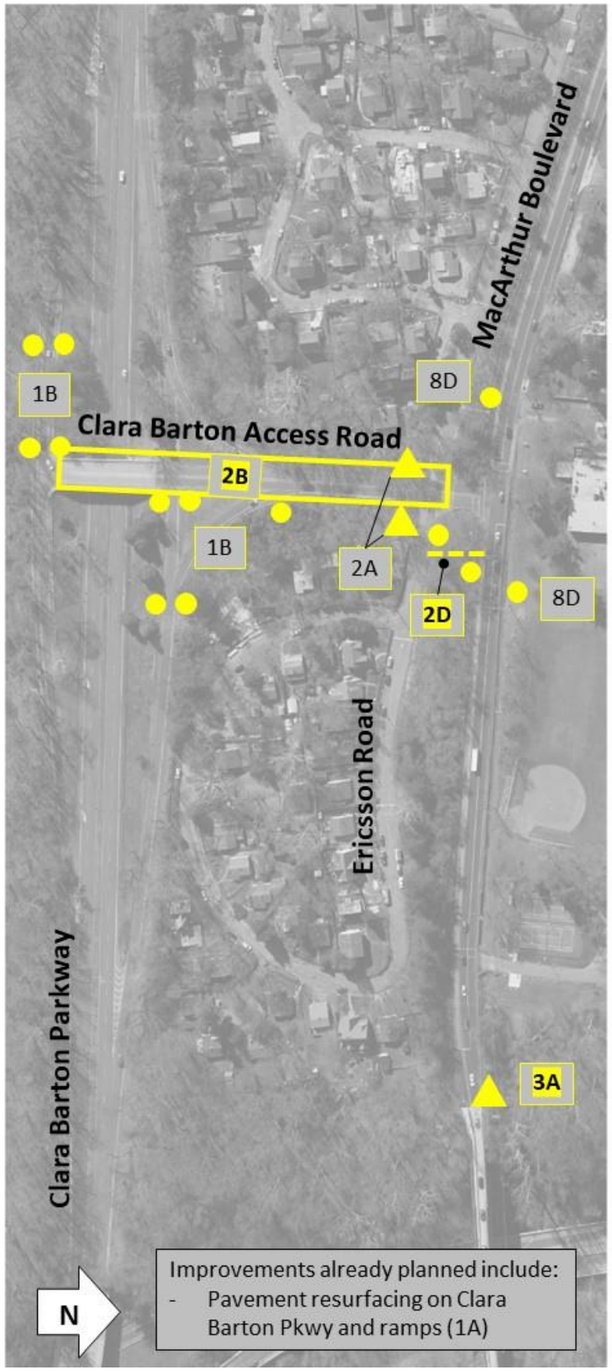
Key:
Add or Relocate Signage
Remove Signage
Update Signing/Striping
Spot Striping/Delineation
Ped/Bike Access
Other Improvements
Major Reconfiguration
Improvements already planned include:
- Pavement resurfacing on Clara Barton Pkwy and ramps (4B, 5A, 7C)
- Guardrail replacement along Pkwy ramp curve at Glen Echo (7B)
- New traffic signal and turn lane at MacArthur Blvd and Pkwy ramp (4A)
N
Scenario 1:
Basic Improvements


MacArthur Boulevard
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Clara Barton Access Road
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8D
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8D
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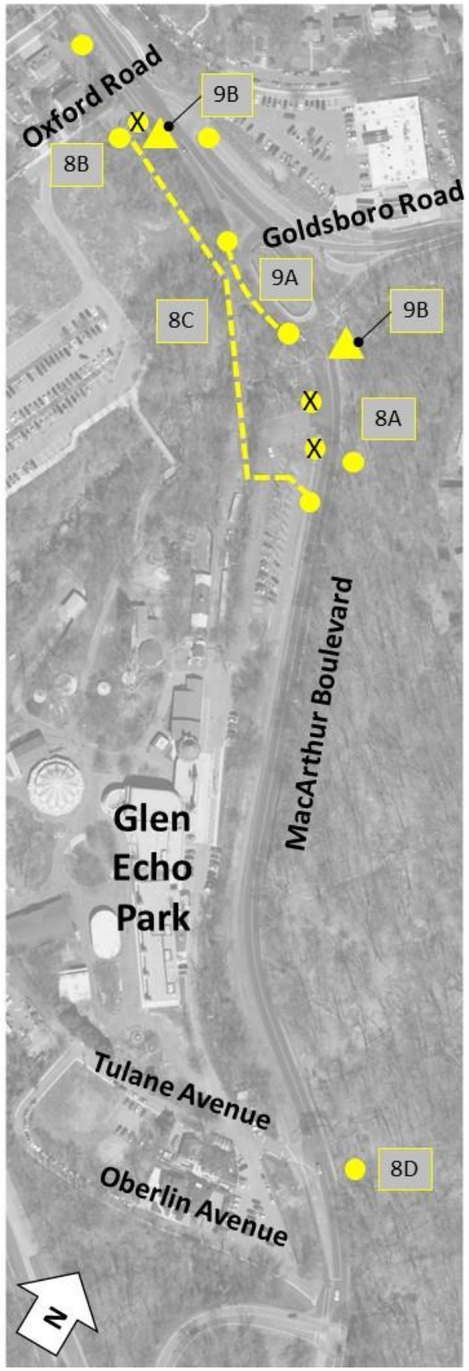
Improvements already planned include:
- Pavement resurfacing on Clara Barton Pkwy and ramps (1A)


Oxford Road
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Tulane Avenue
Oberlin Avenue
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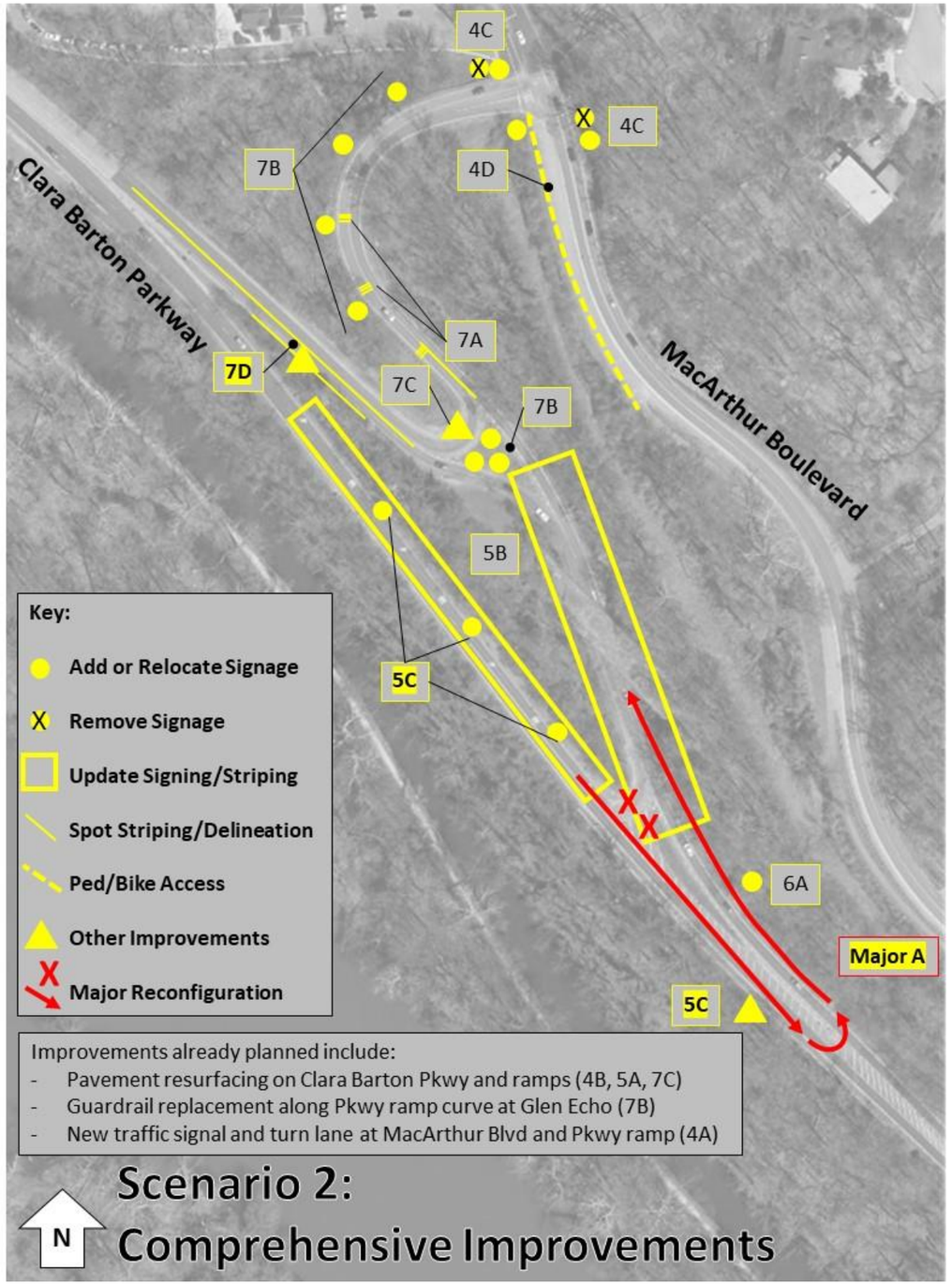
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Clara Barton Parkway
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MacArthur Boulevard
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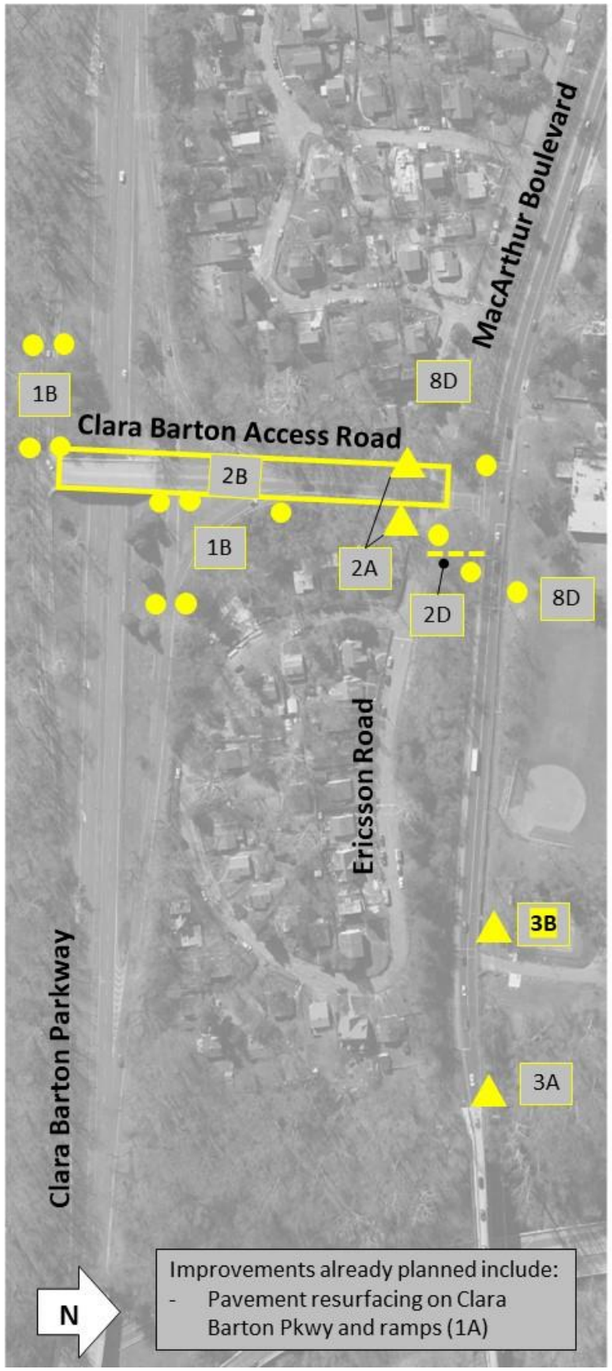
Key:
Add or Relocate Signage
Remove Signage
Update Signing/Striping
Spot Striping/Delineation
Ped/Bike Access
Other Improvements
Major Reconfiguration
6A
Major A
5C
Improvements already planned include:
- Pavement resurfacing on Clara Barton Pkwy and ramps (4B, 5A, 7C)
- Guardrail replacement along Pkwy ramp curve at Glen Echo (7B)
- New traffic signal and turn lane at MacArthur Blvd and Pkwy ramp (4A)
N
Scenario 2:
Comprehensive Improvements


MacArthur Boulevard
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Clara Barton Access Road
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2B
1B
2A
2D
8D
Ericsson Road
3B
3A
Clara Barton Parkway
N
Improvements already planned include:
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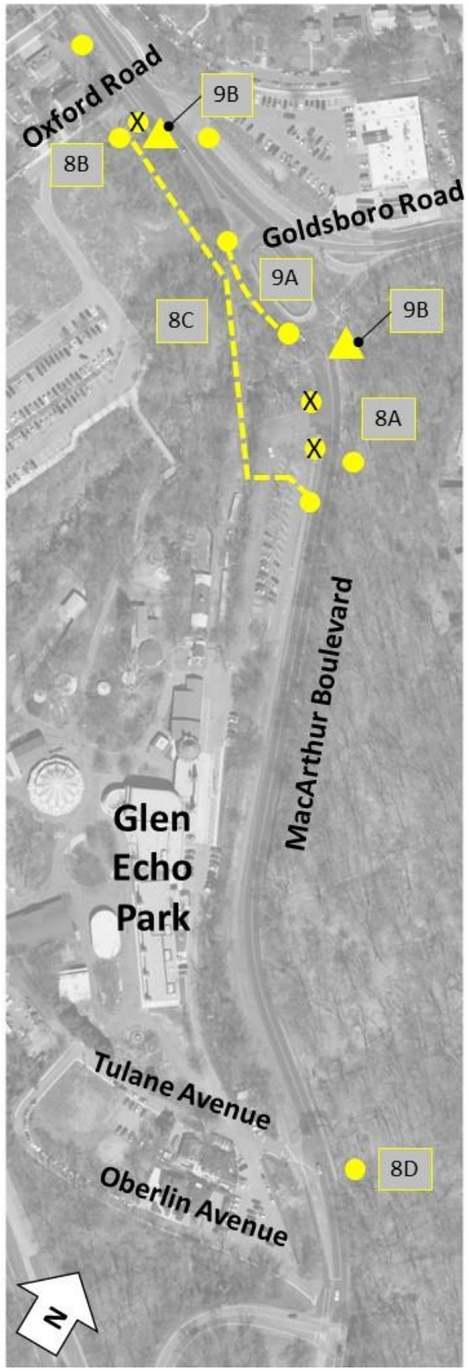
Oxford Road
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Goldsboro Road
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MacArthur Boulevard
Glen Echo Park
Tulane Avenue
Oberlin Avenue
8D
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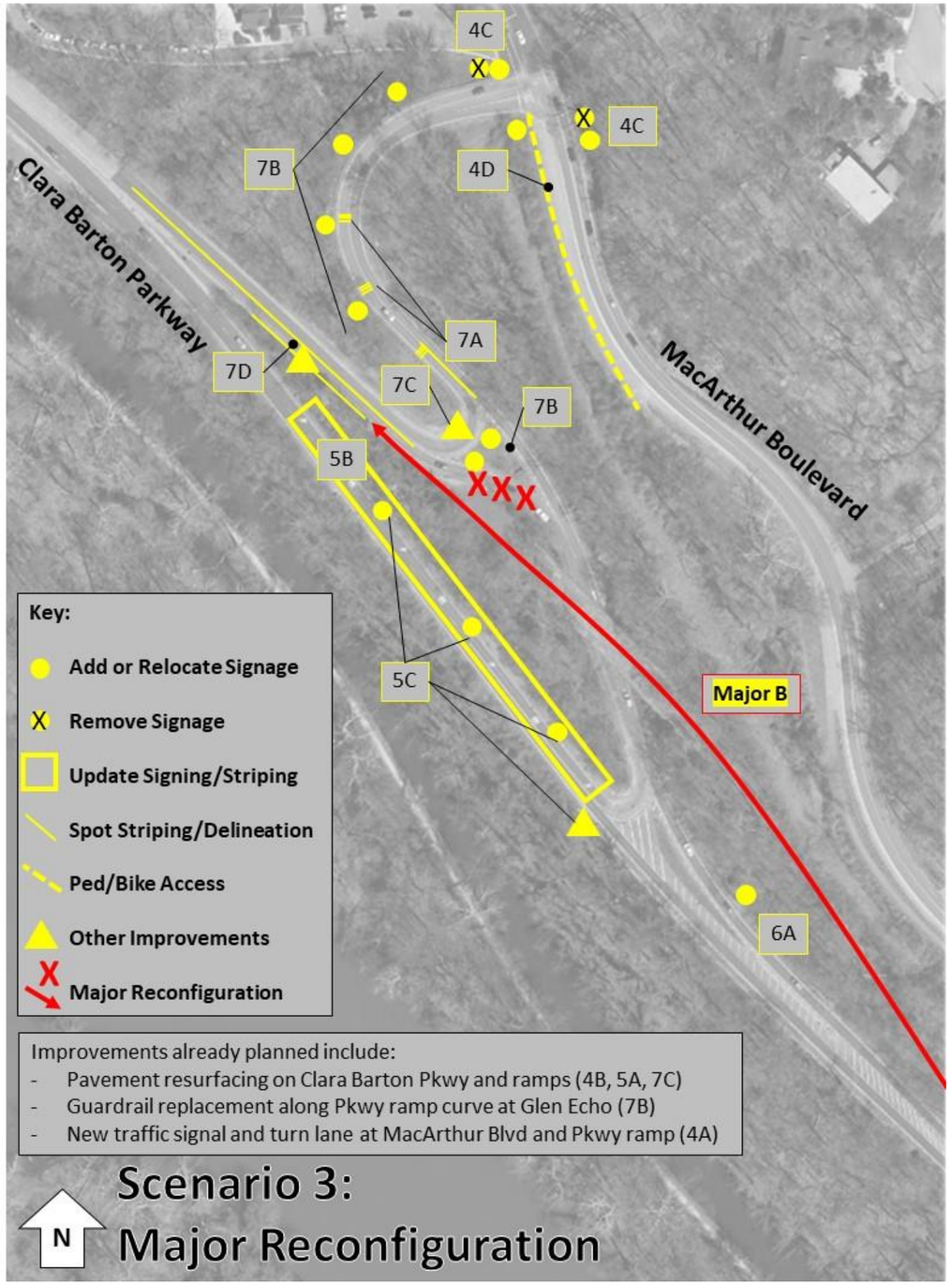
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4C
7B
4D
Clara Barton Parkway
7A
MacArthur Boulevard
7D
7C
7B
5B
5C
Major B
6A
Key:
Add or Relocate Signage
Remove Signage
Update Signing/Striping
Spot Striping/Delineation
Ped/Bike Access
Other Improvements
Major Reconfiguration
Improvements already planned include:
- Pavement resurfacing on Clara Barton Pkwy and ramps (4B, 5A, 7C)
- Guardrail replacement along Pkwy ramp curve at Glen Echo (7B)
- New traffic signal and turn lane at MacArthur Blvd and Pkwy ramp (4A)
N
Scenario 3:
Major Reconfiguration

Implementation Scenario Comparison Matrix

Site	Improvement Option	Timeframe	Scenario 1		Scenario 2		Scenario 3		Notes
			✓	Cost	✓	Cost	✓	Cost	
1	**1A – Resurface Ramps (Planned)**	Planned	✓	-	✓	-	✓	-	Cost not listed because project is already planned and programmed.
1	**1B – Install Wrong Way Signs**	Short-Term	✓	$2,800	✓	$2,800	✓	$2,800	None
2	**2A – Brush Intersection Corners**	Short-Term	✓	$500	✓	$500	✓	$500	None
2	**2B – Restripe Cabin John Access Road**	Short-Term			✓	$9,000	✓	$9,000	None
2	**2C – Widen Shoulders to Accommodate Pedestrians and Cyclists**	Long-Term	✓	$8,600					Higher contingency applied to cost due to anticipated Army Corps coordination.
2	**2D – Construct Trail Access Path East of Cabin John Access Road**	Long-Term			✓	$15,300	✓	$15,300	Higher contingency applied to cost due to anticipated Army Corps coordination.
3	**3A – Construct Bridge Pullout for Use by Queued Vehicles**	Long-Term			✓	$53,500	✓	$53,500	Higher contingency applied to cost due to anticipated Army Corps coordination.
3	**3B – Add Queue Detection along MacArthur Boulevard**	Long-Term					✓	$86,600	None
4	**4A – New Traffic Signal and Turn Lane (Planned)**	Planned	✓	-	✓	-	✓	-	Cost not listed because project is already planned and programmed.
4	**4B – Restripe and Repave Ramp Approach (Planned)**	Planned	✓	-	✓	-	✓	-	Cost not listed because project is already planned and programmed.
4	**4C – Reconfigure Signing at Intersection**	Short-Term / Planned	✓	$900	✓	$900	✓	$900	Costs only partially listed because some elements are already planned and programmed.
4	**4D – Separate Shared-Use Path from Roadway (Planned)**	Planned	✓	-	✓	-	✓	-	Cost not listed because project is already planned and programmed.
5	**5A – Pavement Improvements (Planned)**	Planned	✓	-	✓	-	✓	-	Cost not listed because project is already planned and programmed.
5	**5B – Signing and Pavement Marking Updates**	Short-Term	✓	$7,000	✓	$7,000	✓	$7,000	None
5	**5C – Automated Lane Closure Management**	Long-Term			✓	$147,000	✓	$147,000	None
6	**6A – Post Additional Westbound Approach Warning Signage**	Short-Term	✓	$400	✓	$400	✓	$400	None
7	**7A – Entrance and Exit Ramp Control**	Short-Term	✓	$2,100	✓	$2,100	✓	$2,100	None
7	**7B – Improve Chevron and Guardrail Use Along Ramp Curves**	Short-Term / Planned	✓	$5,700	✓	$5,700	✓	$5,700	Cost estimate does not include any elements already planned.
7	**7C – Improve Drainage and Repair Damaged Pavement and Curb**	Short-Term / Planned	✓	$7,500	✓	$7,500	✓	$7,500	Cost estimate for drainage study only. Study findings may include additional improvements. Cost estimate does not include any elements already planned.
7	**7D – Enhanced Separation of Westbound Movements**	Long-Term			✓	$56,800	✓	$56,800	None
8	**8A – Improve Signage at Permit Lot Access**	Short-Term	✓	$400	✓	$400	✓	$400	None
8	**8B – Improve Signage and Public Parking Lot Access (Oxford Road)**	Short-Term	✓	$900	✓	$900	✓	$900	None

Site	Improvement Option	Timeframe	Scenario 1		Scenario 2		Scenario 3		Notes
			✓	Cost	✓	Cost	✓	Cost	
8	**8C – Install Shared-Use Path Wayfinding Signage**	Short-Term	✓	$900	✓	$900	✓	$900	None
8	**8D – Standardize NPS Wayfinding on MacArthur Boulevard**	Short-Term	✓	$4,100	✓	$4,100	✓	$4,100	None
9	**9A – Limit Risk to Users at Narrow Path Segment**	Short-Term	✓	$700	✓	$700	✓	$700	None
9	**9B – Replace Nonstandard Guardrail End Treatments**	Short-Term	✓	$9,300	✓	$9,300	✓	$9,300	None
Major	**Major A – Lengthened Westbound Weave Area and Relocated U-Turn Lane**	Long-Term			✓	$10,600,000			Magnitude of improvement limits level of confidence in cost estimate to nearest $100,000.
Major	**Major B – Westbound Through Traffic Flyover via Existing Unused Bridge**	Long-Term					✓	$10,100,000	Magnitude of improvement limits level of confidence in cost estimate to nearest $100,000.
	Total Costs			**$51,800**		**$10,924,800**		**$10,511,400**	

Implementation Plan for the Preferred Scenario

Short-Term Improvements

Incorporate New Recommendations into Planned Improvements

- Update FHWA Clara Barton Parkway paving plans to include rumble strips along the Glen Echo Access Ramp entrance **(7A)**, guardrail-related specifications **(7B)**, and other recommendations from drainage study **(7C)** once it is completed.

Basic Signage and Striping

- Coordinate signage and striping improvements so that bulk removal and replacements help limit costs.
  - NPS: **1B, 2B, 5B, 6A, 7B, 8A**
  - MCDOT: **9A**
  - Coordination between both agencies: **4C, 8B, 8C, 8D**

Other Spot Improvements

- Clear brush from the corners of the intersection between Cabin John Access Road and Ericsson Road to improve sight distance **(2A)**.
- Extend flexible bollards along the centerline of the Glen Echo Access Ramp **(7A).**
- Update 'Texas Twist' style guardrail end treatments along MacArthur Boulevard **(9B).**

Long-Term Improvements

Planning, Public Engagement, and Study

- Begin public engagement regarding realignment of westbound lanes on Clara Barton Parkway **(Major B).**
- Begin coordination with MCDOT, Army Corps, and Cabin John to establish plans for shared-use path access to Ericsson Road **(2D)**.
- Coordinate with Army Corps for permitting larger projects along MacArthur Boulevard **(2D, 3A, 4A-4D).**
- Develop preliminary designs for pavement construction and ITS projects near Cabin John Bridge **(3A and 3B)** and along Clara Barton Parkway **(5C and 7D)**.

Intermediate Objectives

- Conduct formal environmental assessment for westbound parkway reconfiguration and develop a record of decision on the project following standard NPS processes **(Major B).**
- Improve MacArthur Boulevard shared-use path as planned signal is installed **(2D, 4A, and 4D).**
- Construct ITS systems to improve traffic operations across the Cabin John Bridge **(3B)** and to automate eastbound lane access along Clara Barton Parkway **(5C).**
- Enhance separation of westbound lanes on the parkway and resurface the road **(1A, 4B, 5A, 7A-7D)**.

Final Objectives

- Once record of decision is established, construct comprehensive realignment of westbound Clara Barton Parkway as shown in improvement option **Major B**.
- Upon receiving construction approvals from the Army Corps, construct Cabin John Bridge pullout along MacArthur Boulevard to improve traffic operations **(3A).**

Appendices

Appendix A – Improvement Option Costs

1A. Resurface Ramps (Planned)						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**N/A**		**N/A**
Rounded Short-Term Cost / Long-Term Cost				**N/A**		**N/A**
Total Site Improvement Cost						**N/A**

1B. Install Wrong Way Signs						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Sign and Pole	EA	$ 250.00	8	$2,000		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$800		$0
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$2,800**		**$0**
Rounded Short-Term Cost / Long-Term Cost				**$2,800**		**$0**
Total Site Improvement Cost						**$2,800**

2A. Brush Intersection Corners						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Trim/Remove Vegetation	SF	$ 1.75	200	$350		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$140		$0
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$490**		**$0**
Rounded Short-Term Cost / Long-Term Cost				**$500**		**$0**
Total Site Improvement Cost						**$500**

2B. Restripe Clara Barton Access Road						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Sign and Pole	EA	$ 250.00	2	$500		$0
Install 4" White Edge Line	LF	$ 1.00	150	$150		$0
Install 4" Yellow Center Line (Per Line)	LF	$ 1.00	1250	$1,250		$0
Install 4" White Skip Line	LF	$ 1.00	150	$150		$0
Install Turn Lane Arrow Marking	EA	$ 140.00	4	$560		$0
Install Crosshatch Striping	SF	$ 2.00	600	$1,200		$0
Remove Single Yellow Center Line (Milling and Overlay)	SF	$ 1.25	2050	$2,563		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$2,550		$0
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$8,923**		**$0**
Rounded Short-Term Cost / Long-Term Cost				**$9,000**		**$0**
Total Site Improvement Cost						**$9,000**

2C. Widen Shoulders to Accommodate Pedestrians and Cyclists						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Sign and Pole	EA	$ 250.00		$0	4	$1,000
Relocate Sign and/or Pole	EA	$ 100.00		$0	3	$300
Install 4" Yellow Center Line (Per Line)	LF	$ 1.00		$0	100	$100
Remove Single Yellow Center Line (Milling and Overlay)	SF	$ 1.25		$0	100	$125
Install Paved Shoulder	SF	$ 5.50		$0	400	$2,200
Roadway Aggregate	CY	$ 43.00		$0	4	$172
Roadway Backfill	CY	$ 35.00		$0	4	$140
Roadway Excavation	CY	$ 30.00		$0	8	$240
Engineering, Mobilization, Traffic Control, Etc.		100%		$0		$4,280
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$0**		**$8,557**
Rounded Short-Term Cost / Long-Term Cost				**$0**		**$8,600**
Total Site Improvement Cost						**$8,600**

2D. Construct Trail Access Paths Separate from Access Road

Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Sign and Pole	EA	$ 250.00		$0	2	$500
Remove Sign and/or Pole	EA	$ 50.00		$0	20	$1,000
Install 4" Yellow Center Line (Per Line)	LF	$ 1.00		$0	70	$70
Install New Pavement	SF	$ 5.50		$0	560	$3,080
Roadway Aggregate	CY	$ 43.00		$0	7	$301
Roadway Backfill	CY	$ 35.00		$0	14	$490
Roadway Excavation	CY	$ 30.00		$0	21	$630
Reseeding after Pavement or Gravel Road Removal (Grass)	SF	$ 0.25		$0	400	$100
Reduce Roadway, Roadbed, or Intersection Width	SY	$ 32.50		$0	45	$1,463
Engineering, Mobilization, Traffic Control, Etc.		100%		$0		$7,630
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$0**		**$15,264**
Rounded Short-Term Cost / Long-Term Cost				**$0**		**$15,300**
Total Site Improvement Cost						**$15,300**

3A. Construct Bridge Pullout for Use by Queued Vehicles

Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Custom Advisory or Destination Sign	SF	$ 20.00		$0	20	$400
Install Custom Advisory or Destination Sign Pole	EA	$ 125.00		$0	1	$125
Install Steel Guardrail and Posts	LF	$ 17.00		$0	60	$1,020
Remove Guardrail and Posts	LF	$ 10.00		$0	60	$600
Install New Pavement	SF	$ 5.50		$0	320	$1,760
Construct Gravel Turnout	EA	$ 17,100.00		$0	1	$17,100
Shoulder Stabilization	SF	$ 34.00		$0	80	$2,720
Reduce Embankment (Cut/Fill)	CY	$ 20.00		$0	40	$800
Headwall, Tailwall, or Slope Stabilization	SY	$ 55.00		$0	40	$2,200
Engineering, Mobilization, Traffic Control, Etc.		100%		$0		$26,730
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$0**		**$53,455**
Rounded Short-Term Cost / Long-Term Cost				**$0**		**$53,500**
Total Site Improvement Cost						**$53,500**

3B. Queue Detection along MacArthur Boulevard

Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Dynamic Queue Warning System	PER SIGN	$ 61,800.00		$0	1	$61,800
Engineering, Mobilization, Traffic Control, Etc.		40%		$0		$24,720
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$0**		**$86,520**
Rounded Short-Term Cost / Long-Term Cost				**$0**		**$86,600**
Total Site Improvement Cost						**$86,600**

4A. New Traffic Signal and Turn Lane (Planned)

Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**N/A**		**N/A**
Rounded Short-Term Cost / Long-Term Cost				**N/A**		**N/A**
Total Site Improvement Cost						**N/A**

4B. Restripe and Repave Ramp Approach (Planned)

Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**N/A**		**N/A**
Rounded Short-Term Cost / Long-Term Cost				**N/A**		**N/A**
Total Site Improvement Cost						**N/A**

4C. Reconfigure Signing at Intersection

Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Sign and Pole	EA	$ 250.00	1	$250		$0
Install Sign Only	EA	$ 125.00	1	$125		$0
Relocate Sign and/or Pole	EA	$ 100.00	2	$200		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$230		$0
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$805**		**$0**
Rounded Short-Term Cost / Long-Term Cost				**$900**		**$0**
Total Site Improvement Cost						**$900**

4D. Separate Shared-Use Path from Roadway (Planned)

Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**N/A**		**N/A**
Rounded Short-Term Cost / Long-Term Cost				**N/A**		**N/A**
Total Site Improvement Cost						**N/A**

5A. Pavement Improvements (Planned)						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**N/A**		**N/A**
Rounded Short-Term Cost / Long-Term Cost				**N/A**		**N/A**
Total Site Improvement Cost						**N/A**

5B. Signing and Pavement Marking Updates						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Sign and Pole	EA	$ 250.00	4	$1,000		$0
Remove Sign and/or Pole	EA	$ 50.00	4	$200		$0
Relocate Sign and/or Pole	EA	$ 100.00	1	$100		$0
Install Type 3 Object Marker	EA	$ 250.00	4	$1,000		$0
Install Custom Advisory or Destination Sign	SF	$ 20.00	48	$960		$0
Install Custom Advisory or Destination Sign Pole	EA	$ 125.00	2	$250		$0
Install Turn Lane Arrow Marking	EA	$ 140.00	4	$560		$0
Remove Spot Pavement Marking	LF	$ 6.00	144	$864		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$1,970		$0
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$6,904**		**$0**
Rounded Short-Term Cost / Long-Term Cost				**$7,000**		**$0**
Total Site Improvement Cost						**$7,000**

5C. Automated Lane Closure Management						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Blank-Out Message Sign	EA	$ 5,000.00		$0	3	$15,000
Lane Control and Closure System	EA	$ 90,000.00		$0	1	$90,000
Engineering, Mobilization, Traffic Control, Etc.		40%		$0		$42,000
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$0**		**$147,000**
Rounded Short-Term Cost / Long-Term Cost				**$0**		**$147,000**
Total Site Improvement Cost						**$147,000**

6A. Post Additional WB Approach Warning Signage						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Sign and Pole	EA	$ 250.00	1	$250		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$100		$0
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$350**		**$0**
Rounded Short-Term Cost / Long-Term Cost				**$400**		**$0**
Total Site Improvement Cost						**$400**

7A. Entrance/Exit Ramp Control						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Flex-Post Delineators with Reflective Strips	EA	$ 52.00	5	$260		$0
Install Raised Thermoplastic Rumble Strips	LF	$ 20.00	60	$1,200		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$580		$0
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$2,040**		**$0**
Rounded Short-Term Cost / Long-Term Cost				**$2,100**		**$0**
Total Site Improvement Cost						**$2,100**

7B. Improve Chevron and Guardrail Use Along Ramp Curves						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Sign and Pole	EA	$ 250.00	1	$250		$0
Remove Sign and/or Pole	EA	$ 50.00	6	$300		$0
Install Chevron	EA	$ 250.00	14	$3,500		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$1,620		$0
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$5,670**		**$0**
Rounded Short-Term Cost / Long-Term Cost				**$5,700**		**$0**
Total Site Improvement Cost						**$5,700**

7C. Improve Drainage and Repair Damaged Pavement and Curb						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Drainage Study	EA	$ 7,500.00	1	$7,500		$0
Project Cost Summary						
Total Short-Term Cost / Long-Term Cost				**$7,500**		**$0**
Rounded Short-Term Cost / Long-Term Cost				**$7,500**		**$0**
Total Site Improvement Cost						**$7,500**

7D. Enhanced Separation of WB Movements						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Flex-Post Delineators with Reflective Strips	EA	$ 52.00		$0	5	$260
Install 4" White Skip Line	LF	$ 1.00		$0	1000	$1,000
Install Steel-Backed Timber Guardrail	LF	$ 100.00		$0	160	$16,000
Remove Guardrail and Posts	LF	$ 10.00		$0	160	$1,600
Install New Pavement	SF	$ 5.50		$0	320	$1,760
Roadway Aggregate	CY	$ 43.00		$0	27	$1,161
Site Brushing, Debris Removal, and Disposal	EA	$ 1,700.00		$0	1	$1,700
Roadside Backfill	CY	$ 35.00		$0	320	$11,200
Headwall, Tailwall, or Slope Stabilization	SY	$ 55.00		$0	107	$5,885
Engineering, Mobilization, Traffic Control, Etc.		40%		$0		$16,230
Project Cost Summary						
	Total Short-Term Cost / Long-Term Cost			**$0**		**$56,796**
	Rounded Short-Term Cost / Long-Term Cost			**$0**		**$56,800**
	Total Site Improvement Cost					**$56,800**

8A. Improve Signage at Permit Lot Access						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Remove Sign and/or Pole	EA	$ 50.00	1	$50		$0
Repost Improperly Posted or Spliced Signpost	EA	$ 175.00	1	$175		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$90		$0
Project Cost Summary						
	Total Short-Term Cost / Long-Term Cost			**$315**		**$0**
	Rounded Short-Term Cost / Long-Term Cost			**$400**		**$0**
	Total Site Improvement Cost					**$400**

8B. Improve Signage at Public Parking Lot Access						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Custom Advisory or Destination Sign	SF	$ 20.00	18	$360		$0
Install Custom Advisory or Destination Sign Pole	EA	$ 125.00	2	$250		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$240		$0
Project Cost Summary						
	Total Short-Term Cost / Long-Term Cost			**$850**		**$0**
	Rounded Short-Term Cost / Long-Term Cost			**$900**		**$0**
	Total Site Improvement Cost					**$900**

8C. Shared-Use Path Wayfinding Signage						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Custom Advisory or Destination Sign	SF	$ 20.00	18	$360		$0
Install Custom Advisory or Destination Sign Pole	EA	$ 125.00	2	$250		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$240		$0
Project Cost Summary						
	Total Short-Term Cost / Long-Term Cost			**$850**		**$0**
	Rounded Short-Term Cost / Long-Term Cost			**$900**		**$0**
	Total Site Improvement Cost					**$900**

8D. Consistent NPS Wayfinding on MacArthur Boulevard						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Remove Sign and/or Pole	EA	$ 50.00	3	$150		$0
Relocate Sign and/or Pole	EA	$ 100.00	3	$300		$0
Install Custom Advisory or Destination Sign	SF	$ 20.00	72	$1,440		$0
Install Custom Advisory or Destination Sign Pole	EA	$ 125.00	8	$1,000		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$1,160		$0
Project Cost Summary						
	Total Short-Term Cost / Long-Term Cost			**$4,050**		**$0**
	Rounded Short-Term Cost / Long-Term Cost			**$4,100**		**$0**
	Total Site Improvement Cost					**$4,100**

9A. Limit Risk to Users at Narrow Path Segment						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Sign and Pole	EA	$ 250.00	2	$500		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$200		$0
Project Cost Summary						
	Total Short-Term Cost / Long-Term Cost			**$700**		**$0**
	Rounded Short-Term Cost / Long-Term Cost			**$700**		**$0**
	Total Site Improvement Cost					**$700**

9B. Replace Nonstandard Guardrail End Treatments						
Improvements	Units	Unit Cost	Short Term Quantity	Short Term Cost	Long Term Quantity	Long Term Cost
Site Improvement Costs						
Install Guardrail End Terminal	EA	$ 3,300.00	2	$6,600		$0
Engineering, Mobilization, Traffic Control, Etc.		40%		$2,640		$0
Project Cost Summary						
	Total Short-Term Cost / Long-Term Cost			**$9,240**		**$0**
	Rounded Short-Term Cost / Long-Term Cost			**$9,300**		**$0**
	Total Site Improvement Cost					**$9,300**

	Glen Echo - Concept Major A			
Limits:	***Clara Barton Pkwy & MacCarthur Blvd Interchange***			
Scope:	***Shift exist. EB U-turn exit ramp ~300' east*** ***Relocate WB lane north to accommodate ramp relo.*** ***Extend weave area, increasing safety***			
Item	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Construction Costs				
Roadway	0.45	Mi	$ 6,550,000	$ 2,977,273
Roadway Demo	1,967	SY	$ 20	$ 39,333
Additional Excavation	9,533	CY	$ 75	$ 715,000
Retaining Wall	7,200	SF	$ 125	$ 900,000
Bridge Rehabilitation	-	SF	$ 200	$ -
Subtotal				***$ 4,631,606***
Additional Const. Costs				
Construction Admin./Inspect.	10	%	-	$ 463,161
Utilities	10	%	-	$ 463,161
Geotech Unknowns	20	%	-	$ 926,321
Contingency	40	%	-	$ 1,852,642
Construction Total				***$ 8,336,891***
Professional Services				
Engineering Design & PM	10	%	-	$ 833,689.09
Environmental	4	%	-	$ 333,476
Survey & Investigation	6	%	-	$ 500,213
Professional Liability	4	%	-	$ 333,476
Legal & Permitting	2	%	-	$ 166,738
Professional Services Total				***$ 2,167,592***
Total Cost				**$ 10,504,483**
			Rounded:	**$ 10,600,000**

	Glen Echo - Concept Major B			
Limits:	***Clara Barton Pkwy & MacCarthur Blvd Interchange***			
Scope:	***Re-route WB Clara Barton Pkwy to utilize exist. Bridge*** ***Separate WB Thru and Exit movements eliminating weave*** ***Lengthen resulting merge lane for exiting traffic***			
Item	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Construction Costs				
Roadway	0.31	Mi	$ 6,550,000	$ 2,046,875
Roadway Demo	767	SY	$ 20	$ 15,333
Additional Excavation	2,133	CY	$ 75	$ 160,000
Retaining Wall	2,400	SF	$ 125	$ 300,000
Bridge Rehabilitation	9,600	SF	$ 200	$ 1,920,000
Subtotal				***$ 4,442,208***
Additional Const. Costs				
Construction Admin./Inspect.	10	%	-	$ 444,221
Utilities	10	%	-	$ 444,221
Geotech Unknowns	20	%	-	$ 888,442
Contingency	40	%	-	$ 1,776,883
Construction Total				***$ 7,995,975***
Professional Services				
Engineering Design & PM	10	%	-	$ 799,598
Environmental	4	%	-	$ 319,839
Survey & Investigation	6	%	-	$ 479,759
Professional Liability	4	%	-	$ 319,839
Legal & Permitting	2	%	-	$ 159,920
Professional Services Total				***$ 2,078,954***
Total Cost				**$ 10,074,929**
			Rounded:	**$ 10,100,000**

Appendix B – Meeting Minutes from December Stakeholder Event

Meeting Date: December 12, 2017

Meeting Time: 9:00 AM – 1:00 PM

Meeting Location: Glen Echo Park, Arcade Building Room 202

Project Team:

Maclean Eke, NPS – GW Memorial Parkway

Joshua Nadas, NPS – GW Memorial Parkway

Aaron Larocca, NPS – GW Memorial Parkway

Makayah Royal, NPS – National Capital Region

Isbel Ramos-Reyes, FHWA EFLHD

Usman Ali, FHWA EFLHD

Tom Fowler, Kimley-Horn

Kathy Falk, Kimley-Horn

Danielle McCray, Kimley-Horn

Dan Malsom, Kimley-Horn

Community Stakeholders:

Harold Pfohl – Community Member

Peter Gray, Washington Area Bicyclist Assn.

David Murphy – Cabin John Citizens Assn.

Tim Bragan – Town of Glen Echo

Emily Rogers – Glen Echo Park Partnership

Christy Hughes – Irish Inn at Glen Echo

Greg Pawlson – Cabin John Citizens Assn.

Subject: Glen Echo Context Sensitive Solutions Safety Assessment Project Kick-Off Meeting

Meeting Discussion

The kickoff effort began with a meeting to review the project scope and existing conditions in the study area. All project team members listed above were present for this portion of the effort.

- Tom Fowler reviewed the goals of the project and asked the project team of any existing efforts that were ongoing within the study area. Isbel Ramos-Reyes noted that the ramps between MacArthur Boulevard and Clara Barton Parkway south of Glen Echo were due to be repaved. Joshua Nadas noted that Montgomery County had recently considered the installation of a traffic signal at the intersection of MacArthur Boulevard and the Clara Barton Access Road, but had decided against taking action in that location.
- Makayah Royal and Joshua Nadas noted that there is an ongoing land swap process involving the NPS and the Irish Inn at Glen Echo. The land swap may be occurring in part to help address drainage issues along Clara Barton Parkway.
- Tom Fowler reviewed collected crash data with the team. Few recorded crashes were present at the Access Road study site, while there were many in the ramp study area. None of the recorded crashes resulted in fatalities.
- Tom Fowler reviewed the existing traffic congestion data from the project site. The project team asked the field review team to confirm hours and operations of inbound/outbound lane closures on Clara Barton Parkway during peak travel periods.
- Joshua Nadas noted that he did not believe NPS owned any right-of-way on MacArthur Boulevard.
- Makayah Royal provided additional background about the project and study area. To her knowledge no recent comprehensive area study has been completed in the Glen Echo area. She said that for this and other reasons having input from local residents and Montgomery County staff will be valuable. In the past, residents have written letters to local congressional representatives about congestion and safety concerns in the area.
- NPS partnered with Montgomery County for the shared use path installation through Glen Echo Park.
- The project team discussed the availability of more traffic count data along Clara Barton Parkway. Usman Ali said that he believed there were one or two count stations located along Clara Barton Parkway that could have data, and that he could query the database to see if more count data was available.

Community Stakeholder Event

Following the kickoff meeting, attendees and community stakeholders met to discuss observations about vehicular and pedestrian traffic and safety conditions within the study area. All project team members and community stakeholders listed above participated in this portion of the effort. Tom Fowler delivered an abbreviated version of the presentation shown during the previous portion of the meeting.

- Isbel Ramos-Reyes said that NPS will be resurfacing 8 miles of the Clara Barton Parkway over the course of the years 2019-2021. She describes this effort as an opportunity to incorporate recommended safety improvements from this study effort into an already planned site improvement.
- Greg Pawlson noted that many cyclists use both the path and MacArthur Boulevard near the Clara Barton Access Road, and that many of them do not obey the posted STOP sign there. He said that a school is located near the intersection, and that there is no crossing guard at the crosswalks there. He said that motorists often get impatient because traffic backs up when the one-lane bridge does not clear, which results in drivers behaving more aggressively to get through the area.
- David Murphy suggested that the project team label the bike path along MacArthur Boulevard on all maps. Kimley-Horn has requested bicycle and pedestrian count data from Montgomery County.

- Harold Pfohl said that Montgomery County has plans to install a traffic signal at MacArthur Boulevard and the ramp access to Clara Barton Parkway. This plan will include a new left turn lane from northbound MacArthur Boulevard onto the ramps. Kimley-Horn will check for availability of turning movement count data for this intersection. Tim Bragan said he would be interested to see whether crash rates were higher during peak traffic hours, as he suspected that was the case.
- Community members noted that studies had been completed in the past regarding queueing at the Clara Barton Access Road, and that the traffic issues in the area are exacerbated by incidents on parallel routes such as George Washington Memorial Parkway. Community members noted that even though the intersection of the access road and Ericsson Road is striped with “Don’t Block The Box” style striping, blocking the box still occurs.
- David Murphy noted that many studies have been completed for the area in the past 15-30 years that the project team had not mentioned. He noted that concerned citizens in the area had completed traffic counts and shared results with public officials, but that the counts were not considered valid because they had not been professionally collected. He said that he believed many of the traffic concerns locally were the result of changes in development patterns elsewhere in the region.
- NPS noted that Ericsson Road is owned and maintained by the Cabin John Citizens Association. The project team clarified that their study would involve a review of all the roads in the study area, regardless of who the road owner was. While the focus of the project is to make recommendations that the NPS can implement, other recommendations will be made that apply to portions of the road owned and maintained by others.
- Community noted that the study areas for this project are typically congested during the PM peak period from 3 pm until 6:30 or 7 pm.
- Community members noted several challenges along MacArthur Boulevard in the vicinity of Glen Echo Park, including the difficulty of turning movements at the MacArthur Boulevard/Parkway Ramp/Oberlin Avenue intersection, the tendency for vehicles to use the Glen Echo parking lot as a cut-through to skip traffic queues on MacArthur Avenue, and difficulty of access to the park facilities for visitors travelling there to attend programs that occur during the PM peak traffic period.
- One community member noted that many of the vehicles travelling in the area had Virginia license plates and asked if origin-destination data would be useful as a part of the study.
- One community member noted that wayfinding in the park area is often unclear, with travelers being presented with too much information and not enough processing time.
- One community member recalled three accidents occurring in the Glen Echo parking lot.
- David Murphy asked the project team to consider ways to improve signing in the project area, since some road users are not local (even though many of the users are commuters).
- Christy Hughes made several comments regarding observations from the Irish Inn. He spoke of diners missing reservations because of traffic congestion along MacArthur Boulevard and Clara Barton Parkway. He also said that there should be signage put up to discourage the use of the Glen Echo parking lot along MacArthur Boulevard as a cut-through. He also requested signage requesting that cyclists walk their bikes through parking areas.
- Aaron Larocca noted that the plan should consider how enforcement and education could help achieve some of the project goals.
- Aaron Larocca shared other concerns he had gathered from staff and visitors. These concerns focused on the tendency for debris to wash onto the road at hairpin curve locations. He asked whether the project study or planned pavement improvements were going to include any storm water management elements to reduce the problems associated with runoff and road debris. Makayah Royal and Isbel Ramos-Reyes explained that since the nature of the upcoming pavement project was specifically road maintenance, storm water considerations had not been included. The project team said that they could examine road debris issues as a potential safety concern and include relevant recommendations in the current project report.

Once the presentation was completed, the project team laid out maps of the two project study locations: the set of ramps between Clara Barton Parkway and MacArthur Boulevard south of Glen Echo Park, and the Clara Barton Access Road site northwest of Glen Echo Park. Attendees were invited to add comments to the map related to observed safety concerns, suggested safety improvements, and existing data or project context that would help the project team in developing recommendations. All comments added to the maps are listed below:

Clara Barton Ramp Site

- Data/Context: Signal installation at MacArthur Boulevard/Ramp intersection and creation of northbound left turn lane from Macarthur Boulevard onto the Clara Barton Parkway entrance ramp is currently in design phase
- Comment: Storm runoff deposits sediment onto ramp curves for vehicles entering and exiting the parkway.
- Comment: Lots of excess pavement where eastbound and westbound parkway lanes diverge in the westbound direction
- Comment: Motorists making U-turn from eastbound parkway to westbound weave segment cannot see oncoming traffic and often hesitate to merge and weave, the two weaving movements there move at very different speeds
- Comment: During AM peak, all DC-bound traffic must use right the lane, and late merging vehicles often slow down traffic at lane drop location
- Comment: Some users entering westbound onto parkway from MacArthur Boulevard think they need to merge once they reach the mainline, even though the second lane remains
- Comment: Illegal U-turns occur for vehicles on the exit ramp toward MacArthur Boulevard so that they may re-enter the parkway via the adjacent entrance ramp
- Comment: Long pedestrian crossing distance along MacArthur Boulevard across Oberlin Avenue/Parkway entrance ramps
- Comment: Cars exiting parkway at MacArthur Boulevard often accidentally turn onto shared-use path when turning right, while others accidentally turn left into Irish Inn parking lot instead of onto MacArthur Boulevard
- Idea: Provide an additional lane of traffic for vehicles heading toward DC at existing lane drop location
- Idea: Provide additional lane dividers at eastbound lane diverge area
- Idea: Modify eastbound U-turn lane on parkway to add merge space further to the east for vehicles heading into DC
- Idea: Enforcement of travelers illegally cutting through Glen Echo Parking lot to bypass queued southbound traffic on MacArthur Boulevard

Clara Barton Access Road Site

- Data/Context: Existing Ride On Route 32 bus runs along MacArthur Boulevard, crosses one-lane bridge
- Data/Context: Signal timing on one-lane bridge assumes 15 mph travel speed across bridge
- Comment: Intersection box is often blocked at Clara Barton Access Road and Ericsson Road

- Comment: The access road is often used as a detour for inbound traffic when a backup forms at the Glen Echo ramp hairpin curve further east on the Clara Barton Parkway
- Comment: Traffic entering the parkway heading eastbound from the access road does not have a STOP or Yield sign posted, so this may create a conflict if eastbound off-ramp traffic thinks the intersection is an all-way STOP
- Comment: Several signal cycles necessary to accommodate traffic (likely referring to the signal at the one-lane bridge across Cabin John Creek)
- Comment: Citizens living in neighborhood along Ericsson Road have no other way to exit neighborhood other than Clara Barton Access Road, causing complaints about congestion and delay
- Comment: Cyclists do not use path across Cabin John Creek one-lane bridge – they use the travel lane instead
- Comment: People sometimes try to direct or stop traffic near the bridge
- Comment: Pedestrians often cross access road at Ericsson Road intersection
- Comment: Heavy bike traffic on MacArthur Boulevard on weekends, cyclists often blow through STOP signs
- Comment: Pick-up/drop-off area near access road for private day school, in the afternoon congestion clears by 5PM
- Comment: Length of crosswalk across access road at MacArthur Boulevard is a long distance for pedestrians to cross
- Idea: Install marked crosswalk across MacArthur Boulevard similar to the one at Glen Echo, and enforce with fines for those who do not obey law
- Idea: Install sensors at either side of one-lane bridge to detect queues that form and adjust signal timings
- Idea: Install exclusive right turn lane from MacArthur Boulevard to Clara Barton Access Road
- Idea: improve signage for turning vehicles heading northbound on Clara Barton Access Road toward MacArthur Boulevard

Note:

Dan Spealman, a bicyclist from the area, was not present at the stakeholder event but sent comments to the project team. He left a comment about the MacArthur Boulevard shared-use path, saying that the intersection “creates a crosswalk that is way too long, has too many potential turn options, and is poorly lit after dark.” He said that he was “always worried that I'm going to get hit crossing there and have actually come close once or twice.” The bicyclist also asked whether the study would consider items related to providing bicycle access from MacArthur Boulevard to the existing Chesapeake and Ohio Canal trail on the opposite side of Clara Barton Parkway.