District Department of Transportation

DC Mobility Innovation District

Submitted in response to the U.S. Department of Transportation's
Notice of Funding Opportunity Number 693JJ319NF00001
"Automated Driving System Demonstration Grants"

Part 1 – Project Narrative and Technical Approach

March 21, 2019

District Department of Transportation

Jeffrey Marootian
Director, District Department of Transportation
55 M Street SE, Suite 400
Washington, DC 20003

March 21, 2019

Secretary Elaine Chao
United States Department of Transportation
1200 New Jersey Ave SE
Washington, DC 20590

Dear Secretary Chao,

Washington D.C. has been at the forefront of innovation in transportation since the 1800's, and also has a rich history of partnership with the federal government to test and then mainstream new mobility innovations. Beginning with the concept of "parking" which Congress codified in 1870's law for the District's grand boulevards, to the ubiquitous Capital Bikeshare, funded 80 percent by federal dollars and physically launched at USDOT, there have been many firsts for the United States that start right here, in the District of Columbia. In fact, USDOT and DDOT are only separated by one block in the Navy Yard District of Washington.

The automation revolution is not new, and in transportation began in the 1970's with Level-1 cruise control. However, the speed of innovation tied to processor power and machine learning has dramatically changed the mobility-innovation curve in recent years. The Washington region and the District specifically has been known as a government town, but this is also changing with Amazon Web Services (AWS) in Virginia, Hilton relocating to Southern Maryland, and now Amazon HQ2 locating over the bridge in Crystal City. The District Government is also evolving and was the first city in the U.S. to open all of its data in 2007, built the hugely successful DC-Net broadband network (shared with many federal agencies). In more recent years, the District has been recognized nationally and internationally with awards ranging from leadership in sustainability to technology to fiscal responsibility.

It should also be noted that the District, with a Mayor and 13 Council Members, resembles a city but functions as a state, aiding its long history of transportation innovation. In fact, the District was one of the first jurisdictions in the United States to proactively prepare for AV's with the adoption of the Autonomous Vehicle Act of 2012 followed by DMV guidelines in 2014.

The District is a well managed, fiscally responsible, collaborative jurisdiction prepared to partner with the federal government, to successfully implement the DC Mobility Innovation District.

District Department of Transportation

Southwest Washington is the smallest quadrant of the District, with a tremendous amount of change happening, beginning with the Wharf Development on the Southwest Waterfront. Also, Southwest has a robust Business Improvement District, is home to federal and local government agencies, and has every street typology within its 6 square miles. In partnership with the Southwest Business Improvement District (SWBID), which has already issued an RFI for autonomous testing, the District is excited to co-create a Mobility Innovation District to support and expedite the testing of autonomous driving systems and services, culminating in replacement of the existing SWBID shuttle system with automated shuttles that will run to DDOT and USDOT's front doors on M Street by year 3. It only makes sense to work with USDOT and the private sector to accomplish this, and at the same time, make Washington a leader nationally in the transportation- technology sector, creating jobs and supporting the transportation industry directly in the Nation's Capital.

Sincerely,

Jeff Marootian, Director
District Department of Transportation

Project Name/Title	DC Mobility Innovation District ADS Pilot Program
Eligible Entity Applying to Receive Federal Funding (Legal Name + Address)	District Department of Transportation 55 M Street SE Washington, DC
Point of Contact (Name/Title; Email; Phone Number)	Amanda Stout Deputy Chief of Staff amanda.stout@dc.gov 202-671-2307
Proposed Location for Demonstration	Southwest Washington, DC
Proposed Technologies for the Demonstration (brief list)	• Level 4 ADS from two vendors • LIDAR sensor arrays • Automated ride dispatch/route optimization • Roadside units for signal phasing and timing (DSRC or 5G)
Proposed Duration for the Demonstration	3 years
Federal Funding Amount Requested	$8,975,312
Non-Federal Cost Share Amount Proposed, if applicable	$3,298,600
Total Project Cost (Federal Share + Non-Federal Cost Share, if applicable)	$12,273,912

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1. Executive Summary

a. Vision, goals and objectives

The District of Columbia presents a unique opportunity to demonstrate automated driving system (ADS) technology to a wide audience of users and to showcase the innovative work being done with the support of the U.S. Department of Transportation (USDOT).

The District of Columbia, through the District Department of Transportation (DDOT), has been focused on developing innovative transportation solutions to meet the needs of residents and visitors alike. To this end, through a new Autonomous Vehicles Working Group (the Working Group) established by Mayor Bowser in February 2018, the District is engaging in peer-to-peer learning with other cities to explore implications of automated vehicles on an urban street network, including safety, equity, workforce and employment, curbside management, street design, and a range of other issues. The Working Group has published an Autonomous Vehicles Principles Statement that reflects the input of DDOT and almost a dozen other agencies. The Statement reinforces the District's commitment to safety, equity, efficiency, and sustainability and directs us to achieve these principles through adaptability, transparency, comprehensiveness, and stakeholder alignment. Last year, in partnership with the Working Group, the Southwest Business Improvement District (SWBID) released a Request for Information for an automated vehicle pilot program on 10th Street SW.

In response to this Notice of Funding Opportunity for Automated Driving System (ADS) Demonstration Grants, we envision designating the Southwest Business Improvement District (SWBID) area as the DC Mobility Innovation District (DC MID). The SWBID covers 483 acres of Southwest DC, stretching from 15th Street SW to South Capitol Street, Independence Ave to Maine and M Streets SW, and includes the Southwest Waterfront. The DC MID will not only serve as a testing ground for new mobility solutions, including automated vehicles and micro-mobility, but also create an open ecosystem for the exploration of innovative public policy, connected and accessible infrastructure, public-private partnerships, and positive behavioral change in an era of rapid innovation in transportation technology. The DC MID will serve as a showcase for policy makers, private companies, and the general public to explore while offering a real-world, dynamic context for researchers, designers, technologists, and the District of Columbia to demonstrate and evaluate their ideas and solutions.

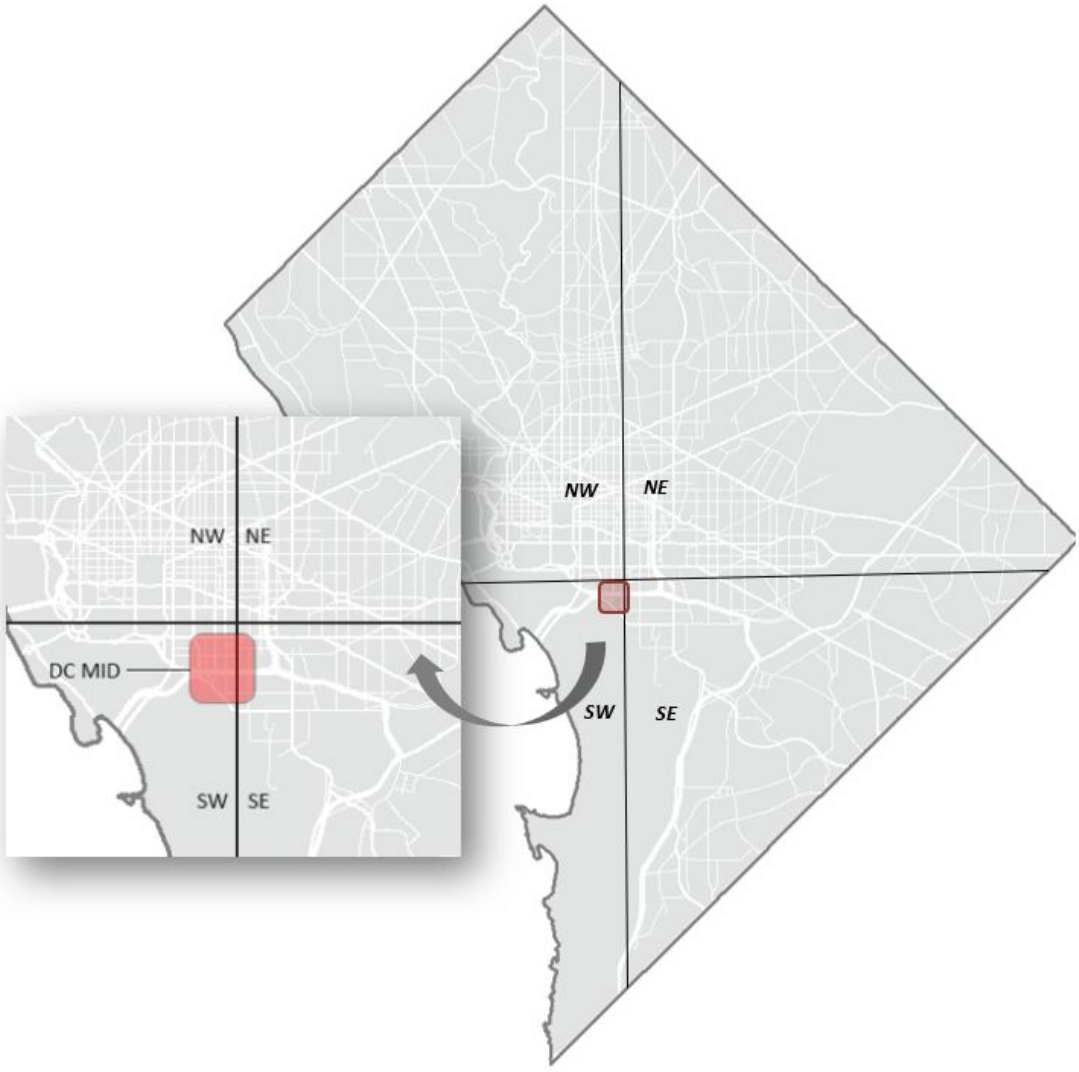

Figure 1: Study Area

Our vision is to keep the District on the cutting-edge of AV technology while providing safe, reliable, and accessible transportation options to the most vulnerable users, including people with disabilities and our aging population, and to serve as a showcase for both national decision makers and the public to familiarize themselves with this emerging technology. DDOT's goal is to fill access gaps in our existing transportation system and foster multimodal connectivity by serving a population with limited transportation options. We are aiming to reach this goal by deploying Level 4 automated shuttles through a phased operational approach in collaboration with the SWBID. The project objectives are to:

- Provide first-mile/last-mile connections to L'Enfant Plaza and Navy Yard Metro Stations,
- Provide mobility options for disadvantaged users including persons with disabilities and older adults,

- Test demand-responsive services or services similar to this in an urban neighborhood to provide seniors with access to neighborhood amenities, and
- Collect critical safety data to help prepare for a more automated transportation system in the future.

Our phased approach includes launching a fixed-route shuttle along 10th Street SW (Phase 1), followed by an expansion plan to supplement or replace the existing SW Neighborhood Shuttle between L'Enfant Plaza Metro and the Wharf or to create a Southeast-Southwest connector between the Wharf and the Navy Yard/Capitol Riverfront area (Phase 2). Finally, we will institute a demand-responsive service that could include fixed (skip-stop) and demand-responsive routes among local amenities in the area, with a focus on servicing the local older adult population centered at Greenleaf Senior Center (Phase 3). More detail on the three phases can be found below in section 1D.

Not only does our proposed phased automated shuttle pilot present an opportunity to build on the SWBID's proposed (but unfunded) automated vehicle pilot, it also aligns with the District's Autonomous Vehicle Principles and supports our Vision Zero, MoveDC, and Age-Friendly DC initiatives.

b. Key partners, stakeholders, team members, and others proposed to participate

In proposing the development of the three-phased automated shuttle approach, we envision a broad, inclusive consortium of stakeholders and partners to not only participate directly in the development of pilot and tests, but in the assessment and evaluation of the various solutions and opportunities. Potential stakeholders and partners include:

- Public sector partners and stakeholders
  - The Mayor's AV Working Group (which includes DMV, Office on Aging, and the Office of Disability Rights)
  - Age-Friendly DC Working Group
  - Multimodal Accessibility Advisory Council
  - Oak Ridge National Laboratory
- Private sector partners
  - Shuttle Providers
    - EasyMile
    - MayMobility
  - Via, an on-demand ride-sharing dispatch platform
  - Ouster, a Multi-Beam Flash LiDAR provider
  - Consultant support for evaluation (DDOT will procure)
  - Consultant support for outreach to the public, stakeholders, and peer jurisdictions
- Nonprofit partners

  - SWBID, DDOT's key partner who will be largely running the operations and procurement of automated shuttles.
  - Other organizations to support outreach both to the public and to other state and local jurisdictions
- Academic partner
  - Samer Hamdar, Center for Intelligent Systems Research, George Washington University

c. Issues and challenges to be addressed, the technology(ies) that will be demonstrated to address the issues, and any quantifiable performance improvements that are anticipated

DDOT has identified three primary challenges to be addressed in undertaking this demonstration project: safe operations, public trust, and preparing the operating environment. The project is designed to allow DDOT, stakeholders, the public, vendors, and USDOT to gain an understanding of whether and how well automated shuttle vehicles can handle complicated urban operations and their ability to support urban mobility.

Challenge #1: Ensuring Safe Operations on District Streets
This first challenge is for DDOT and the District to determine whether it is safe to operate automated shuttles on our public roads. This challenge is closely related to USDOT's goals for this program. Addressing this challenge will require testing, coordination with our agency partners (namely the District Department of Motor Vehicles), and ongoing monitoring. Additional information about safety and safety performance are discussed in Section 2 of the Project Narrative, but in summary, we need to consider a range of safety-related elements for how automated vehicles deal with other roadway users (non-motorized, other vehicles), with the roadway environment itself (including work zones), and how the vehicles handle risk (near-collision as well as basic collision data).

Technology demonstrated to address the issue/challenge: To address this challenge, we propose to demonstrate two different types of automated shuttle vehicles (provided by EasyMile and May Mobility) in increasingly complicated operational scenarios. We will rely on data from the vehicles themselves, as well as additional LIDAR sensors (provided by Ouster) and camera footage, to monitor vehicle performance. The additional sensors allow us to fill in any gaps in data access from the vehicles themselves, which can arise from confidential business information concerns and the sensor data agreements used by the vehicle manufacturers. Ouster's FleetGuide system adds collision avoidance sensors and real-time in-cab 360 degree overhead visual perspective (birds-eye view) and audible alerts for potential conflicts.
Quantifiable Performance Improvements: Effective program design and implementation will allow the District to gain confidence in the performance of ADS on District streets. This experience will allow the District to establish an appropriate policy and regulatory structure for

assessing future ADS requests, provide greater certainty that the right requirements are in place for approval, and, ultimately, shorten the approval process.

Challenge #2: Understanding the level of public trust
As with any new technology, unfamiliarity can lead to fear from those first encountering the technology. Given that ADS technology is still largely in the research and development stage, there is much uncertainty among the public as to how these vehicles will operate, if they are safe to travel in and around, and how to interact with them. Through the phased demonstration with strong public outreach, this project seeks to assess levels of public trust and identify how to address identified concerns.

Technology demonstrated to address the issue/challenge: Surveys will be the primary means of collecting data, through on-board digital surveys in the automated shuttles, opportunities for public feedback (surveys, meetings, events), and gathering of biometric data from a sampling of the public traveling in and around the vehicles.
Quantifiable Performance Improvements: Data and feedback will be collected before, midway through, and at the end of each phase to assess how the demonstrations have impacted public trust. If deployments meet the project goals, an increase in the public trust of the vehicles and the District's ability to regulate them is expected.

Challenge #3: Preparing the operating environment
The District, and particularly DDOT, is seeking to prepare for a future with greater transportation automation, but is currently uncertain as to how to best prepare our infrastructure and workforce. Through physical demonstrations of ADS on our streets, we will gain an understanding of where there are gaps in our public infrastructure and help prioritize our investments to support automation where it can best support the District's goals.

Technology demonstrated to address the issue/challenge: Data on disengagements and incidents, feedback from operators on where automated shuttles struggle, and feedback from users and the public on vehicle operations will all help to identify where the District's operating environment may have contributed to operational issues for ADS.
Quantifiable Performance Improvements: While the District may not choose to address all the identified issues (and instead wait for the technology to improve so it can better handle the operating environment as-is), knowing the types of issues and investments needed will shape future ADS operations and potentially focus future investments.

d. Geographic area or jurisdiction of demonstration

The District's plan is to build on a request for information issued last year by the District and the SWBID for a shuttle on 10th Street SW. The Southwest Waterfront is in the midst of a complete urban transformation with a large existing population who are committed to aging in place and an influx of both visitors and new residents. The area is uniquely positioned, as a rapidly growing and changing multi-use neighborhood in the heart of the District, to become a national

hub for the deployment of innovative mobility solutions. DDOT proposes to bring automated shuttles to the SWBID area in a phased approach beginning with a pilot in a relatively stable environment and building to expand service in more complex urban environments.

Phase 1: Phase 1 begins the ADS demonstration with a fixed-route automated shuttle deployment on 10th Street SW. This street, also known as L'Enfant Plaza SW, is the primary route connecting the National Mall at Independence Ave and the Southwest Waterfront at the Banneker Memorial. This low-traffic street is less than .5 mile in length, . The proposed route does not have any cross traffic nor does it require interaction with existing traffic signals. By starting in this context, DDOT and its partners can gain confidence in the safe operation of the shuttles, while still providing the first part of the desired connectivity in the SWBID area.

While a low traffic street, 10th Street SW is located less than a mile from Capitol Hill and is the site of the US Department of Energy, L'Enfant Plaza Metrorail and VRE stations, the L'Enfant Hotel, and the recently relocated International Spy Museum. Approximately 60,000 office workers are located within a half mile of 10th Street SW and the street is bookended by the National Mall (drawing more than 20 million annual visitors) and the new Wharf development. The Wharf Phase I is a $2 billion mixed-use project that includes three hotels, a 6,000-person music hall, offices, residential, restaurants, recreation facilities, and 10 acres of public space.

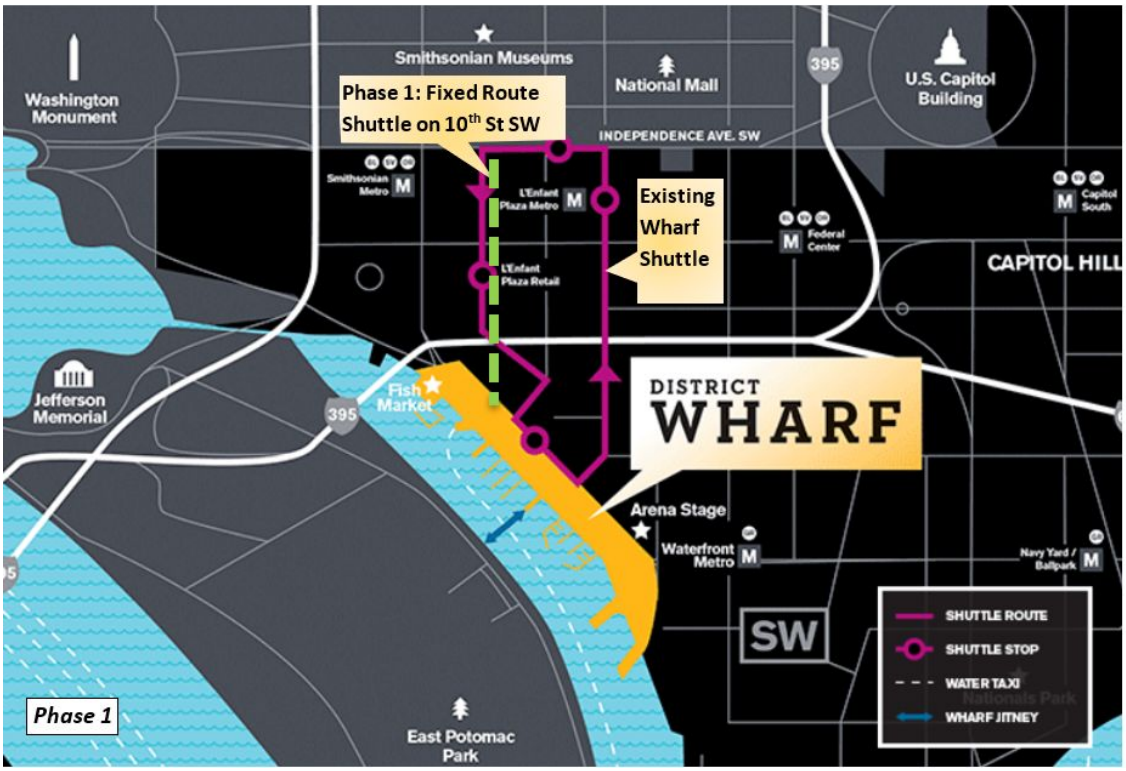

Figure 2: Phase 1 - 10th St SW

Phase 2: During Phase 2 we will expand the fixed-route shuttle to supplement or replace the existing Wharf shuttle or create a Southeast-Southwest connector between the Wharf and the Navy Yard Metrorail Station, approximately a mile to the east. The connection to Navy Yard would partially supplement an existing DC Circulator bus route between the L'Enfant Plaza and Eastern Market Metrorail stations. Exact routing will be developed based on lessons learned in Phase 1 and the results of initial testing, and may be adjusted during the demonstration.

In Phase 2, the street complexity and traffic volumes increase along the route. There are signalized intersections along the route and more potential interaction with pedestrians and cyclists. This phase is expected to increase the utility of the automated shuttle service and, therefore, see greater ridership. The expanded area of operation will also bring more members of the public into contact with the automated shuttles, giving greater opportunities to solicit feedback and provide outreach about ADS. Additionally, skip-stop service via iOS and Android applications can be introduced to more efficiently service the route based on actual demand. In addition, the SWBID and its financial partners in the currently operating SW Neighborhood Shuttle have begun to evaluate the opportunity to augment and or replace the SW Neighborhood Shuttle with an Autonomous Vehicle Fleet with an existing RFI. Pending a successful review of the first 12 months of the program and then subject to a vote of approval by the SWBID Board of Directors, the SW Neighborhood Shuttle Partners will provide additional resources for the Phase 2 and 3 tests of said fleet.

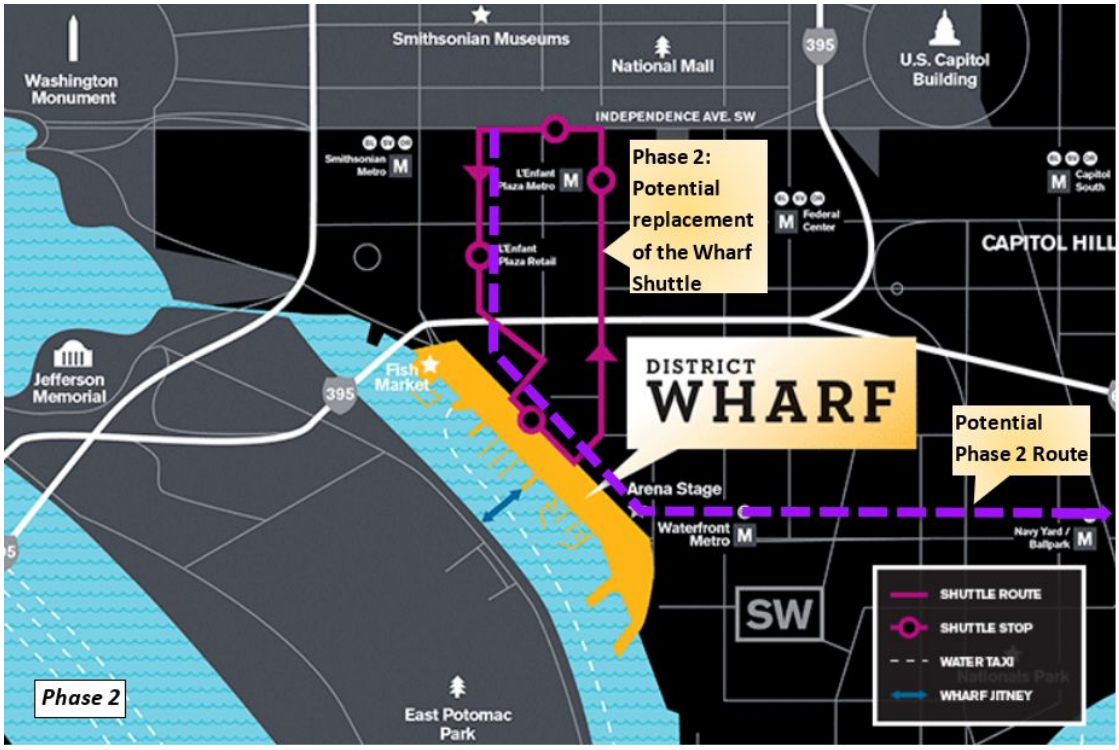

Figure 3: Phase 2 - Wharf/ SW-SE Connection

Phase 3: Phase 3 introduces a separate, more demand-responsive ADS service among local amenities in the area, targeted particularly to serve the older adult population and persons with disabilities. The exact capabilities of the ADS vehicles will determine how this service is structured: fully demand-responsive within a zone, a demand-responsive system limited to certain destinations, or more limited skip-stop service on a defined route between destinations. The key destinations to be served during this phase will be identified through outreach to the senior population in this area, but some expected destinations include the Greenleaf Senior Center housing, the Waterfront Metrorail station area (including a grocery store and pharmacy), and the Southwest Public Library.

The street and route complexity and traffic volumes increase during this phase, which presents even more interactions between the shuttle and pedestrians, cyclists, freight deliveries, and pick-up/drop-off activities along the route.

Figure 4: Phase 3 - Demand Responsive

e. Proposed period of performance including a schedule for implementation and evaluation of demonstration

DDOT proposes for this demonstration to take place over three years, with ADS operating on public right of way for at least two of those years. DDOT will work with academic and other research partners to perform ongoing evaluation during the life of the pilot. In addition, after the completion of each phase, we will evaluate the performance of the vehicles according to

project evaluation plan submitted to USDOT. Once Phase 3 is completed DDOT will submit (1) a final evaluation plan describing how the project has met or not met the original goals described in the PMP; (2) evaluation results of the project according to the Project Evaluation Plan; (3) summary of any complications experienced with the ADS demonstration, including interactions between the ADS and pedestrians, infrastructure, and/or other vehicles; and (4) how to use the demonstration results to help the public interact and better understand the operations of ADS.

The exact schedule for implementation and evaluation will depend on when the award is made. DDOT has assumed a start date in July 2019 as shown in Table 1 below, but we recognize that timing will shift depending on the exact award date. In addition, the timing for Phases 2 and 3 may shift depending on the prior phases' evaluations, public reaction, and the technical capabilities of the partners. The next phase will not commence for public operation until the preliminary evaluation is complete for the prior phase. Phase 3 is expected to take more preparation than Phases 1 and 2 due to the greater complexity of routing and the area covered.

2. Goals

DDOT's proposal supports and strongly aligns with the goals identified in the NOFO. As identified in our vision, safety and understanding the safe operation of automated vehicles are the primary objectives and challenges this demonstration seeks to address. DDOT also recognizes the importance of collaboration around automated vehicles, both for the benefit of shared learning and for the simple fact that our jurisdiction is part of a multi-state region that will need to develop a common understanding of safe operations if automated vehicles are to be deployed on a broad scale.

a. Safety

DDOT's demonstration project will involve automated shuttles running on public roads in mixed traffic. Our phased approach is designed to ensure that there is safe integration into the urban environment, which will be one of the most complicated operational design domains for automated vehicles to navigate on the Nation's on-road transportation system.

The questions of how to determine safe operation is addressed in the next section on data for safety analysis and rulemaking.

b. Data for Safety Analysis and Rulemaking

Evaluating safety and developing related metrics and performance measures have been challenging research topics even before the introduction of automated driving systems (ADS). However, the core motivation for incorporating connected and automated vehicles (CAVs) into roadway traffic has been to improve safety and eliminate human errors leading to collisions and thus further fatalities and injuries. Our approach focuses on gathering data from the vehicles,

sensors, users, and the public to identify the risks, opportunities, and key considerations that rulemaking at the federal and District (and state/local) level must address.

To this end, a core question to answer in this project becomes: how to assess and evaluate the safety of deployed CAVs and what are the metrics to be adopted? Toward answering this question, the DDOT team will utilize a comprehensive set of measures that fall under the following categories: 1) vehicle measures; 2) roadway measures; 3) traffic measures; 4) collision measures; 5) surrogate safety measures; and 6) human experience and human factors measures. These measures, their data, and how to gather that data are discussed below.

The vehicle measures focus on the speeds and accelerations (lateral and longitudinal) along with their corresponding distributions (including variance measures) in time and space. Such measures are compared to comfort/maximum thresholds that translate into safety thresholds (for example: when defining "erratic maneuvers") especially when dealing with transit service with drivers and multiple passengers being involved. In addition, the vehicle measures are associated with the internal ADS adopted and thus incorporate the number of Automated Vehicles (AVs) disengagements, the operational design domain violations, the false detection rate, and the error/uncertainty in terms of both detection and communication.

Roadway measures are mainly related to the infrastructure quality when defining the AV right-of-way; this includes available clearances, separation type, marking/sign/signal (i.e., control devices) types and quality, and pavement quality. Even though not directly associated with AV safety, AV system resiliency to infrastructure imperfections is measured by the detection rate and the positioning of the AVs with respect to different infrastructure elements when dealing with such imperfections.

The third type of measure is associated with the surrounding traffic macroscopic/aggregate characteristics. The focus is on flow, density/occupancy, and speed along with their variance in space and time. The research team will use both traffic detector data and camera data along the proposed path of the ADS in order to measure the impact of the ADS (i.e. before and after analysis) on the flow perturbations experienced in the surrounding vehicular and pedestrian traffic. The higher the perturbations in the surrounding traffic, the more unsafe the system is.

The collision measures are standard measures often adopted when analyzing safety by transportation safety experts. These measures include collision metrics (i.e., absolute/frequency measures, standardized measures per million vehicle miles travelled, etc.) and the resulting fatality and injury rates. These measures will be adopted as a normalizing threshold for comparison between AV and non-AV shuttles. However, it should be noted that collisions are expected to still be rare events when deploying the proposed ADS.

Accordingly, a fifth type of measures is needed: surrogate safety measures. These measures are specifically introduced to define near-collision or near-incident events. The main surrogate safety performance measure that may be deduced from every-day traffic trajectories is

time-to-collision (TTC). TTC is the time difference between the vehicle (in this case, the AV) and the surrounding traffic units that may lead to collision if these units keep their current speeds without performing evasive maneuvers. In an intermodal environment, the traffic unit may be a pedestrian, a cyclist, a scooter, a personal vehicle, or another bus/shuttle. This type of microscopic measure requires surrounding trajectory data, and the research team will adopt secondary LIDAR units and cameras to be installed on the AVs in order to record such trajectories. Other TTC related safety measurements may be derived from the surrounding trajectory data including the rear-end crash index (CPI), the Time Exposed Time-to-collision (TET), and the Time Integrated Time-to-collision (TIT). The team will explore additional surrogate safety measures during the course of the project. These safety measures have never been calculated in an ADS environment and thus their use for ADS safety evaluation is still a topic to explore. These measures are the number of surrounding shockwaves created, the post-encroachment time (PET) and the deceleration to safety (DTS). Based on the surrogate safety measures, the research team will adopt the method of Lareshyn et al. (2010) where a hierarchical framework is used to evaluate safety. This approach divides the encounters between roadway users into three categories: collision encounters, conflict encounters, and undisturbed passages. Safety in each category is characterized by micro-behavioral measures or indicators and thus the need for trajectory data.

All the aforementioned safety measures are based on objective data collected through different sensors. However, a different kind of data is needed in this work especially when dealing with travelers vulnerable to collisions: pedestrians and cyclists. This kind of data relies on observational studies and surveys and is to be translated into human experience and human factors measures. These kind of measures are mainly associated with the responsiveness of the users of the ADS (i.e., operators and riders) along with surrounding travelers. Human factor measures will mostly focus on the heart rate and blood pressure data collected through wearable (wrist) sensors. As for the human experience measures, they will be collected through surveys. These surveys rely mostly on the Dula Dangerous Driving Index (DDDI) that can be adapted to measure the corresponding index for the AVs (as recorded by the operators). Moreover, the index can be utilized to measure the likelihood of dangerous behaviors through the manipulation of self-reported measures. The research team expects a multivariate analysis testing for the change of behavior with and without the presence of the ADS (i.e., the hypothesis). It should be noted again that the exact survey language has been studied by the research team, which found that some questions from the DDDI are inapplicable to the ADS scenario being evaluated in terms of safety. Some questions are to be added from other resources including the Driver Stress Inventory (DSI) (Matthews et al., 1997) and the Driving Behavior Questionnaire (DBQ) (Reason et al., 1990). Additional questions may be related to the travelers' habits and travel history.

This aspect of the project will be led by the team at George Washington University, led by Dr. Samer Hamdar, with support for data management from Oak Ridge National Laboratory (ORNL). Our approach is meant to separate implementation and operation of the demonstration from the evaluation. Storing the data at ORNL gives us an independent third

party to compile data from a range of vendors and provides access to DDOT and USDOT. We are also interested in supporting any future data repositories, including those that will be developed by City Cohort partners (see section 5C) , that may address the needs of industry and government partners.

c. Collaboration

The DDOT team represents a blend of state and local government, academic, and private sector partners. All members of the team, and particularly DDOT and the evaluation partners, are committed to sharing information about what is learned from the demonstration projects. As both a state and city, DDOT is a member of the American Association of State Highway and Transportation Officials (AASHTO) and the National Association of City Transportation Officials (NACTO). Both of these groups strongly support information sharing among their members, and DDOT would seek to leverage these groups, and others, during the pilot.

To support best practice sharing and information dissemination, we include an outreach task in program design and will reach out to peer jurisdictions early and often. DDOT is a member of a group dubbed the City Cohort, along with Austin, Detroit, Kansas City, Omaha, and South Bend, and has agreed to collaborate with public, private, and non-profit partners to advance shared data initiatives. More information on the City Cohort can be found in section 5C.

3. Focus Areas

a. Significant Public Benefit(s)

By designating the Southwest Waterfront area as the DC Mobility Innovation District (DC MID), the project will allow the area to serve not only as a testing ground for new mobility solutions, including automated vehicles and micro-mobility, but also create an open ecosystem for exploration of innovative public policy, connected and accessible infrastructure, public-private partnerships, and positive behavioral change in an era of rapid innovation in transportation technology. The DC MID would also serve as a showcase for policy-makers, private companies and the general public to explore while offering a real-world, dynamic context for researchers, designers, technologists, and the District of Columbia to demonstrate ideas and solutions.

Establishing the DC MID in the Nation's Capital provides an opportunity for broad exposure to the public and to federal policy-makers. The District of Columbia receives more than 20 million visitors (from across the country and globe) every year, and more than two million of those visit destinations either inside or within a half-mile of the project area, including the National Mall, the Wharf, and the Museum of the Bible. Unlike projects in communities that do not attract large numbers of visitors, this project has the potential to inform and engage a massive audience from different communities across the country. In addition, a project in Washington, D.C., will be a showcase for the many policy-makers residing in and coming to visit the District.

The phasing approach also allows the project to test more than one use case and serve a range of different users. Phase 1 capitalizes on the tourist/entertainment destination-heavy environment of L'Enfant Plaza, along with the relatively simple operating environment, to introduce novel technology to a user population that both (a) can be expected to seek out new experiences, and (b) has transportation needs that are otherwise not well-met. Phase 2 adds a new major entertainment, shopping, and residential destination (the Wharf) that needs better transportation connections, along with the federal government-heavy corridor of 7th Street SW. It also incrementally adds complexity to the operating environment, allowing more robust testing of the various technologies' capability in handling signalized intersections, a greater number of pedestrians, cyclists, and scooterists, and a variety of curbside management protocols. Phase 3 (to be introduced after successful testing of Phases 1 and 2) presents the greatest operational complexity, as well as the greatest potential to serve a broader range of users, to include the residents of both the greater Southwest neighborhood and the Greenleaf Gardens and Greenleaf Senior public housing communities.

b. Addressing Market Failure and Other Compelling Public Needs

A primary goal of this project is to test the ability of ADS to serve user groups and destinations that otherwise have limited access to flexible transportation options that adequately serve their needs. In particular, the District project team has chosen to focus on identifying solutions that increase access and mobility for older adults and people with disabilities.

The Washington region's MetroAccess paratransit service, offered by WMATA, faces numerous challenges. A 2016 McKinsey report commissioned by WMATA recommended a range of possible measures to outsource paratransit rides to reduce the growing cost of MetroAccess, which provides more than 2 million annual trips on a budget of about $110 million (i.e., more than $50 per passenger). By 2025, the analysts predicted more than 3 million trips and an annual operating cost of $170 million because of an aging population. WMATA and the regional jurisdictions have been experimenting with alternative delivery mechanisms (including both traditional taxis and TNCs) to provide travel options for older adults and people with disabilities, but cost containment and market segmentation (not all paratransit users require wheelchair-accessible vehicles) remain problematic.

EasyMile provides a high level of accessibility in their vehicles and can provide a manual ramp that is fully ADA-compliant as well as tie-downs. EasyMile is actively working to make their vehicles fully ADA-compliant. May Mobility is currently working on a vehicle with accessibility options including wheelchair access that will be available in the Spring of 2019 and added into the existing fleet. In preparation for developing accessible vehicles, May Mobility increased the door width to provide better access, including wheelchair capabilities.

The project also presents an opportunity to serve populations where transportation options are limited, regardless of age or physical ability. The groups of visitors most likely to find that their transportation needs are well-served in the project area are single adults with disposable

income, who are familiar with the area or have high confidence in their ability to navigate, and who have the ability to connect to the many private transportation providers (TNCs and dockless bike and scooter operators) via smartphone. Families traveling with children have limited options for affordable, convenient, reliable service that meet their travel needs. Tour operators have traditionally relied on large motorcoach vehicles to transport visitors from destination to destination. While this model works well for the intercity component of trips, the vehicle size and operational demands, lack of driver facilities, and challenging/high-demand curbside environment in the area makes this model unsuitable for the internal circulation functions that many such visitors need. The shuttle services proposed in this project, utilizing smaller multi-passenger vehicles that can be operated with a more dynamic and flexible approach, solve many of these challenges.

First-mile/last-mile connections to transit also inform our thinking about the opportunities presented in this project area. Destinations like the Fish Market at the north end of the Wharf are nearly three-quarters of a mile distant from the closest Metro station. As we look to create new behaviors in a rapidly developing area of the District, we have the potential to avert market failures by establishing new transit behaviors, rather than working to change existing behavior.

c. Economic Vitality

The project team includes US-based companies that are at the forefront of technological innovation in the deployment of real-world transportation and information solutions. These include:

- May Mobility - an ADS start-up based in Ann Arbor, MI. May Mobility deploys modified Polaris GEM vehicles, which are multipurpose, 100 percent all-electric transportation and utility vehicles manufactured in Anaheim, CA.
- Ouster - A start-up based in San Francisco; domestic software and hardware manufacturer, and service provider to government (Fleet Guide)
- Via - Grown from its origins as a small operator in New York City, now a world leader in on-demand transit that provides more than 2.5 million rides per month.
- EasyMile - A French software and hardware company, now with U.S. operations in Denver, Colorado.

The District's Economic Strategy designates Technology as a "core sector" of the city's economy, meaning that it has a significant presence in the DC economy, in terms of employment and/or GDP contribution. In addition, the Economic Strategy designates Smart Cities and Civic Solutions, Security Technology, and Data Science and Analytics as "opportunity areas," i.e., cross-cutting industry clusters that offer high potential for tax revenue growth, industry development, and an increase in living wage (or better) jobs with various levels of educational attainment. These areas are poised for growth due to their strong existing activity, growth potential, and ability to play to the District's comparative strengths and workforce assets.

The project will support economic vitality at the regional level by providing opportunities to connect residents of low-income and under-served communities to these core and opportunity sectors of the District's growing economy. Census Tract 6400, which includes the Greenleaf Senior and James Creek public housing properties, and is immediately adjacent to Greenleaf Gardens and Greenleaf Additions, is a federally certified Opportunity Zone.

Additionally, a goal of the Mobility Innovation District is to catalyze new technology-transportation businesses to locate in Washington D.C. and not limited to the software space. 3-D Printing, light manufacturing and other "makers" are going to be strongly encouraged to create jobs both skilled, semi-skilled and technical in nature in the MID.

d. Complexity of Technology

The project will demonstrate a collection of projects that demonstrate automation, including L4 automation technologies (EasyMile and May Mobility). Our approach integrates these technologies with cutting edge data collection (Ouster) and routing (Via) to ensure a full stack of technologies to support the spectrum of needs, from riders to policy makers and data analysts.

Via: Via develops and operates the most powerful on-demand transit systems in the world. Via's cloud-based technology enables customers to share rides by dynamically routing vehicles in real time in response to demand, turning any fleet into an advanced on-demand transit network. Using algorithms developed by elite researchers and engineers, Via's technology optimizes the balance between maximizing fleet utilization and ensuring that each rider has a high-quality experience, delivering services that are as appealing as they are efficient. In deployments of fleets of autonomously driven vehicles, the integration with the Via solution enables the utilization of the core asset of the fleet--each and every seat.

By including the demand response and routing solution in this proposal, DDOT is addressing several dimensions of the Complexity of Technology focus area by not only experimenting with autonomous driving technology but also with the integration of such technologies into real world ridesharing services--a likely mass-scale use case for this technology. For DDOT, Via will deploy an infrastructure that has been tested in the company's largest markets. Via's system has over one million registered users who complete over 65,000 rides per day. This partner has already solved the platform processing challenges that arise when scaling on-demand transit services and we are confident that Via's systems will support the requirements of this service.

EasyMile: EasyMile was at the forefront of NHTSA's October 2018 changes to the process for receiving exemption from Federal Motor Vehicle Safety Standards (FMVSS). This is a testament to the level of experience that EasyMile has deploying the autonomous technology around the world, resulting in being recognized as a leader in this space. The company continues to work closely with NHTSA, the Federal Transit Administration (FTA), the Federal Highway

Administration (FHWA), the Volpe Center, and other branches of the federal government, along with state governments, as driverless regulations are developed and refined.

EasyMile's vehicles, including the EZ10 are Level 4 according to the SAE definition of Driving Automation Systems for On-Road Motor Vehicles - J3016_201806. A Level 4 system is an Automated Driving System (ADS) that can itself perform all driving tasks and monitor the driving
environment – essentially, do all the driving – in certain circumstances. The human need not pay
attention in those circumstances. The EZ10 is preprogrammed by EasyMile engineers or certified partners to run on predefined routes or network of routes, under certain circumstances.

May Mobility: May Mobility offers transportation services leveraging a low-speed electric vehicle (LSEV) 2018 Polaris GEM e6; with a top speed of 25mph. While May Mobility modifies the vehicles substantially from Polaris, none of the core structural and safety measures are altered. Due to this, our vehicles are compliant with federal standards based on the certification, licenses, and other approvals for the overall Polaris GEM platform.

The vehicle is approved for operation on public roads up to 35mph, complying with FMVSS 500 regulations. It is designed to operate as an SAE Level 4 automated vehicle. The vehicle is 63in wide, 176in long, and 72in in height. Without passengers, the vehicle weighs 1,700 pounds. May Mobility is currently working on a vehicle with accessibility options including wheelchair access that will be available in Spring of 2019 and added into the existing fleet. Since the accessible vehicles are in development, the exact dimensions are not available. The final specifications will be communicated immediately upon completion and finalization of the prototype. In preparation in developing accessible vehicles, May Mobility increased the door width to provide better access, including wheelchair capabilities.

Along with the autonomous software in the vehicle, May Mobility is a connected vehicle to the surrounding environment. May Mobility shall implement Roadside Sensing Units (RSUs) with the ability to accurately view the state of traffic signals as input to guide the self-driving shuttle system. May Mobility's on-board hardware stack will be able to receive SPaT data via existing DSRC communication as an additional signal to guide the self-driving shuttle system. May Mobility will be able to support DSRC communications with installed roadside units for activity such as Traffic Signal Priority (TSP) and Vehicle Turn Right in Front of Transit Vehicle (VTRFTV).

Ouster: Ouster provides a uniquely reliable LIDAR sensor array that will enhance the team's capabilities to evaluate the research questions posed in this project. LIDAR sensors produce the data that enable vehicles to "see." LIDAR data is one of the most important data inputs that inform self-driving vehicles because of the rich spatial information and lighting-agnostic sensing capabilities that it has. As such, LIDAR sensors should be rugged and reliable as a physical system and produce accurate and detailed data.

Ouster's decision to develop LIDAR sensors based on semiconductor technology has helped make their sensors extremely rugged and reliable. Further, these technology choices allow for radically streamlined design and manufacturing, fewer points of failure in the field, and robustness with respect to shock, vibe, jitter, thermal cycling, and other challenging environmental conditions such as extreme temperatures.

High Resolution LIDAR Output: Software processors developing automated driving systems rely on LIDAR data to measure the distance and velocity of objects in the surrounding environment. Using these (along with other) data inputs, software processing will then determine a route and send instructions to the components responsible for moving and controlling the vehicle. These inputs also allow software processors to develop obstacle avoidance algorithms, predictive modeling, and other object identification to help the vehicle navigate as it is moving.

However, despite the importance and usefulness of LIDAR data for ADS, most LIDAR sensors lack the raw resolution and efficient array structure of visual camera images. Further, most 3D point clouds are more difficult to encode in a neural network or process with hardware acceleration. In order to bring the best aspects of visual camera and LIDAR into a single sensor, Ouster has incorporated firmware that allows LIDAR to output fixed resolution depth images, signal images, and ambient images in real time, all without a camera.

Deep Learning Applications: This huge breakthrough solves one of the biggest bottlenecks in implementing deep learning models for ADS--accurate, multi-layer labeled training data. Ouster's unique data output allows these images to be directly fed into deep learning algorithms that were originally developed for cameras (i.e., use of 2D deep learning algorithms on data), thereby solving current challenges in making 3D LIDAR data usable.

FleetGuide: This high-resolution output of LIDAR also enables the detailed in-cab visualizer and 3D reconstruction capabilities of FleetGuide. LIDAR data also enables the calculation of various telematic information including harsh braking, acceleration, cornering, and surrounding vehicle detection (i.e., proximity and velocity).

e. Diversity of Projects

The District's project has the advantage of serving a variety of communities within a single project area. Tourists, federal employees, public housing residents, older adults, and people with disabilities are all specific rider communities that the project, in its separate phases, is designed to serve. By varying vehicle types to include ADA-accessible vehicles, the project will test different configurations to best serve the needs of this population. By varying operating models to include regular fixed-route, skip-stop, and demand-response services, the project has a unique opportunity to test the vehicle and driving systems' capabilities to serve the markets for these different types of trips.

f. Transportation-Challenged Populations

The District of Columbia is home to over 700,000 people, with approximately 140,000 of those residents living with disabilities. In the greater Southwest neighborhood of the District, approximately 18 percent of residents are 65 years or older. The DC MID project team's service model will expand service for these broader communities, as well as meet the needs of the particular populations served by the public housing communities within the service area. The Greenleaf Senior high-rise serves 177 households. Forty-two percent of the current residents are older adults, and 50 percent have some type of physical disability.

g. Prototypes

This project is focused on demonstrations for ADS vehicles that are past the test track phase. Vehicles will be tested in real world conditions under increasing complexity. The DC MID project envisions the demonstration of automated shuttles under a limited range of use cases and operating environments that affords the ability to incrementally test greater complexity.

4. Requirements

a. Each demonstration must focus on research and development of automation and ADS technology with a preference for demonstrating L3 or greater automation technologies

The EasyMile solution to be demonstrated in Phases 1 and 2 is considered L4. The May Mobility solution to be demonstrated in Phase 3 is considered L4.

b. Each demonstration must include a physical demonstration

Each of the three phases of this initiative include physical demonstrations of increasing complexity in Southwest DC and beyond.

c. Each demonstration much include the gathering and sharing of all relevant and required data with the USDOT throughout the project, in near real-time. Minimum of five years after award.

We will seek to clarify USDOT's needs at the outset of the project and our proposed evaluation will cover all major data points. DDOT confirms that we will negotiate and sign a mutually agreeable data sharing agreement with USDOT ensuring at a minimum the above-required data accessibility for at least the minimum defined period.

d. Each demonstration must include input/output user interfaces on the ADS and related applications that are accessible and allow users with varied abilities to input new destination or communicate route information and to access information generated by the ADS.

The ADS services offered during the demonstration will be available to passengers with varying accessibility needs. During the life of the project, the team will operate a variety of I/O user interfaces that are accessible and allow users with varied abilities to input new destination or

communicate route information and to access information generated by the ADS. For example, EasyMile's EZ10 shuttle is designed for on-demand use by passengers. Passengers have the ability to order an autonomous electric shuttle via a smartphone application. The passenger screen can also be used to push messages from the control center, for instance to provide geolocalized information, emergency procedures, next stops, and ETA.

e. Each demonstration must address how the demonstration can be scaled to be applicable across the Nation to similar types of road environments, and include an outreach task to share demonstration status, results, and lessons learned with other jurisdictions and the public, in furtherance of technical exchange and knowledge transfer

Given the District's status as both a City and State and audience of local residents and national visitors, it is uniquely positioned to share and communicate with a variety of constituencies. Our plan includes both outreach to the public and peer jurisdictions, and all findings will be made available on a rolling basis throughout the demonstration.

5. Approach

a. Technical approach to implement and evaluate the demonstration

Implementation and evaluation of this pilot project will advance over a three year time frame as detailed in Table 1 and described in three stages below:

Setting the Stage : This phase includes any preparation work required to finalize partnerships and start procurement processes. During this phase DDOT will also further advance required documents needed from the operators, project evaluation partners and/or consultants including Project Management Plan (PMP), Concept of Operations (CONOPS), and components of the Data Management Plan (DMP).

Pre-Implementation: During this phase DDOT will conduct any necessary field preparation work such as making any required changes to infrastructure, ITS systems, signage, and identifying vehicle storage and charging locations. During this phase the agency will also obtain any regulatory or waiver approvals such as Buy America Waiver requests as well as any necessary waivers from NHTSA, and the District Department of Motor Vehicles (DMV).

Implementation and Evaluation :The District will deploy the pilot in three phases taking an incremental and iterative approach while evaluating the performance of the vehicles in each phase. Outreach to stakeholders will take place throughout all three of these stages. Outreach to older adults and persons with disabilities will be important during preparations for the Phase 3 (on-demand) service operations, to ensure acceptance and that the service profile meets user needs. The project team will leverage connections with the District's Age-Friendly DC office, the Office of Disability Rights, and the Department of Aging and Community Living, along with the DC Housing Authority (which manages Greenleaf Senior Center), and the Waterfront Village, a local 501(c)(3) nonprofit organization supporting residents who wish to age in place.

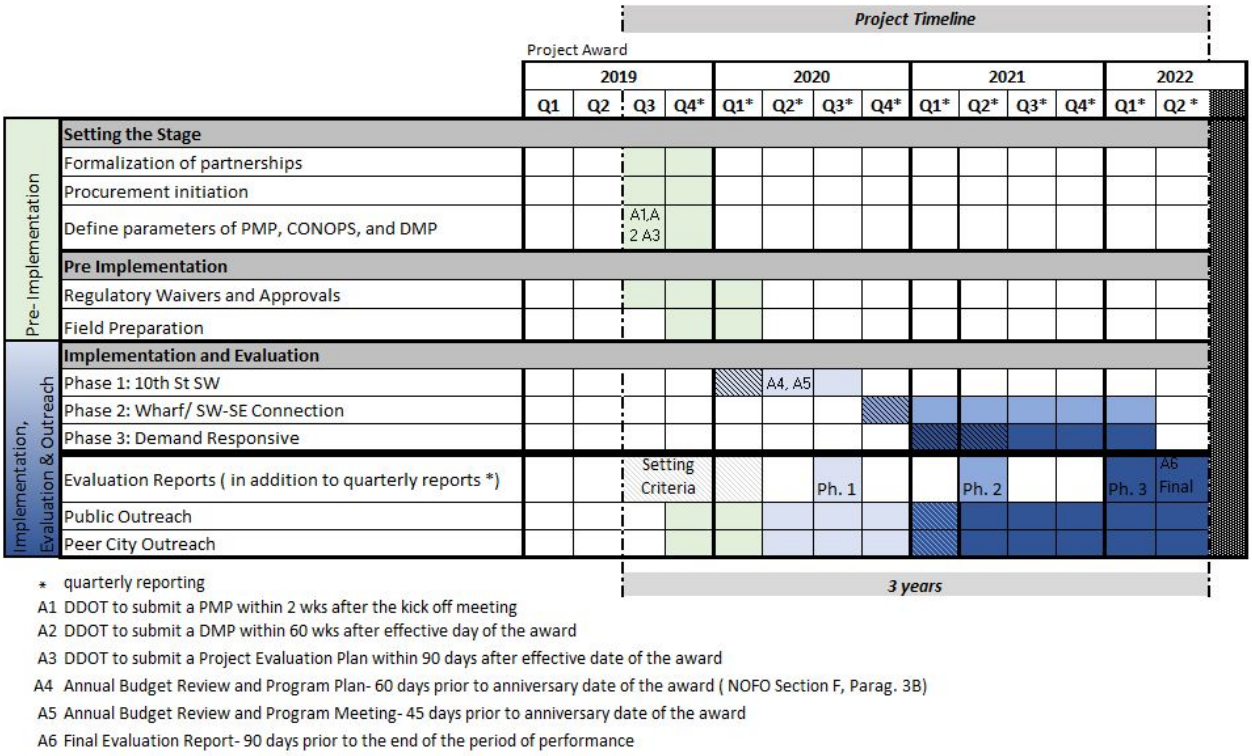

Table 1: Project Timeline

b. Approach to address any legal, regulatory, environmental, and/or other obstacles to demonstrating the technology(ies)

DDOT will work closely with the District Department of Motor Vehicles (DMV) to secure permission to operate automated shuttles in the District. There are no current regulations on ADS operations in the District, but DMV will be a project partner so that lessons learned in this demonstration will inform future regulations and permitting done by DDOT and DMV for automated vehicles.

The MID project envisions the demonstration of automated shuttles under a limited range of use cases and operating environments that affords the ability to incrementally test greater complexity. EasyMile will provide the EZ10 15 PAX vehicles for transport service. The EasyMile shuttle requires federal exemption from NHTSA to operate on public roads since it does not comply with current FMVSS standards. The EZ10 requires exemption from the Buy America Act. In October 2018, NHTSA updated their process for granting exemptions from the FMVSS and EasyMile was the first to apply and be approved for projects via this new process. May Mobility offers transportation services leveraging a low-speed electric vehicle (LSEV) 2018 Polaris GEM e6, with a top speed of 25 mph. While May Mobility modifies the vehicles substantially from Polaris, none of the core structural and safety measures are altered. Due to this, the vehicles

are compliant with federal standards based on the certification, licenses, and other approvals for the overall Polaris GEM platform. The vehicle is approved for operation on public roads up to 35 mph, complying with FMVSS 500 regulations. It is designed to operate as an SAE Level 4 automated vehicle. All May Mobility vehicles satisfy "Buy America" requirements.

c. Commitment to provide data and participate in the evaluation of the safety outcomes of proposed activities and note measures of effectiveness in other arenas, such as mobility

DDOT's MID project offers a unique technology solution to a common challenge with data-sharing in the ADS arena. The deployment of ADS demonstration projects involves unusually sensitive data from on-board systems proprietary to the OEMs or their technology partners. While data protection is critical to the protection of intellectual property, a lack of shareable data can inhibit evaluation of safety outcomes. The DDOT team is carefully considering the methodology of both the storage and sharing of the collected data to ensure compliance with all applicable privacy laws.

Commitment to Coordinate, Collaborate and Share: In addition, the District of Columbia has agreed to collaborate with the cities of Austin, Detroit, Kansas City, Omaha, and South Bend (the City Cohort) around several activities, including:

- **Common Data Framework**. The City Cohort is committed to collaborating on a common framework for data that will allow for each city and its partners to use a common language and develop common data protocols to better enable robotics, artificial intelligence, and safety related to ADS, and to ease the exchange and sharing of data with USDOT, City Cohort members, and others as more fully set forth in the Data Management Plan.
- **Automated Driving System Community of Practice**. The City Cohort will collaborate in developing, standing up, and participating in a Community of Practice dedicated to the sharing of what is working, and what needs improvement in the execution of the USDOT ADS grant, as well as to gain insight from industry experts. It is expected that USDOT will participate if desired and it will be open to other grantees and other public agencies as appropriate.
- **The Development of an Open Data Commons**. The City Cohort will collaborate to develop decentralized, open and secure data sharing to better enable robotics, artificial intelligence and safety related to ADS as more fully set forth in the Data Management Plan.
- **Data Sharing Agreements between the City Cohort**. The City Cohort will collaborate on a data sharing agreement between the cities.
- **Development and Use of a Common ADS Lexicon**. The City Cohort commits to the development and use of common terminology to allow for a consistent communication with USDOT.
- **Automated Driving Systems Advisory Council:** In order to bring expertise from the private sector, the City Cohort has assembled a team of organizations that agree to provide

technical advice to the cities in four areas: Robotics/Artificial Intelligence, Safety, Mobility, and Data. The level of technical advice, and whether it is in one or all four of the areas, is at the discretion of the individual organization. The Advisory Council is meant to supplement and be supportive of each cities' operational partner support. The organizations listed below have agreed to provide uncompensated technical advice to these cities based on their commitment to the advancement of safe automated driving systems in the United States. The Cohort will continue to add organizations to the Advisory Council as they proceed with the grant.

AT&T Inc.	Disability Rights Education & Defense Fund	
Audi North America	IOTA Foundation	National Renewable Energy Lab
Booz Allen Hamilton	Lawrence Berkeley Laboratory	NXP Semiconductors
Deloitte	MITRE Corporation	Panasonic

d. Approach to risk identification, mitigation, and management

The District and DDOT have a proven track record of effectively deploying state-of-the-art technology projects and programs by successfully identifying and managing the inherent risks of such deployments through a robust risk mitigation and management strategy. DDOT applies Project Management Institute's Risk Management framework to plan, identify, analyze, respond and monitor/control risks associated with projects.

In addition, DDOT also has the capacity, framework and institutional knowledge to manage grants that involve multi-agency stakeholders. In the recent past DDOT has successfully managed grants from USDOT (including High Speed Intercity Passenger Rail and TIGER funds through the Federal Railroad Administration, and Value Pricing Pilot funds through the FHWA), the Department of Homeland Security, and other federal agencies.

DDOT has identified technical, institutional, and policy risks associated with our proposed three-phase ADS shuttle approach, along with mitigations. Table 2 below identifies risks and potential mitigation strategies.

Risk	**Mitigation**
Technological	

DDOT will deploy and test state-of-the-art technology as part of this pilot. There are technical risks in such deployments. These risks include, but are not limited to: ● Lack of consistent standards. ● Market-readiness of technologies in non-test bed setting, especially in a vibrant, multi-modal, urban environment. ● Interoperability across agencies, jurisdictions, and transportation modes. ● Public acceptance and market penetration of new technologies. ● Demonstrating quantifiable benefits and metrics that can be traced back to new deployments. ● Sustainability of connected vehicle infrastructure beyond grant life cycle.	The District has an innovation culture and experience in deploying new transportation technologies. System-users are early adopters of innovative technological solutions, and past experience has identified mitigations, e.g.: ● Follow the traditional system development life cycle process and develop requirements prior to implementation. ● Adopt an incremental and iterative approach to deploying new assets and technologies ● Follow the District's ITS and Open Data standards and philosophy to avoid getting locked into proprietary solutions. ● Leverage lessons learned from other jurisdictions that had similar deployments.
Cost & Schedule Risk	
Being at the forefront of innovation comes with inherent risks related to project schedule and costs due to: ● Deployment in a new environment ● Interfacing with new partners to ensure interoperability	To mitigate these risks DDOT will implement sound project management techniques that include: ● Rigorous cost and schedule control ● Using established qualitative and quantitative risk analysis techniques to identify risks in advance
Policy	
Aspects of the pilot could require policy changes. Some of the policy risks include: ● Implications of connected vehicles on system security, particularly in conjunction with open data. ● Required Buy America and other waivers from NHTSA	The District has already worked to set the foundation for policy needs: ● DDOT has the legislative and policy framework in place to launch the program. (the District was one of the first jurisdictions to pass legislation on automated vehicles)

• Potential liability for information provided through open data channels.	• The Mayor's AV Working Group has developed a set of principles that are specific to the needs and opportunities of the District. • Engage with national organizations such as NHTSA to obtain necessary waivers. • DDOT has begun coordination with the District Office of Chief Technology Officer (OCTO) regarding data sharing.
Managing and operating transportation systems requires coordination across a set of traditional stakeholders. Given the District's geographical setting and travel patterns, other stakeholders come into play, including neighboring DOTs, counties, MWCOG, the federal government, FBI, Secret Service, and others. This leads to some challenges and opportunities: • Successfully collaborating across agencies requires significant consensus building skills • Different agencies have different risk appetites, tolerances, and thresholds. • Interoperability and consensus across agency and jurisdictional boundaries.	DDOT has worked closely with federal and regional agencies to establish protocols and maintains working groups that can serve as a model for smart city programs: • Smaller and nimbler than traditional state DOTs. Shorter decision making process. • Scale of DDOT responsibilities as a state/city DOT mean DDOT is more integrated and nimble in addressing system-level issues. • Automated vehicles feature prominently in existing policy documents. • Experience managing interagency processes, recognizing the risk profile of an agency, and developing a customized communication strategy. • Existing forums in the District and the region for these discussions to occur and Including maintenance and operating costs of assets as a part of funding. • Marketing and education about automated shuttles through goDCgo
Cost & Schedule Risk	

Being at the forefront of innovation comes with inherent risks related to project schedule and costs due to: ● Deployment in a new environment ● Interfacing with new partners to ensure interoperability	To mitigate these risks DDOT will implement sound project management techniques that include: ● Rigorous cost and schedule control ● Using established qualitative and quantitative risk analysis techniques to identify risks in advance

Table 2: Risks and Potential Mitigation Strategies

e. Approach to contribute and manage non-federal resources (cost share) proposed for the demonstration implementation and evaluation, if applicable

If selected, DDOT and its partners intend to contribute the following non-federal resources to implement the DC MID project:

- DDOT: $718,496 in-kind contribution of staff labor
- SWBID: $300,104 in-kind contribution of staff labor (and material?), and $1,980,000 as a cash contribution made possible through savings realized by the elimination of the BID's current conventional shuttle operations starting in Phase 2
- May Mobility: $125,000 in-kind contribution
- EasyMile: $140,000 in-kind contribution
- Via: $95,000 in-kind contribution