DATE: May 23, 2017

TO: Honorable Mayor and City Council

FROM: James Lightbody, Project Manager
Michael A. Fuller, Public Works Director

VIA: Daniel H. Rich, City Manager

TITLE: **Automated Guideway Transit Study**

STUDY SESSION MEMO

CITY OF MOUNTAIN VIEW

PURPOSE

The purpose of this Study Session is to solicit City Council input and direction on technology options, corridor characteristics, and evaluation criteria for the Automated Guideway Transit Study.

BACKGROUND

At its June 16, 2015 meeting, the City Council adopted three new major goals and accompanying projects for Fiscal Years 2015-16 and 2016-17. In support of the goal to improve transportation by enhancing mobility and connectivity, the Council directed staff to initiate a multi-year process in conjunction with other cities and agencies to improve last-mile connections, particularly fixed-rail options.

During an October 27, 2015 Study Session, the City Council provided the following additional direction to guide the development of a work plan that appropriately responds to/addresses the Council's desired result:

- The focus should be on the development of an off-street, automated guideway transit (AGT) system (e.g., automated people mover, group rapid transit, personal rapid transit, etc.).

- Priority focus should be given to the corridor linking the Downtown Transit Center to the City's North Bayshore Area.

The City Council also directed staff to monitor/track the North Bayshore Area transportation study that Google has contracted with the Valley Transportation Authority (VTA) to conduct.

On February 2, 2016, the City Council provided input regarding a proposed process to explore the development of an AGT system for the Downtown Transit Center to North Bayshore, and on December 6, 2016, the City Council authorized the City Manager or his designee to execute a professional services agreement with Lea+Elliott, Inc. (Lea+Elliott), to prepare the study.

Lea+Elliott and the AGT Feasibility Study team's work includes the following:

- Developing an understanding and description of the characteristics of the corridor area to be evaluated for AGT.

- Conducting a multi-faceted community outreach and engagement process.

- Developing passenger market and demand estimates.

- Identifying system design/operation requirements that will serve the estimated passenger demand and other characteristics.

- Identifying a range of potential transportation technologies to serve the Downtown Transit Center to North Bayshore Area corridor (e.g., automated people mover, group rapid transit, autonomous vehicles on a guideway, etc.).

- Conducting an evaluation/comparison of transportation technologies to determine the general viability of the technologies to successfully operate in the corridor.

- Preparation of a final evaluation/feasibility study report, including potential next steps and implementation strategies.

Community and Agency Outreach

- **Project Website**—The project website (www.mountainviewagtfeasibility.com) provides information and updates regarding the AGT study. More than 350 individuals have visited the website and 28 have signed up to receive news and event notifications. The City, through various social media outlets, has also disseminated additional information regarding the project and notifications regarding City Council discussions.

- **Project Community Meeting**—Eighteen (18) members of the public attended a community meeting on Monday, April 3, 2017. Meeting participants were given an overview of the study and provided input on the technology options, project

goals and objectives, and key considerations. A summary of the Community Workshop is provided in Attachment 1.

- **Business Outreach**—Project team members will provide a briefing to a committee of the Chamber of Commerce in June and will continue to engage other companies and business groups throughout the study.

- **Partner Agency Discussions**—Initial outreach is under way with stakeholder agencies, including Caltrain, the Santa Clara Valley Transportation Authority (VTA), and the Mountain View Transportation Management Agency (TMA). In particular, there have been discussions with VTA to coordinate the Google-funded North Bayshore Transportation Study with the AGT Study.

DISCUSSION

The study to date has identified potential demand for AGT service, identified and categorized the technology options, reviewed the potential corridors, and developed the criteria and process for evaluation. Each is discussed further below.

Market Demand

The projected demand for an AGT system is difficult to predict, given the unique characteristics of such a system in Mountain View, the number of variables affecting use, and the range of technology options. Therefore, a fairly large range was developed in order to reflect this uncertainty. The approach utilized for this assessment relies on existing travel patterns, including existing shuttle utilization, and projected transportation demand to establish a potential range of ridership for a future AGT system.

Future demand projections were based in part on projected growth in Caltrain ridership and the increase in transit connections to meet future mode-share targets in North Bayshore. For existing and future residents, it was estimated that a 10 percent mode-share increase could be achieved with a more convenient connection to the Transit Center.

Several market-demand sources were considered when estimating future AGT usage. The largest anticipated demand market consists of Caltrain commuters to North Bayshore who live outside of Mountain View. The second largest demand market consists of possible future residents of North Bayshore who would use an AGT system to access the Mountain View Transit Center or downtown Mountain View.

Ridership demand is anticipated to primarily be associated with the following four trip types:

1. Caltrain Riders Accessing North Bayshore

2. Future North Bayshore Residents' Commute Trips to Downtown Mountain View/Transit Center

3. Current and Future Local Mountain View Residents and Employees of Local Businesses Along the Corridor Accessing North Bayshore or Downtown Mountain View/Transit Center

4. Future North Bayshore Residents' Noncommute Trips to Downtown Mountain View/Transit Center

The following table displays the preliminary lower and upper bounds of the daily and peak hour results of the demand estimation analysis.

Table 1—Estimated Demand

Lower and Upper Bounds Ridership Estimate		
	Lower Bound Estimate	**Upper Bound Estimate**
Total Daily	4,900	7,560
A.M. Peak Hour (8:00 a.m. to 9:00 a.m.)	820	1,270
P.M. Peak Hour (4:00 p.m. to 5:00 p.m.)	880	1,360

AGT Technologies

Several technologies are being considered in this study, with the objective of linking the downtown Transit Center to the North Bayshore Areas. As the AGT Feasibility Study focuses on automated transit, the defining characteristic shared by all of these technologies is that they all are fully automated and driverless. Each transit system is able to fully function in picking up passengers at designated stations and transporting them on a specified route in a safe and efficient manner. Additionally, each technology will primarily operate on an exclusive right-of-way separated from vehicle, pedestrian, and bicycle traffic. These exclusive rights-of-way may consist of overhead cables or elevated guideways with tracks or other guidance systems. For some systems, guideways can also be at grade if they are fully separated from other traffic. A possible

exception, needing further exploration, is autonomous transit that may be able to operate partially in mixed flow under controlled situations.

For assessment purposes, the technologies were separated into four groups based on key characteristics such as speed, capacity/size, type of guidance system, and overall technology maturity. The four technology groups are Aerial Cable Transportation, Automated Transit Network, Automated People Movers, and Autonomous Transit. A breakdown of each technology group follows below (Figure 1) and is provided in more detail in Attachment 2.

Figure 1—Technology Options

Aerial Cable Transportation This type of transit system uses one or more cables for propulsion and stability, carrying passengers in suspended cabins above the ground. There are different types of aerial cable transportation technologies such as gondolas, aerial trams, and funitels contained in this group. There are differences in capacity between them, as the smaller-sized gondolas can transport about 2,000 people per hour per direction. The larger aerial trams can transport up to 6,000 passengers per hour in one direction. They generally operate in the 10 to 20 mph range. Due to the large towers that are needed to support the suspended moving cables, this system is extremely difficult to expand after the initial system is constructed compared to the other technology groups.	 **Roosevelt Island Tramway, Aerial Tram (NYC, NY)**  **Portland Aerial Tram (Portland, Oregon)**

Automated Transit Network (ATN)

Smaller automated vehicles operating on a network of guideways and providing point-to-point service for passengers can characterize this technology group. ATN guideways can use sensors and other technology to provide guidance, rather than tracks or cables. Personal Rapid Transit (PRT) and Group Rapid Transit (GRT) technologies were included in this group as they both have smaller capacities and similar operation. Multiple vehicles can be located at stations and are deployed when called on by passengers leading to shorter wait times. Aside from GRTs having a slightly larger vehicle capacity than PRTs, each technology operates at similar speeds, uses similar guideways and travel networks for taking passengers to their destination. The guideway system for this technology is easier to expand since the vehicles are on a network system and additional stops and routes can be added.

Ultra Global PRT (Heathrow, England)

2getthere GRT (Business Park Rivium, Capelle aan den Ijssel, the Netherlands)

Automated People Movers

This technology is best described as an automated transit system with large capacity vehicles operating on a fixed guideway. Propulsion can be of several methods, such as cable, electrical power, or magnetic levitation. Considered in this technology grouping are rubber-tire and steel-wheel automated people movers (APM), monorails and maglevs. These technologies can reach greater speeds compared to the other technology groups and thus can achieve greater system capacities. Automated people movers operate on a fixed guideway between stations, providing line-haul service rather than point-to-point service. Due to the equipment and guideway structure, this technology may be harder to expand after the initial construction.

Mitsubishi: Crystal Mover APM (Miami International Airport, FL)

Bombardier: Innovia Monorail (Las Vegas, NV)

Autonomous Transit

This technology group consists of automated vehicles on a mapped network, preferably with dedicated lanes, but capable of operating in mixed-flow traffic. Equipped with sensors and GPS, guidance is provided by the vehicle rather than the guideway. Capacity is lower for this technology, similar to Automated Transit Network, although there is potential for higher-capacity vehicles to be developed. While current pilot operations involve lower speeds, average speed of the vehicles has the potential to increase in the future as the technology becomes more mature and service proven. Of the four technology groups, this is the least mature but is rapidly evolving. Currently, there are several pilot programs around the world that are using this technology on a trial run basis.

EasyMile: EZ10 9 Swiss Federal Institute of Technology in Lausanne, Switzerland

Navya: Arma

Guideways for these systems are typically elevated, but some offer the potential for surface or below-grade operation. Attachment 3 provides a comparison of the typical guideway dimensions for different systems.

Table 2 below provides some urban setting examples of the technology groups and their capacity/daily passenger numbers. Note that autonomous transit examples are not provided, as the data sample is small due to the relatively young maturity of the technology.

One recent project of interest is in Jacksonville, Florida. The City there is exploring the repurposing of a 1970s-era elevated people mover to operate exclusively with autonomous transit shuttles and to potentially extend the guideway using local streets. Further information about this plan is provided in Attachment 4.

Table 2—AGT System Examples

Technology Group	Name of System	Location	Capacity (pphpd)	Daily Passengers
Aerial Cable Transportation	Portland Aerial Tram	Portland, Oregon	-	3,370
Aerial Cable Transportation	Roosevelt Island Tramway	NYC, NY	-	5,500 - 6,500
Automated Transit Network	Morgantown GRT	Morgantown, WV	4,800	16,000
Automated Transit Network	Masdar PRT	Masdar City, Abu Dhabi	300	700-1,000
Automated Transit Network	Ultra Global PRT - Heathrow Airport	Heathrow, England	656	-
Automated People Mover	Jacksonville Skyway	Jacksonville, Florida	-	5,000 (2015)
Automated People Mover	Metromover	Miami, FL	-	33,000 (2016)
Automated People Mover	Las Vegas Monorail	Las Vegas, NV	-	13,510 (2011)

Corridors

The review of AGT technologies will be performed at a corridor level, focusing on the connections between key nodes. The key nodes that this project will focus on connecting are the Downtown Transit Center, Moffett Field and NASA, and North Bayshore. Candidate corridors include Shoreline Boulevard, Moffett Boulevard, and Charleston Road as shown in Figure 2.

Within the corridors, connection opportunities and constraints will be identified, including areas for the potential alignment to traverse, service for the residents and local businesses and areas, and physical infrastructure constraints. Specific alignments will not be identified for this study; instead, high-level representative alignments for connecting the nodes will be used for the analysis and evaluation of feasibility of the AGT technologies.

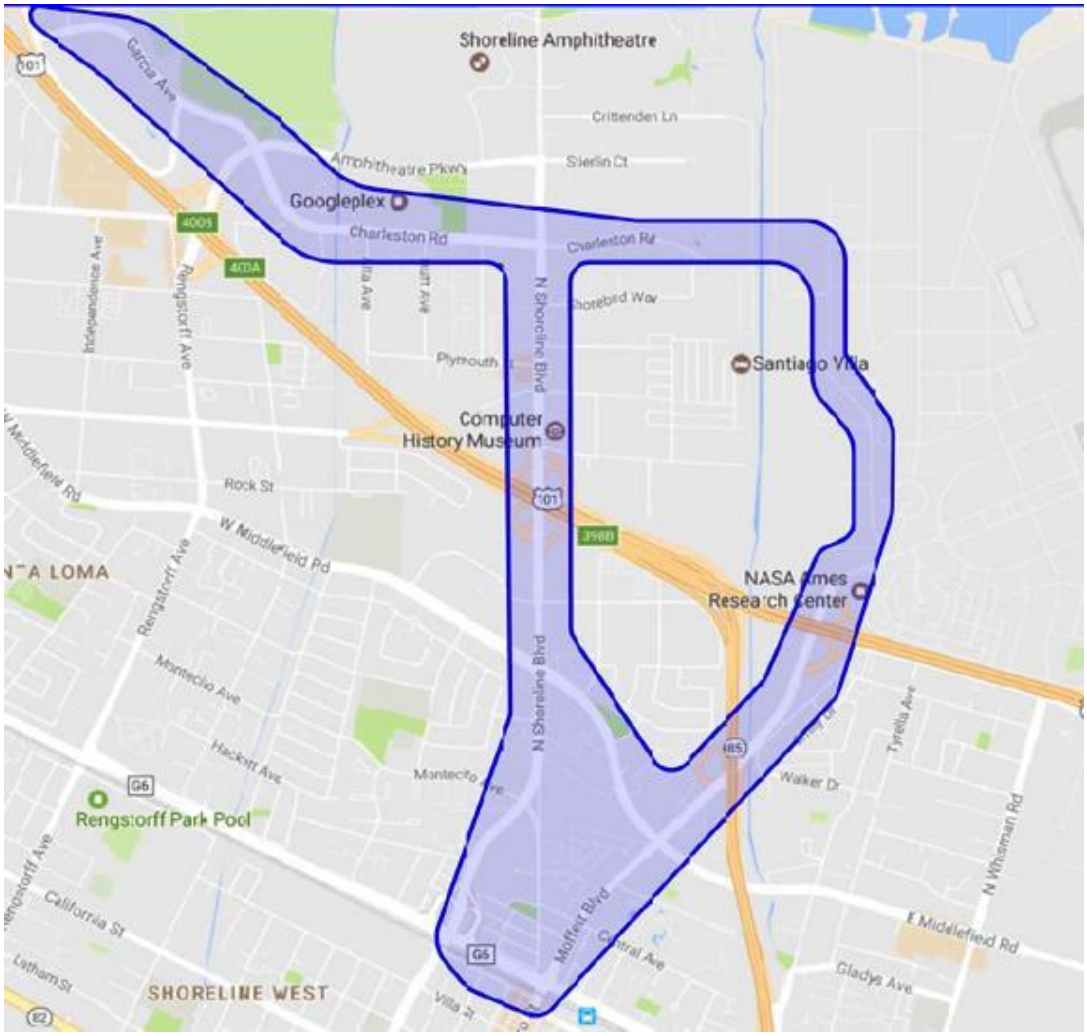

Figure 2—Corridor Options

Evaluation Criteria

The technology options will be evaluated against a set of criteria established to provide a comprehensive analysis on the feasibility of an AGT system. The criteria, summarized in Table 3 with more detail provided in Attachment 4, cover the technical aspects of the system, including operations and cost, as well as the benefits and impacts to neighborhoods the AGT may operate through or within. The evaluation will include both qualitative and quantitative assessments and will be supported by high-level analysis of travel times, costs, and alignment restrictions or impacts of potential routes within the identified corridors.

Table 3—Evaluation Criteria

Operations	1	Ability to serve market demand estimate
	2	Flexibility in service/responsiveness to demand
Financial and Economic	3	Cost estimate
	4	Financial feasibility
Neighborhood Connectivity and Impact	5	Ability to expand to connect to existing and future land use or other service areas
	6	Possible impact on neighborhoods
Customer Experience	7	Provides convenient and high-level service
System Delivery	8	Integration into Transit Center and North Bayshore
	9	Ability for system to be easily expanded
	10	Ability of the system to adapt as technology changes
	11	Ability to fit within the local environment
Technology Development	12	Level of technology maturity

RECOMMENDATION

Staff seeks input on the following:

1. Does the City Council support the inclusion of all four of the potential technology options for further analysis? Are there others that should be added?

2. Does the Council have any input or preferences on the potential alignment options?

3. Does the Council agree with the proposed evaluation criteria?

NEXT STEPS

Based on Council comments and direction, the project team will evaluate technology and corridor options in terms of their ability to serve the estimated demand, system costs, community impacts, and other criteria. During this process, discussions with partner agencies (e.g., MVTMA, VTA, Caltrain, Santa Clara County) will continue. This evaluation will be further discussed with the Council in late 2017.

PUBLIC NOTICING

In addition to the City's standard agenda posting requirements, notices regarding this Study Session discussion were distributed to the persons who have signed up on the project website for updates and information, previous business and/or community meeting participants, nearby City neighborhood associations, and representatives of the VTA, Caltrain, Mountain View TMA, Santa Clara County Roads and Airports Department, Central Business Association, Mountain View Chamber of Commerce, Downtown Committee, Bicycle/Pedestrian Advisory Committee, and other interested parties.

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Attachments:
1. April 3,2017 Community Meeting Summary
2. Technology Options
3. Vehicle and Guideway Comparison
4. Jacksonville Skyway Modernization Project
5. Proposed Evaluation Criteria