Commuter Shuttle Hub Study

FINAL REPORT | NOVEMBER 2016

SFMTA Municipal Transportation Agency

San Francisco County Transportation Authority

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Executive Summary

The purpose of this study is to assess an alternative reduced-stop, hub-based approach to the San Francisco Municipal Transportation Agency's (SFMTA's) current Commuter Shuttle program and to determine how this model would more effectively meet the goals for a commuter shuttle regulatory program. A "hub" model would limit permitted shuttle activity to a smaller number of locations than the current 125 maximum allowed zone system, with riders accessing shuttle stops via other modes of travel, rather than primarily accessing stops by foot or short Muni ride, as the current Commuter Shuttle Program provides. A successful hub system by design should achieve this goal of improving quality of life in San Francisco while meeting commuter needs and reducing the physical footprint of a commuter shuttle system.

This Study considers four scenarios: a single hub; a five-hub BART-oriented system; a nine-hub, freeway-oriented system; and a 17-node consolidated network. All four scenarios were evaluated using a range of performance metrics to measure how each scenario meets the goals of the Commuter Shuttle Program, as well as the current system for baseline comparison. Key findings are as follows:

- **MODE SHIFT AND VEHICLE MILES TRAVELED (VMT):** under all four scenarios some current shuttle riders would shift to a different commute mode. Shuttle ridership would drop between 24% and 45%, nearly all those prior shuttle riders would switch to driving, and VMT would increase five- to eight-fold.
- **SAFETY:** All scenarios would increase the risk for collisions, given the significant increase in surface street VMT that would be generated by each, with the Single-hub having the greatest potential to increase conflicts.
- **TRAVEL ON NON-ARTERIAL STREETS:** Commuter shuttles travelling on non-arterial streets would decrease under all scenarios relative to the current program, although the decrease represents a minimal reduction as a proportion of overall shuttle travel on streets. Further, the shift to driving by many former shuttle riders would significantly increase total traffic on non-arterial streets.
- **MUNI CONFLICTS:** The reduction in the number of commuter shuttle zones, combined with scenario designs that sited them separate from Muni zones, would likely result in reduced conflicts between shuttles and Muni services depending on the final system design.

- **UNAUTHORIZED STOPS AND PROGRAM ENFORCEMENT:** Under all scenarios the rate of unauthorized stops is expected to increase resulting in a need for more enforcement compared to the current program.
- **PARKING REMOVAL AND DEMAND:** All scenarios would generally involve a net increase in competition for unrestricted or all-day parking curb space near the stop locations. The Single-hub requires no parking removal while the Consolidated Network Scenario would require the most parking removal, at approximately 230 spaces.

The hub scenarios present a number of tradeoffs in relation to the current program. While the vehicle miles traveled by shuttles on streets throughout the city would decrease, the same number of shuttles would concentrate their operations on a small number of city streets. In addition, a substantial proportion of current riders, about 20% - 45% based on current usage, would be expected to shift their travel to driving. Other prior shuttle riders may drive their own vehicles, or ride in carpools, transportation network companies (TNCs), taxis, or other point-to-point services to the hubs, increasing the total vehicle miles traveled on city streets in private vehicles.

Introduction

In November 2015, the San Francisco Municipal Transportation Agency (SFMTA) Board approved a program for regulating privately-operated commuter shuttle buses within San Francisco ("Commuter Shuttle Program" or "current program") which incorporated recommendations from the evaluation of a Pilot Program in operation from August 2014-January 2016. In February 2016, the Board of Supervisors introduced Resolution 160118, urging the SFMTA to modify the Commuter Shuttle Program by reducing the number of shuttle stop locations and capping the total number at 125. In addition, the Board of Supervisors requested that the SFMTA, in collaboration with the San Francisco County Transportation Authority (SFCTA) prepare a study ("the Study") to determine the feasibility of a commuter shuttle program based on a "hub" model, which would concentrate commuter shuttle loading and unloading at a small number of designated locations in the city rather than providing a dispersed citywide network of loading zones. While this resolution was never passed by the Board of Supervisors, SFMTA agreed to make these changes to the current program and conduct the Study. The following sections summarize the background of the Commuter Shuttle Program and the purpose of this Study.

BACKGROUND

Before August 2014, San Francisco did not regulate commuter shuttles. Shuttles operated throughout the city on both large arterial streets, such as Van Ness Avenue and Mission Street, and smaller non-arterial streets. Shuttles loaded and unloaded passengers in a variety of legal and illegal locations including Muni zones, legal curb space, and in bike and travel lanes. The SFMTA addressed conflicts on an ad hoc basis, which was not sustainable. It also led to a confusing operating landscape, lack of clarity for the public, inconsistent enforcement, and real and perceived conflicts with other transportation modes. Prior to the implementation of the Pilot program, shuttles stopped at approximately 250 zones throughout San Francisco. Shuttle operators established the number and location of stops without consultation of SFMTA. Operators did not share stop location information with SFMTA, and locations could change at any time without notice.

In order to address these issues, SFMTA staff developed a regulatory framework which the SFMTA Board approved in January 2014. The Pilot Program began in August 2014 and created a network of shared Muni zones as well as shuttle-only loading (white) zones which restricted parking for specified hours during the day in order to create a network for use by those commuter shuttle buses whose operators paid fees and chose to participate in the program.[1] While participation in the program was voluntary, only participating operators were allowed to use the designated shuttle zones. The use of designated zones by other vehicles, as well as the failure to comply with requirements for use of designated zones or the use of Muni zones not included in the established network, were violations subject to enforcement. Enforcement by SFMTA parking control officers (PCOs) was funded through per-stop event[2] fees paid by shuttle operators. At the end of the 18-month period, the Pilot shuttle zone network included 125 zones.

During the Pilot, which lasted from August 2014 to January 2016, the SFMTA collected data from shuttle operators, riders, San Francisco residents, and community stakeholders. SFMTA prepared an evaluation of the Pilot[3], which served as the basis for recommendation of a number of changes for a new Commuter Shuttle Program. Components of the new program included requirements for labor harmony, restricting shuttles over 35 feet in length to Caltrans-designated arterial streets, and after discussions with the Board of Supervisors, capping the number of shuttle zones at 125 zones.

In November 2015, the SFMTA Board passed legislation creating the current Commuter Shuttle Program, incorporating the Pilot Program's recommendations. In February 2016, the San Francisco Board of Supervisors introduced, but did not adopt, Resolution No. 160118 urging, among other things, that the SFMTA explore, in collaboration with the SFCTA, transitioning the commuter shuttle program to a hub, or other more efficient model. In response, the SFMTA Board passed Resolution No. 16-028 committing to study a hub or potentially more efficient node network model in collaboration with the SFCTA.

The current Commuter Shuttle Program went into effect on April 1, 2016 for a period of one year from that date. Since that time, the SFMTA has prepared a 6-month evaluation of the Program, to be presented to the SFMTA Board and the Board of Supervisors in November 2016. That evaluation, paired with this study of potential hub scenarios, will help inform SFMTA recommendations regarding future regulation of commuter shuttle activity in San Francisco.

PURPOSE OF THIS STUDY

The purpose of this Study is to assess an alternative regulatory approach to commuter shuttles—a "hub" model, whereby permitted shuttle activity would be limited to a small number of locations with riders travelling to the locations via other modes of travel, rather than being dispersed through San Francisco as the current program provides. This Study assesses whether a range of hypothetical shuttle hub scenarios would more effectively meet the goals for a commuter shuttle regulatory program, and address impacts and concerns regarding the operational impacts of shuttle movement and stop activity identified in the Pilot Evaluation and through feedback received from the community and the Board of Supervisors during Fall 2015 and Spring 2016.

During the approval process, some members of the public and the Board of Supervisors raised concerns about the role of shuttle zones as an amenity or "perk" for riders, and the potential impact on rising housing costs and displace-

1 Shuttle zones refer to designated shared Muni stops and designated commuter shuttle-only white loading zones.
2 A "stop event" is defined as an individual instance of a shuttle vehicle stopping at a zone in the shuttle zone network
3 https://www.sfmta.com/sites/default/files/projects/2015/Evaluation%20Report%20-%20Oct%205%202015.pdf

ment in neighborhoods convenient to shuttle zones. This Study is not intended to analyze that issue. Instead, it provides information regarding the viability of alternative approaches to designating locations for shuttle activity to help determine if such a system is a desirable alternative to the current program. The Board of Supervisors resolution recommended that the effects if commuter shuttles on housing affordability be studied by the Budget and Legislative Analyst's office.

HUB SYSTEM GOALS

The current Commuter Shuttle Program is designed in response to a set of six Goals established by SFMTA during the development of the current program and supported by SFCTA staff. They include safety, environmental, and administrative considerations. This Study designed and evaluated hub scenarios in response to those same Goals, with one addition, as described below, and with the consultation of the Board of Supervisors. In addition, SFMTA and SFCTA staff established hub system objectives and performance metrics for each goal to provide a basis for evaluation of the efficacy of each scenario.

1. Ensure that commuter shuttles do not adversely affect operations of public transportation in San Francisco
2. Integrate commuter shuttles into the existing multi-modal transportation system
3. Provide a safe environment for all street users in support of the San Francisco's Vision Zero safety policy
4. Work collaboratively with shuttle sector to refine policies and address concerns and conflicts
5. Establish a program structure that meets current needs and has the potential to evolve as the sector grows and evolves
6. Facilitate a shuttle program that minimizes shuttle operations in neighborhoods
7. Support more focused enforcement, ease of administration and on-going oversight

The additional Goal included for this analysis is Goal Six: minimize shuttle operations in "neighborhoods." A successful hub system by design should achieve this goal of improving quality of life in San Francisco while meeting commuter needs by reducing the physical footprint of a commuter shuttle system and placing the hubs in locations that minimize shuttle vehicle travel on non-arterial streets.

These Goals provided the foundation for the performance metrics which are the basis for the evaluation framework. Performance metrics were identified to provide a basis for analyzing hub scenarios relative to each other and to the current program. Table 1 (next page) provides the goals, objectives, and performance metrics for a hub system.

SCENARIOS

This Study considers four scenarios. For a hub-based shuttle program three scenarios are considered: a Single-hub Scenario, located at the site now occupied by the Temporary Transbay Terminal (this site is planned for affordable housing and a park and is used as a representative location); a BART-oriented Scenario with hubs located in proximity to the BART stations in San Francisco; and a Freeway-adjacent Scenario with hubs located near freeway access points. The selection of hub locations is described in Section 2, Scenario Formulation.

Because a hub system would be a substantial change from the current program, this study also analyzes a fourth scenario that would provide some features of a hub system while still maintaining characteristics similar to the current program. This scenario, referred to in this study as the "Consoidated Network Scenario" was designed to reduce the number of shuttle zones substantially (by at least 75%), while still providing a network of nodes throughout the city.

Participation Assumption

Commuter shuttles are regulated by the California Public Utilities Commission (CPUC) as Charter Party carriers, and as such cannot be required to participate in SFMTA's Commuter Shuttle Program. Participation in the program is voluntary, and the benefit to providers who participate is that they are given access to desirable curb space for their drop off and pickup activities. The current program is designed to be self-funding, with shuttle providers paying fees for use of zones on a per-stop event basis (i.e. each time a shuttle vehicle uses a zone, the shuttle provider is assessed a fee) which is limited by state law to only cover the costs to administer the program including enforcement, administration, signage, and other expenses.[4]

There is no metric by which to assess whether and how shuttle providers would participate in a hub or substantially consolidated network-based

4 The current fee is $7.31 per stop event. A total of $2.1 million in fees was generated from April 2016-September 2016, as reported in the "Commuter Shuttle Program April—September 2016 Status Report"

TABLE 1. Commuter Shuttle Hub System goals, objectives, and performance measures

GOAL	OBJECTIVES	PERFORMANCE MEASURES
1. Ensure that commuter shuttles do not adversely affect operations of public transportation in San Francisco	Minimize shuttle conflict with Muni and other vehicles	Zones shared with Muni
	Avoid exacerbation of existing Muni crowding	Peak period transit demand by shuttle riders
2. Integrate commuter shuttles into the existing multi-modal transportation system	Reduce drive-alone trips and support City's environmental goals	Mode Share Vehicle Miles Traveled (VMT) by shuttles and other vehicles Greenhouse Gas (GHG) emissions (Tons CO2 Annually)
	Provide hubs accessible by existing Muni	Frequency of transit to hubs
	Reduce shuttle operations on surface streets	Shuttle travel on SF surface streets
	Support SFMTA's parking management efforts	Parking removal Demand for on-street parking
3. Provide a safe environment for all street users in support of the City's Vision Zero safety policy	Reduce potential for collisions on city streets	Vehicle Miles Traveled (VMT) by shuttles and other vehicles
4. Work collaboratively with shuttle sector to refine policies and address concerns and conflicts	Ensure that providers would continue to seek permits and participate in the regulatory program, rather than operate shuttles outside the program.	Employer/Operator feedback
5. Establish a program structure that meets current needs and has the potential to evolve as the sector grows and evolves	Allow for program flexibility and expansion	Capacity for shuttle operations
6. Facilitate a shuttle program that minimizes shuttle operations in neighborhoods	Decrease shuttle activity on non-arterial streets	Driving on non-arterial streets
	Minimize shuttle loading at unauthorized stops	Expected level of unauthorized stops
7. Support more focused enforcement, ease of administration and on-going oversight	Minimize need for active enforcement	Number of enforcement officers needed

program. Therefore, this Study assumes all current providers continue to participate in and comply with the shuttle program at the same rates as the existing program; where participation and compliance rates are especially relevant to the analysis this is noted and discussed. However, consistent participation and compliance is not the expected result. Based on interviews with shuttle operators and feedback from companies and their representatives, a significant number of shuttle providers may opt out of a voluntary regulatory program that takes a hub (or similar) form. As identified in the mode shift analysis and additional evaluations of unauthorized stopping, eliminating shuttle zones in much of the city will reduce the incentive for shuttle operators or the employers that use them to take part in a voluntary program because the shuttle program might not be sufficiently attractive to users to support continued participation or compliance by providers. Because shuttle company clients will look for options that best meet the needs of their employees and because to a large extent the City cannot restrict where shuttle providers may legally drive their vehicles, there is an incentive to drop out of the program and return to the business practices that were the norm before the SFMTA's regulatory program was put in place.

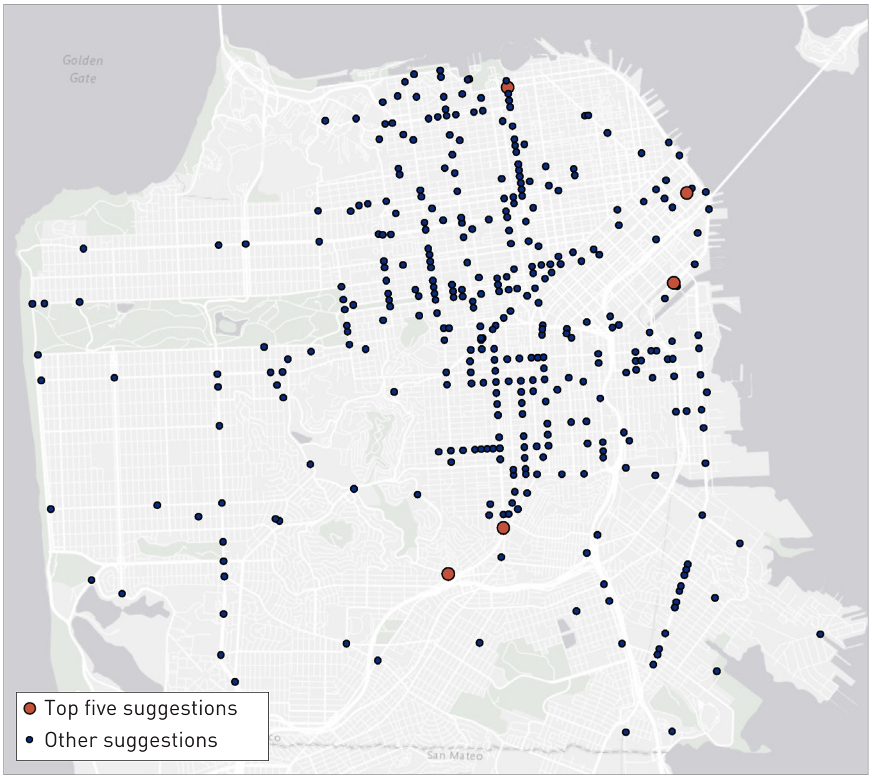
The likely reduction in shuttle program participation would affect—potentially significantly—the analysis and outcomes reported in this Study. The current program requires certain practices that are of benefit and importance to the city and its residents, including labor harmony, vehicle model year requirements to reduce exposure of residents to emissions, and requirements for use of zones in a safe and non-disruptive manner. If providers do not participate in the program or participate but do not fully comply with the limitations on stop activity, driving on non-arterial streets would likely increase relative to the results reported in this Study. There would also be increases in other impacts such as stop events at unauthorized locations, and conflicts with Muni, pedestrians, bicyclists, drivers, and vulnerable road users, including seniors and people with disabilities. At the same time, as shuttles would likely continue to operate throughout the city, fewer current shuttle riders would shift to driving, and so personal vehicle VMT and GHG emissions would decline (relative to the results reported in this Study). No data exists to estimate the participation rate of current providers under each of the scenarios, and thus these potential impacts of reduced participation are speculative. Therefore, the following analysis should be considered as a "best-case" scenario, in which all current (voluntary) Commuter Shuttle Program participants continue to participate in a new (also voluntary) hub system. The benefits estimated from a hub scenario and therefore the ability of a hub system to accomplish the purposes of shuttle regulation are likely to be reduced by an unknown amount due to lower actual participation rates of shuttle providers if the regulatory program took a hub form.

SCENARIO FORMULATION

IDENTIFICATION OF POTENTIAL HUB LOCATIONS

To identify potential hub locations, SFMTA issued a public call for suggestions to the SFMTA's Shuttle Program email database, the Board of Supervisors, and through SFMTA and SFCTA's social media channels. From June 8 to July 4, 2016, SFMTA accepted hub location suggestions from the public and received a total of 1,605 responses. The sole purpose of this outreach was to identify potential locations that could serve as shuttle hubs. When tallied, responses were found to represent 378 unique locations within the city limits (See Figure 1).

FIGURE 1. Map of hub location suggestions



Of the 378 unique locations identified by the public, the top five most popular suggestions are:

- Caltrain Station at 4th Street and King Street (80)
- Temporary Transbay Terminal (73)
- Glen Park BART Station (55)
- Dolores Street and San Jose Avenue (34)
- Van Ness Avenue and Bay Street (33)

The online submission form focused on location suggestions. There were a number of suggestions for locations outside of San Francisco. Staff did not consider these locations for the Study as they are outside of the City's jurisdiction. In addition, a number of respondents used the call for location suggestions to submit statements of opposition and support for a hub system. Full summaries of all location suggestions and comments are available in Appendices A and B.

Staff reviewed the publicly submitted hub location suggestions and found that some areas with large numbers of existing riders, particularly in the South of Market and west side areas of the city, were not represented in the suggested locations. Six additional locations were identified to be screened for consideration in hub scenarios:

- Howard Street and Third Street
- 6th Street and Harrison Street
- 9th Street and Folsom Street
- Junipero Serra Boulevard and Holloway Avenue
- Junipero Serra Boulevard and Ocean Avenue

LOCATION SCREENING CRITERIA

Staff developed criteria to screen potential locations for viability in a hub system and to identify a hub system that could be expected to accommodate the current and growing shuttle ridership. The hub scenarios evaluated in this analysis include only those locations that meet all of the criteria.

The screening process is based on a total of five criteria (Table 2). The criteria ensure that locations included in the evaluation can accommodate current shuttle ridership while also supporting the goals of a hub system.

TABLE 2. Criteria for screening potential node locations

CRITERIA*	PURPOSE
1. Physical space to accommodate dozens of shuttle buses every hour a) Curb space (for on-street sites) b) Size (for off-street sites)	Able to accommodate many and large vehicles—assuming a node replaces many stops and the ridership demand of the current program remains. Curb space enables compliance with operating guidelines; load/unload passengers safely; allows for designated areas for passengers to wait safely. Size of off-street location should allow for large vehicles to maneuver
2. Available weekday AM and PM peak hours	Location is available** during time periods when shuttles are most active.
3. Accessible by frequent transit—within ¼ mile, transit every 10 minutes or better	Passengers can take transit to access the node.
4. Accessible to/from highway	Limit shuttle contribution to surface street congestion.
5. Accessible by non-auto one-leg journey within 30 minutes for most riders	Contributes to goal to integrate commuter shuttles into multi-modal transportation system.

* Criteria one though four were used for the evaluation of five sites earlier this year by the SFMTA (see the memo dated February 3, 2016 from the SFMTA to the Board of Supervisors).

** A location is considered "available" for stops if there are no physical impediments (driveways, not enough space, etc.) or muni operational issues in siting the stop in the proposed location. Existing parking uses, which can be removed for the times during which shuttle operations would be needed, do not make a location "unavailable."

HUB SCENARIO TYPOLOGIES AND A CONSOLIDATED ZONE NETWORK

Considering the goals and objectives for a Commuter Shuttle Program and a hub system in particular, staff created scenario typologies:

1. **Single-hub:** A single location in San Francisco, either on or off-street, or a combination of on and off-street at a single location
2. **BART-oriented:** Up to eight nodes proximate to BART stations
3. **Freeway-adjacent:** Up to 15 nodes located near freeway on and off-ramps
4. **Consolidated Network:** Up to 30 nodes sited along a few corridors

The typologies represent a spectrum of hypothetical scenarios. The first three scenarios are hub models; shuttle activity would be concentrated in a few locations, with the expectation that most riders would travel to the hubs from their residences dispersed throughout the city, rather than walking to a nearby zone. The fourth scenario represents a node network more similar to the existing system, but with substantially fewer zone locations (up to 30 nodes, instead of the current network of 63 nodes under the current program.) Although this Consoidated Network Scenario was not determined to be a "hub" scenario or explicitly requested by the Board of Supervisors, the project team included it in the Study to provide a broader range of information about potential approaches to shuttle regulation. In providing this fourth analysis, staff at both the SFCTA and SFMTA believe the Hub Study provides analysis of the full range of consolidated hub models that meet the spirit of the call for a hub study.

The scenario types also vary by size (number of hub zones) at ranges that are a significant reduction in the number of nodes from the current 63 allowed shuttle nodes of the existing system. Table 3 (next page) illustrates the range in the number of hub zones for each scenario.

TABLE 3. Scenario typologies and size ranges

SCENARIO TYPE	SIZE RANGE (NUMBER OF NODES IN SCENARIO)		
	1–5	6–15	16–30
Single Hub	Yes	—	—
BART-oriented	Yes	Yes	—
Freeway-adjacent	Yes	Yes	—
Consolidated Stop Network	—	Yes	Yes

The four reduced-stop scenarios comprise systems that have fewer stops and nodes than the current program. For comparison, the current program has approval for up to 125 designated stops for shuttles, it currently has 110 approved stops, of which 99 are actively used. These make up 63 shuttle nodes, where a node is a set of stops serving a specific area, typically a pair of stops, one on either side of the street serving in-bound and out-bound shuttles. (See Table 4.)

TABLE 4. Number of active stops and nodes in each scenario

	CURRENT PROGRAM (STOPS WITH SHUTTLE ACTIVITY)*	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
Nodes	63	1	5	9	17
Zones (stops)	99	1	5	9	25

* Number of active stops and nodes in each scenario

SCREENING OF ELIGIBLE HUB LOCATIONS

Staff then screened the combined 384 suggested locations and the existing 81 active shuttle-only white zones (a subset of the 110 active zones that excludes shared Muni zones) to identify the hypothetical locations to include in each scenario. Specific locations are for analysis purposes only; if a hub or consolidated scenario were pursued, selection of locations would be conducted as part of program development, although in some scenarios (e.g. the BART-oriented Scenario) there are limited location options. Described below are each of the steps in the location screening process.

Step 1: Screen with Rapid Transit Criterion

Staff screened all suggested locations and existing shuttle-only white loading zones using Criterion number three (accessible by frequent transit—within ¼ mile, transit every 10 minutes or better). Locations that did not meet this criterion were removed from further consideration.

Step 2: Screen with Highway Access Criterion

Staff screened remaining hub locations using Criterion number 4 (accessible to a freeway entrance via an arterial route).

Step 3: Identifying Eligible Locations by Scenario Types

Once locations with insufficient transit and freeway access were eliminated, staff screened remaining locations based on scenario-specific parameters as follows:

- **Single-hub**: One location that meets all scenario requirements in a single location. Locations for this scenario were selected using the criteria in step 3 as each potential location had to meet the full scenario requirements.
- **BART-oriented:** Within a quarter-mile of the eight BART stations within the city limits.
- **Freeway-adjacent**: Within a quarter-mile of freeway on- and off-ramps.
- **Consolidated Network**: Eligible zone locations for this scenario must be sited along a few corridors that are in locations with high ridership, provide minimal coverage in all four quadrants of the city and meet the overall scenario selection criteria. Eligible locations are existing commuter shuttle-only white loading zones, or suggested locations that are not shared with Muni.

Following the scenario-specific location screenings, the number of eligible locations for each scenario was as follows:

- Single-hub: 62
- BART: 39
- Freeway: 72
- Consolidated: 35

Step 4: Screen with Direct Transit Access Criterion

Staff calculated the percentage of existing shuttle riders that could access each potential location within a 30-minute, one-leg transit journey (requiring no transfers). Since home address information for riders was not available, stop location was used as a proxy for home location for those riders boarding at each stop. Currently the majority of shuttle riders walk to their shuttle stop, thus it can be reasonably assumed that they live within the direct vicinity of the shuttle stop where they board. Methodology for this analysis is described in Appendix C. The most transit-accessible zone locations can be accessed in 30 minutes by 85% of current shuttle riders.

Steps 5 and 6: Screen with Physical Space Criterion and Availability During AM/PM Peak Criterion

Staff identified necessary capacity for each scenario and size range combination. The team then applied these capacity thresholds to screen out zone locations unable to meet the demand of the Commuter Shuttle Program. The capacity thresholds vary based on the total number of nodes in each scenario. Appendix D explains the assumptions for developing the capacity thresholds and dimensions for both on-street (at SFMTA regulated public curbs) and off-street locations (on nearby private or public property currently vacant or being used as surface parking). The capacity thresholds indicate the physical space needed at each location to meet the vehicle activity of the existing Commuter Shuttle Program. In conjunction with the assessment of physical space, existing and potential availability for use during the morning (6:00–10:00 AM) and evening (4:00–8:00 PM) peak shuttle periods was considered.

Considering the physical space required for the Single-hub Scenario (approximately 21 bus berths during the peak shuttle hour), only off-street locations would be feasible for this alternative.

Hub scenarios with fewer than five hubs would require a large amount of physical space at each hub location (more than five bus berths). While a number of off-street locations met the physical capacity thresholds for scenarios with fewer than five hubs, they were in private use and therefore unavailable during the peak shuttle periods. Technically it may be feasible to acquire private property for this use, however the feasibility of this is not a given, thus this analysis focused on public right-of-way. Further study would be needed to determine if private property could be purchased or leased. Given these considerations and limitations, staff determined that the BART-oriented and Freeway-adjacent hub scenarios would need to include at least five hubs and use only on-street locations. In general, due to the potential infeasibility of use of private property, staff determined that on-street locations would be preferable to off-street locations for all but the Single-hub Scenario.

SCENARIOS DEFINITION AND DESCRIPTION

This section describes the requirements and considerations for each of the four scenarios (from the pool of all eligible locations); and describes each of the four scenarios analyzed in the next section. In the Single-hub, BART-oriented, and Freeway-adjacent scenarios, shuttles stop at only one hub on their route from San Francisco to destination. In the Consolidated Network Scenario, shuttles would travel on a route that includes stops at several zones within the city.

Single-hub Scenario

As previously explained, a Single-hub Scenario requires an off-street site that includes at least 21 bus berths during the peak shuttle hour. The Transbay Temporary Terminal was identified as the only viable site for a Single-hub Scenario. It currently has 18 saw-toothed bus bays used by AC Transit and Lynx, and eight angled bus stalls used by long-distance, intercity bus operators (Greyhound and BoltBus). Viability of this site as the Single-hub location would require exclusive use of most of the site. The terminal will be used by its current operators until at least the first quarter of 2018, when the new Transbay Terminal is expected to open for use. The City approved an Environmental Impact

Report including two residential towers on the parcel, as well as a new city park between them. Despite its likely unavailability, there were no other eligible sites that met both physical space and transit accessibility criteria, and evaluation of a Single-hub Scenario was necessary for full understanding of the various potential hub system outcomes.

BART-oriented Scenario

This scenario would include hubs near each of the San Francisco BART stations. The BART Scenario requires two to five bus berths for each hub. Five zones meeting all criteria were identified near the Embarcadero, Civic Center, 16th Street, 24th Street and Balboa Park BART Stations for this scenario. The pool of eligible locations did not include a zone near Glen Park BART station that met the physical space thresholds of the BART-oriented Scenario despite the popularity of the location. There were a few eligible zones near the Powell and Montgomery stations that met physical space criteria but were not ultimately included in the final BART-oriented Scenario because their potential siting was deemed logistically challenging.

Freeway-adjacent Scenario

This scenario would include up to 15 hubs within a quarter-mile of freeway on- and off-ramps. The Freeway-adjacent scenario requires one to five berths for each hub. Many eligible locations met the capacity thresholds. In developing the Freeway-adjacent Scenario, staff prioritized locations that could be easily accessed using transit by a higher percentage of existing shuttle riders. At least one location was needed on the west side of the city to serve existing commuter shuttle riders in this area. In total, this scenario included nine hubs on 10 zones.

FIGURE 2. Single-hub Scenario route and shuttle stop

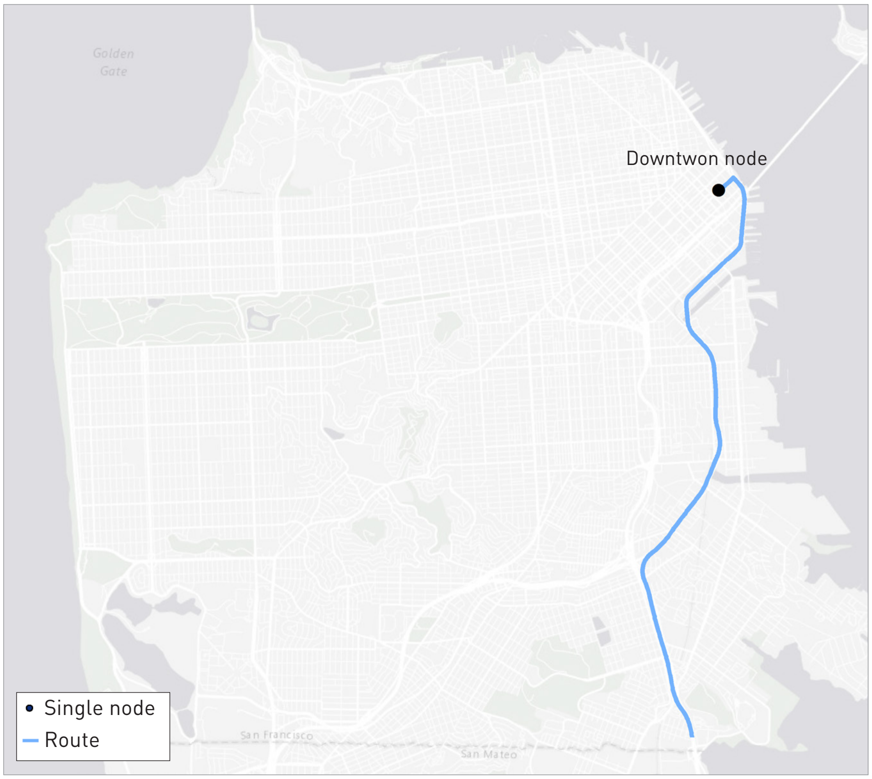
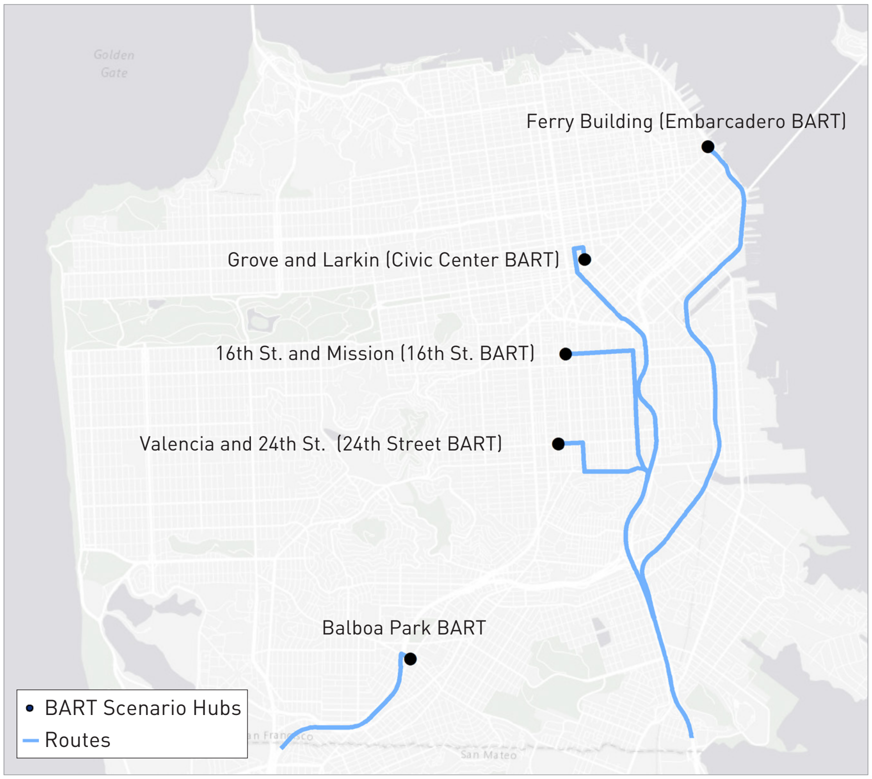


FIGURE 3. BART-oriented Scenario routes and shuttle stops



Consolidated Network Scenario

In developing the Consolidated Network scenario, staff sought to identify a network that would include a significant reduction in zones relative to the existing 110 zones currently in use, while also meeting the objective to reduce miles driven by commuter shuttle vehicles on surface streets within the city. The existing Commuter Shuttle Program's 110 approved zones is a 50% reduction in the number of zones compared to the pre-pilot condition. In determining the size and scope of the Consolidated Network scenario, staff considered a network that would remove approximately one of every two current zones (with 30–45 total nodes remaining). Operators participating in such a network would likely keep the same number and configuration of routes as today, but make fewer stops. Staff ultimately concluded that this size range would not meaningfully reduce the extent of the shuttle network and amount of surface street miles driven by shuttle vehicles. Instead, staff sought to identify a network of about one-quarter of the zones of the existing Program (30 or fewer), with zones sited in areas with high current shuttle ridership, and oriented along key corridors. This configuration, by contrast, would result in fewer total routes and routes with a more limited footprint on surface streets, better advancing the goal of the study. While staff sought to identify up to 30 nodes for this scenario, it was difficult to identify enough zones that met the criteria along limited routes. Because the criteria of the Study are stricter than the current program parameters, it would have been more challenging to build a consolidated network with an even greater number of nodes.

FIGURE 4. Freeway-adjacent Scenario routes and shuttle stops

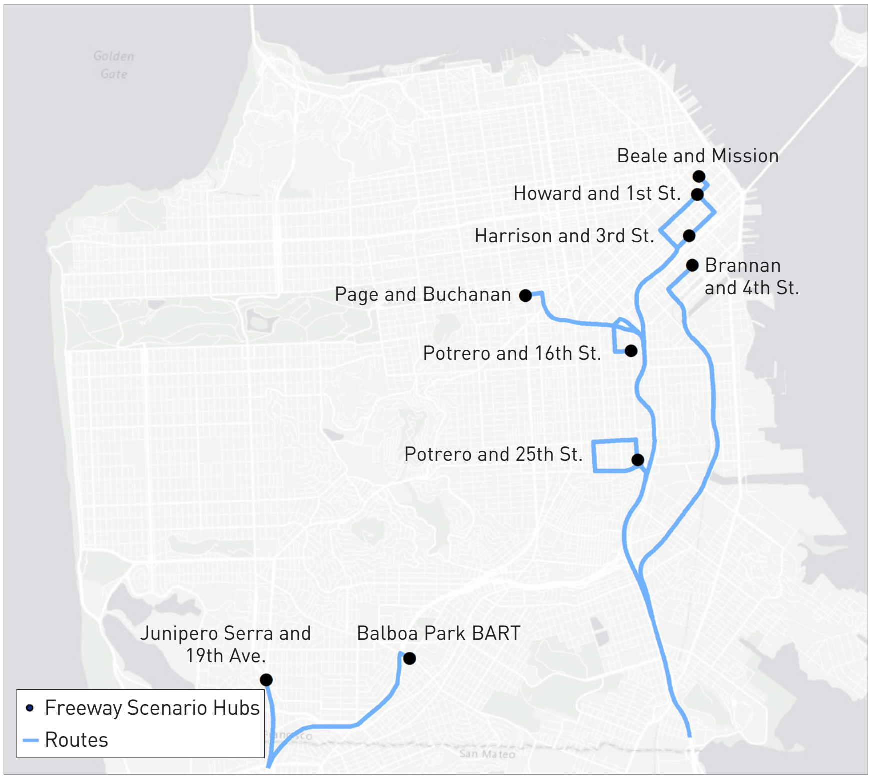
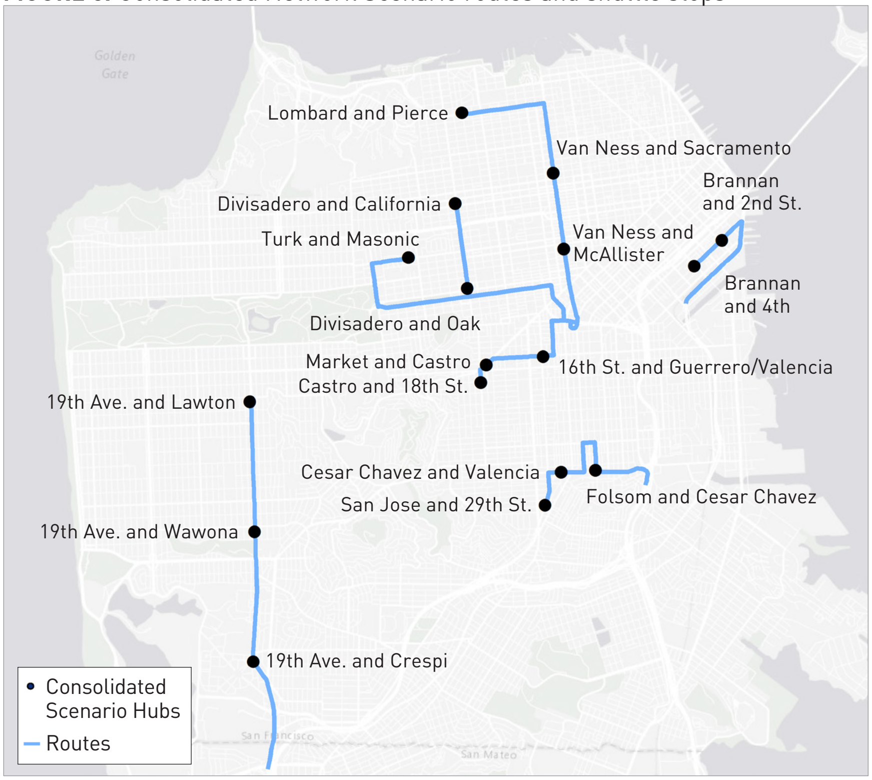


FIGURE 5. Consolidated Network Scenario routes and shuttle stops



In developing the Consolidated Network Scenario, staff began by considering existing shuttle-only white loading zones that met the criteria of access to the Muni Rapid Network and arterial streets. Staff identified concentrations of high ridership (number of boardings at existing zones), and identified proximate eligible zone locations (both existing zones as well as suggested zone locations) to screen for capacity. Staff identified 17 node locations (25 designated stops) for the Consolidated Network Scenario that coalesce around corridors of high ridership. Unlike the other scenarios, the Consoidated Network Scenario assumes that shuttles would use specific and distinct routes, and that vehicles would use multiple zones along a route. There are 25 designated stops identified for use in the Consolidated Network Scenario for both the morning and evening shuttle periods.

MODE SHIFT ANALYSIS

Mode shift—that is, the projected change in travel choices of shuttle riders if substantial change is made in the shuttle program—is an important factor to understand for an assessment of the viability and desirability of each scenario and is utilized in the evaluation of several of the goals and objectives. A successful shuttle program should seek to reduce drive-alone trips and support the City's environmental and transportation goals.

This analysis applies a simple model to estimate whether, and how many, current shuttle riders would shift to other modes of travel to work under different hub scenarios, using data provided to SFMTA by shuttle operators as required under the current program. All shuttle operators participating in the current program provided the following data for each intercity shuttle route they operate: number of riders boarding at each stop, time of day each stop is made, map with stops along the route identified, type of vehicle used, destination, and number of times a specific route is driven each day. For this analysis, morning shuttle operation data was used as it was assumed that the mode choice made in the morning period would dictate evening mode choice. In addition, only boardings on intercity routes, routes starting and ending in different jurisdictions, were included in this analysis. Most operators participating in the current program provide intercity service. Because routes circulating exclusively within San Francisco represent a small fraction of the overall program and are typically shorter distances, staff determined they would not dramatically impact mode shift results, and thus were not included in this part of the analysis.

The model considers three travel modes: drive-alone, transit, and shuttle. For more detail on the model and the mode choice methodology, please see Appendix E.

MODE CHOICE RESULTS

The model reveals reductions in shuttle ridership under all the scenarios. Shuttle riders are forecast to make the greatest shifts in their mode choice under a Single-hub Scenario; about 45% of the 8,200 current intercity shuttle riders would likely shift to an entirely non-shuttle mode for their trip. This result is consistent with the relative importance of convenience and time in mode choice, especially for those with the option to own a car.

TABLE 5. Mode Shift Analysis results

	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
MODE SHARE					
Shuttle trips	100%	55%	73%	72%	76%
Drive trips	0%	41%	24%	25%	22%
Transit trips	0%	4%	3%	3%	2%
NUMBER OF TRIPS					
Shuttle trips	8,200	4,500	6,020	5,930	6,230
Drive Trips	0	3,330	1,960	2,050	1,780
Transit trips	0	370	220	220	190

Under the BART-oriented, Freeway-adjacent, and Consolidated Network scenarios, staff forecasts that about three-quarters of the current intercity shuttle riders (approximately 6,000) would continue taking the shuttle for their trip, with about one quarter shifting to a different mode.

The model forecasts that nearly all (about 90%) shuttle riders who shift away from the shuttle system to a different commute mode are expected to switch to driving. This forecast is consistent under all scenarios, resulting in an increase of approximately 1,800–3,300 automobile trips during the AM period, depending on the scenario.

The model forecasts that approximately 10% of current shuttle riders would switch to transit (e.g., Caltrain). This small shift to transit reflects the fact that Caltrain has limited stop locations in San Francisco, that many employers are not located close to Caltrain stations along the Peninsula, and that there are very few express bus services along the Peninsula. For the vast majority of current shuttle riders, a shift to transit would require riding three different forms of transit (Muni, Caltrain, and a last-mile provider to their employer). This explains why the model predicts that the vast majority would switch to a single-seat ride in a car. The model was not equipped to predict, however, whether shuttle riders would shift to driving their own cars, riding in carpools, or some other point-to-point driving modes such as TNCs. If a significant portion chose to use carpools of some kind, that would affect the VMT and GHG results presented in Table 6.

Staff calculated two other metrics of this objective based on mode shift forecasts. One is vehicle-miles-traveled (VMT) of shuttles and autos. The other measurement is greenhouse gas (GHG) emissions (CO2 only). The GHG emissions calculation reflects the distance travelled by shuttles and private automobiles, as well as the vehicle/fleet type.

TABLE 6. Vehicle Miles Traveled and Green-house Gas Emissions

	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
VMT (Annually)	7,970,772	66,062,924	41,628,833	42,744,989	42,213,430
GHG (Tons of CO_2 annually)	15,412	38,671	27,515	28,034	28,034

The Single-hub Scenario would generate about eight times the VMT of the current Commuter Shuttle Program. The other scenarios would generate about five times the VMT of the current program. Increases in GHG emissions, while still substantial, would be less extreme (ranging from 1.8 times to 2.5 times as high levels of CO2 emission) because of the differences in the content of emissions from private automobiles and from large vehicles used as shuttles.

EVALUATION OF SCENARIOS

In addition to the mode shift analysis, each scenario was evaluated using the performance metrics identified for each of the program goals and objectives, as described in Table 1.

GOAL 1: Ensure that commuter shuttles do not adversely affect operations of public transportation in San Francisco

Zones Shared With Muni

Objective: Minimize shuttle conflict with Muni and other vehicles

One of the principal objectives of SFMTA's current Commuter Shuttle Program is to minimize or avoid shuttle conflicts with Muni and other roadway users. This objective was maintained in developing the scenarios. According to the 2015 Commuter Shuttle Pilot Program Evaluation Report, there were no blocked Muni buses observed at seven of the eight shuttle-only zones in the field data sample of the June 2015 field data collection. This suggests that when shuttles are provided exclusive zones that are long enough and adjacent to intersections, conflicts with Muni are almost completely removed. For this reason, in the current program, new or replacement zones are almost always sited separately from Muni zones, and SFMTA staff ensure that zones are sufficient in length and appropriately placed with respect to the block face and intersection. As such, this suggests that conflicts would be reduced in scenarios with fewer shared zones. Of the current shuttle zones, 73% are shared with or close to Muni zones. This share will likely decrease over time as SFMTA continues to replace busier shared Muni zones with separate shuttle loading zones in order to minimize conflicts with Muni.

TABLE 7. Shuttle zones shared with Muni

	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
Percent of shuttle zones shared with Muni*	72%	0%	0%	11%	20%

*For scenarios, staff calculated shuttles zones sharing block faces with Muni zones

Conclusion: Hub and consolidated scenarios would reduce the potential for conflicts with Muni relative to the current Commuter Shuttle Program. This is because most or all zones in each scenario would be sited exclusively separately from Muni stops. The current program has a large share of zones shared or on the same block as Muni.

Peak Period Muni Transit Demand

Objective: Avoid exacerbation of existing Muni crowding

Staff evaluated the increased demand for Muni's crowded routes to connect to hub and consolidated network locations under each scenario. Of course, Muni service levels are not static—Muni currently seeks to increase capacity and reduce crowding where it does exist. If a scenario increased demand for certain Muni routes significantly, Muni could aim to introduce more service in response. This measure sought to estimate what that near term increase in demand for Muni might be, and whether that near-term increase would affect routes that are currently crowded.

A previous academic study suggests that about 80% of riders in the pilot program to walked to their stop[5]. From this, staff inferred that at most about 20% of current riders (1,640 people) may take transit to their shuttle stop.

Under the scenarios, approximately 4,500–6,200 riders per day are expected to continue riding shuttles. Staff analyzed how many of these continuing riders would potentially take Muni or other transit to access the smaller shuttle system, and concluded that approximately 2,300–4,100 riders would likely use transit to access the hubs over the entire morning commute period. The increase in Muni riders would be people who would likely no longer walk to their stop because proposed hub locations are farther away. This equates to an additional 600–3,000 riders on transit during the morning peak period. Potential for increased demand would be most noticeable in the Single-hub Scenario as 4,120 shuttle riders would be taking transit to one destination. Additionally, transit lines in this downtown direction are currently known to be crowded during the morning peak period.

TABLE 8. Shuttle riders to use transit to access hubs during morning peak period

	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
Number of shuttle riders	1,640	4,120	3,431	4,566	2,262

Conclusion: All scenarios have higher potential than the current program to generate demand for travel on Muni during the peak period, by potentially generating up to 4,100 additional transit riders, 3,000 of whom would travel during the morning peak period, and potentially on routes that are currently crowded.

5 Dai D and Weinzimmer D, "Riding First Class: Impacts of Silicon Valley Shuttles on Commute & Residential Location Choice" (2014), 12.

GOAL 2: Integrate commuter shuttles into the existing multi-modal transportation system

Frequency Of Transit To Hubs

Objective: Provide nodes accessible by existing Muni

Staff considered transit accessibility as part of the screening process to identify potential node locations. In addition, this section analyzes the transit accessibility of each scenario in general, relative to the current Program. Staff measured transit access by the average number of Muni arrivals near a shuttle zone during the 6:30 AM to 7:30 AM hour. Based on data collected from shuttle operators, this hour has the most number of shuttle runs departing San Francisco during the morning travel period.

Hubs in the BART-oriented and Single-hub scenarios are served by the most frequent Muni service, on average (approximately 50–60 Muni arrivals per hour). However, with the small number of nodes in these scenarios, there are fewer total Muni arrivals than the more dispersed scenarios, and shuttle riders would consequently be concentrated among a smaller number of Muni vehicles.

Nodes in the Freeway-adjacent and the Consolidated Network scenarios would be served by about the same average number of Muni arrivals per location per hour—30–40—as the zones in the current program. However, zones in the Consolidated Network Scenario and the current program are served by a greater total number of Muni arrivals than the other scenarios; the current Commuter Shuttle Program network is served by almost ten times as many transit vehicles during the hour of analysis as the Consolidated Network Scenario. In addition, the Consolidated Network scenario and current Program are accessible to a larger number of Muni routes than any of the other scenarios; riders accessing zones by Muni under these scenarios would be distributed over several routes rather than concentrated on a few.

Staff did not seek to propose Muni service re-routes in order to provide better transit service to hubs, as shuttle riders would represent a small proportion of Muni riders and there are multiple issues to consider in Muni service delivery decisions.

TABLE 9. Frequency of transit to hub locations, 6:30–7:30 AM

	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
Total number of Muni arrivals	4,015	51	316	331	486
Average number of Muni arrivals	36	51	63	37	29

Conclusion: The current program is more accessible by Muni than any of the scenarios. Among the scenarios considered, the Consolidated Network Scenario would have substantially better overall Muni service than the other three. The BART-oriented Scenario has the greatest number of Muni arrivals at each location, consistent with the need to provide links between local and regional transit at BART stations.

Shuttle Travel On San Francisco Surface Streets Vs. Freeways

Objective: Reduce shuttle operations on surface streets

The intention of this objective is to reduce operations of commuter shuttles on surface streets, measured by the number of miles shuttle bus vehicles are anticipated to drive on San Francisco streets under each of the scenarios, relative to the current program. Staff also measured the number of miles shuttle bus vehicles would drive on San Francisco highways.

Staff then multiplied the measured mileage by the number of total morning runs for each route and extrapolated the known routes to represent the entirety of the permit-holding shuttle sector. The result is the total morning mileage traveled by shuttles in the current program; staff calculated shuttle miles driven under each scenario in a similar manner. "Dead-head" miles, or miles shuttle travel before picking up passengers were not included in this calculation.

By design, the Reduced Stop scenario would result in much lower mileage driven on San Francisco streets by shuttle vehicles, than the current program—a reduction of between 50% and 85%. The Freeway-adjacent Scenario would result in the fewest commuter shuttle miles driven on San Francisco surface streets. At the same time, the remaining surface street mileage by shuttles would be concentrated on a few hub-adjacent streets. The Consolidated Network Scenario would result in a greater number of annual shuttle bus miles on city streets than the other scenarios, but would still result in less than half as much travel by buses on streets as the current program.

The scenarios would in general increase the number of miles driven by shuttles on freeways within San Francisco.

TABLE 10. Shuttle travel on San Francisco surface streets and freeways (annually)

	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
Shuttle bus VMT on San Francisco surface streets	983,500	290,500	225,500	108,500	451,500
Shuttle bus VMT on San Francisco freeways	765,000	998,500	754,500	862,000	844,000

Conclusion: As intended, hub scenarios would result in much lower mileage driven on San Francisco streets by shuttle vehicles than the current program. The Consolidated Network Scenario would involve more travel by shuttle buses on city streets, but would still involve less than half as much shuttle bus surface street travel as the current program.

Parking Impacts

Objective: Support SFMTA's parking management efforts relative to use and management of curb space.

Staff assessed whether the hub scenarios would support the efficient use and management of curb space. The hub study included an evaluation of the scenarios' impact on curb use in two ways:

1. The number of parking spaces that would be restricted during the morning and/or evening shuttle operating periods (6:00–10:00 AM and 4:00–8:00 PM) in order to accommodate shuttle zones
2. The number of shuttle zones with all day parking allowed or unrestricted curb space nearby, indicating potential for increased driving to stops and potential neighborhood concerns with parking and riding.

SFMTA has put peak period parking restrictions in place where necessary to accommodate shuttle-only loading zones as part of the current program. Eighty-nine parking spots are restricted during the morning and 70 during the evening. About 40% of these are metered, with Commuter Shuttle Program fee revenue reimbursing the SFMTA general fund for lost meter revenue during the shuttle zones' effective hours. The need for such restrictions has increased since SFMTA began increasing the use of designated shuttle-only zones as compared to shared Muni zones.

PARKING REMOVAL

The Single-hub Scenario would not further restrict parking, based on the assumption that the shuttles would utilize the bus berths of the Temporary Transbay Terminal. Curb space currently restricted for shuttle zone use would become available for other uses.

The other scenarios would generally require a net increase in peak period parking restrictions, relative to the current program. This number is greatest with a Consolidated Network Scenario as over 200 spaces would need to be restricted during each operating period. The BART-oriented Scenario would not restrict substantially more parking spaces citywide than the current program, although the restricted spaces would be concentrated at the BART-oriented hubs rather than dispersed across the current network.

Conclusion: With the exception of the Single-hub Scenario, all scenarios would generally involve a net increase in peak period parking restrictions, relative to the current Program, to provide adequate space for shuttle bus activity.

DRIVING AND PARKING

Under the existing Commuter Shuttle Program, SFMTA has received a few complaints from residents and stakeholders of increased competition for all-day parking or for on-street unrestricted curb space near existing stops in the outer Sunset and Noe Valley. These complaints typically concern stops that are not in dense areas, and thus are not within walking distance for many shuttle riders in general. Staff reviewed hub scenarios for the presence of unrestricted curb space nearby, due to the decrease in walking access to zones under a hub scenario and, therefore, the potential for increased driving to access hub zones.

In response to aforementioned complaints, the SFMTA conducted an intercept survey of shuttle riders boarding at 19th Avenue and Wawona Street in June 2016. The survey results show that 34% of those interviewed drive to the location, and 10% are dropped off.

No unrestricted curb areas are located in the vicinity of the Single-hub Scenario, but competition for unrestricted curb space may increase around many of the hubs in the BART-oriented, Freeway-adjacent, and Consolidated Network scenarios. Three of the five BART-oriented Scenario nodes have unrestricted curbs nearby (within 3 blocks). These were the 16th and Mission, 24th and Mission and Balboa Park BART stations. These zones are likely already competitive due to their proximity to BART stations, but the competition might be exacerbated further with the addition of commuter shuttle hubs. While there is unrestricted curb space around many of the shuttle locations in the Freeway-adjacent and Consoidated Network scenarios, these scenarios would see more dispersed impacts because there are more locations and they are necessarily in demand by those driving to regional transit. The Consolidated Network Scenario is expected to result in the least net increase in demand for parking, since a greater share of riders could walk to access the shuttle zones. Any demand for parking would also likely be more dispersed. It important to note that some shuttle riders may take transportation network companies (TNCs) like Uber and Lyft to the hub locations, but if there are unrestricted curb areas nearby then there is potential for increased demand for those spaces.

TABLE 11. Parking impacts

	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
Required parking space removal*	AM: 89 PM: 70	0	95	152	AM: 236 PM: 228
Stops/hubs that have unrestricted curb space nearby (within 3 blocks)	40	0	3	6	10

* Number of on-street spaces—net reinstatement from current program)

Conclusion: All scenarios would generally involve a net increase in competition for unrestricted or all-day parking curb space. The BART-oriented Scenario could see the most concentrated increased competitiveness around the 16th and Mission, 24th and Mission and Balboa Park BART stations with unrestricted curb space nearby.

GOAL 3: Provide a safe environment for all street users in support of the City's Vision Zero safety policy

Objectives: Reduce potential for collisions on city streets

Safety, in the context of the shuttle program, is extremely complicated with discussions about the issue mixing compelling anecdotal accounts with larger data driven efforts. In identifying the safety issues to consider, staff identified three categories for consideration:

- Fatal and severe injury collisions
- Collisions caused by shuttle behavior
- Near misses and the perception of danger related to shuttles

Staff used a range of quantitative data on the street and land use conditions around each of the hubs to evaluate the four scenarios with regards to their ability to reduce the likelihood of collisions for all street users on San Francisco streets. The most direct indicator of collision risk is vehicle miles traveled (VMT) on surface streets by shuttle vehicles and vehicles in general. A previous study conducted by the San Francisco Department of Public Health found traffic volumes to be a strong predictor of vehicle-pedestrian injury collisions[6].

6 Wier M, Weintraub J, Humphreys EH, Seto E, Bhatia R, "An area-level model of vehicle-pedestrian injury collisions with implications for land use and transportation planning. Accident Analysis & Prevention" (2009), 137- 45

In the Pilot Program evaluation, SFMTA did not identify a pattern of collisions related to shuttle vehicles. This could be a factor of the small number of vehicles in use in a given year. Looking at national safety research, the one study in the Journal of Safety Research found that the fatality rate per one million miles travelled is about the same for buses (of all types) as it is for automobiles[7]. Because all of the scenarios would lead to an increase in total VMT, as identified earlier in this study, it is likely that all of the scenarios would result in an associated increased risk of collisions and fatalities.

Before SFMTA initiated the shuttle program, many complaints and concerns were raised related to behavior of shuttle drivers double parking, blocking intersections and crosswalks, etc. The recent mid-year evaluation of the current shuttle program found that active regulation of the shuttle program, which includes adapting shuttle stop sizes to meet the need of the program, has reduced conflicts with Muni. Because the reduction is the result of the program being in place, staff found no safety benefit related to collisions caused by shuttle drivers behaving inappropriately. In all scenarios, current or hub, SFMTA staff has the ability to adjust shuttle stop locations and configurations to mitigate and eliminate any safety concerns that arise.

It should be noted that in any scenario where providers begin to operate outside the program, whether by running routes not in the program or by dropping out of the program entirely, SFMTA's ability to regulate safety would be diminished. This suggests that a program configuration with a higher participation rate will address more safety conflicts than a program configuration with a lower participation rate.

Staff at both SFCTA and SFMTA are aware of the many experiences that have been shared by San Francisco road users where a shuttle vehicle has put people in unsafe situations or caused situations that resulted in negative outcomes. Because shuttles are large vehicles, they have greater impacts on visibility and when they are involved in collisions, they have a much greater impact on those they collide with. Nothing in this report is meant to ignore or diminish those experiences. They are meaningful and the City should work to reduce and eliminate them.

The scenarios have localized potential to reduce conflicts between shuttles and other street users through improved zone placement and design. These siting and design measures could also be taken under the current program. However, the net effect of all of the hub scenarios would be to increase safety conflicts, as all of the scenarios increase the overall number of vehicles on city streets as a result of mode shifts from shuttles to driving.

A precept of Vision Zero, the City's policy to eliminate traffic fatalities, is that human error will continue to occur and the system should be designed to ensure that when mistakes are made, death is not the result. Consistent with this data-driven policy, staff weighed the experiences that have been expressed with the data that is available that indicates that all of the hub scenarios would result in increased VMT. The project team has concluded that the safest system is one with the lowest VMT and highest ability to regulate the behavior of vehicles. In doing so, residents are exposed to the lowest risk of collision and provided the greatest level of responsiveness in addressing very real concerns and issues.

TABLE 12. Vehicle-Miles Traveled in Scenarios

	CURRENT PROGRAM	SINGLE HUB	BART	FREEWAY	CONSOLIDATED
VMT (Annually)	7,970,772	66,062,924	41,628,833	42,744,989	42,213,430

Conclusion: All scenarios would increase the risk for collisions because of the significant increase in surface street VMT that would be generated by each scenario. The Single-hub Scenario has the greatest potential to increase conflicts, as the overall number of vehicles on city streets would increase the most as a result of mode shifts from shuttles to driving. The Consolidated Network Scenario most closely resembles the current Commuter Shuttle Program, and distributes hubs more evenly throughout the city than the other three scenarios.

Safety concerns related to shuttle operations have been demonstrably addressed through regulation of commuter shuttles and through the decision to avoid establishment of shared Muni zones. The reduced-stop scenarios would increase safety conflicts, as the overall number of vehicles on city streets would increase as a result of mode shifts from shuttles to driving.

7 http://www.ncbi.nlm.nih.gov/pubmed/22974682

GOAL 4: Work collaboratively with shuttle sector to refine policies and address concerns

Employer/Operator Perceptions

Objective: Ensure that providers would continue to seek permits and participate in the regulatory program, rather than operate shuttles outside the program.

The project team conducted interviews with shuttle program sponsors (companies that provide shuttle programs for their employees) and/or shuttle operators to gauge the potential impact of the hub systems on shuttle program operations and the likelihood of shuttle providers continuing to seek permits and participate in the voluntary regulatory program. The team invited six employers/operators to participate in interviews. These contacts were selected to represent a sample of intercity and intracity services as well as both small and large scale shuttle operations. Of the six contacts, three agreed to be interviewed:

1. A large scale, intercity operation
2. A small scale, intercity operation
3. A small scale, intracity operation

Given the small sample size, further surveying would be needed to reach definitive conclusions about the effect of a hub system on operators. However, the responses illustrate some issues of concern to shuttle operators and provide areas for further consideration if a hub or consolidated system were to be pursued.

QUESTIONS

Each respondent was asked the following questions:

1. How have the changes in the shuttle program from the pilot to the current program impacted your ridership and service?
2. [The four scenario concepts were described to respondent]. How might your operations change under each of these scenarios?
3. If the implementation of a hub system results in fewer shuttle riders, how might this impact your shuttle operations? (e.g. Would you use smaller vehicles, provide more/less service, etc.?)
4. Would the conversion of the program to a hub system affect your willingness to participate?
    a. Why? What are your major concerns with a hub system?

Conclusion: Current program participants voiced some concerns about a reduced-stop system, but would not indicate whether or not they would maintain interest in participating in the program were it to take a smaller form. If providers do cease to participate, do not comply with program requirements, or shift to smaller vehicles, increased unauthorized stopping and/or travel along non-arterial streets could occur. For a summary of the interviews refer to Appendix F.

GOAL 5: Establish a program structure that meets current needs and has the potential to evolve as the sector grows and evolves

Potential For Expansion

Objective: Allow for program flexibility and expansion

This portion of the evaluation explores whether the identified zones in each scenario have sufficient physical capacity to accommodate increased demand by shuttle vehicles over time. Insufficient capacity could lead to safety issues like double-parking and blocked bicycle or vehicular travel lanes. Staff used capacity standards for multi-berth on-street bus stops to estimate the number of 40 to 45-foot buses that could be accommodated. These standards apply the same assumptions used in the physical space criterion analysis.

The existing Commuter Shuttle Program has the greatest capability to physically accommodate additional shuttle vehicles within the existing number of zones. In both the morning and evening operating periods, the current program could accommodate six times the current maximum demand. The Consolidated Network Scenario has opportunity to accommodate additional activity, but not nearly as much as the current program. The other three scenarios can expand but only minimally as each has space to accommodate fewer than 100 additional shuttle runs during the peak shuttle hour. Given the space requirements of concentrated activity at the hubs, especially in a constrained urban setting, allocation of additional space at the hubs beyond what was assumed for the analysis would be challenging.

	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
Number of bus berths in scenario	AM: 108 PM: 101	36	26	37	56
Scenario capacity: Maximum number of runs that could be accommodated at per hour	AM: 648 PM: 606	216	156	222	336
Potential for growth of program: Additional runs that can be accommodated beyond current peak hour demand of 128 runs	Yes, maximal +478	Yes, minimal +88	Yes, minimal +28	Yes, minimal +94	Yes, moderate +208

GOAL 6: Facilitate a shuttle program that minimizes shuttle operations in neighborhoods

Community feedback reviewed as part of the Pilot Program Evaluation reveals that the most frequently received comments focused on shuttles being too large for small streets or shuttles being in a place where they are either not permitted or appreciated. These included: idling on streets, using weight-restricted streets, using unauthorized stops, or simply being unwelcome in a particular location or generally on the streets of San Francisco. These issues were addressed as feasible in the formulation of the current program, which provides further restrictions on shuttle activity, tracking, and a higher level of enforcement. Performance of the current program relative to these and other issues is addressed in the Commuter Shuttle Program April to September 2016 Status Report.

Driving On Non-Arterial Streets

Objective: Decrease shuttle activity on non-arterial streets

The current program restricts large shuttles over 35 feet in length to the arterial street network as designated by the California Department of Transportation ("Caltrans") in order to shift shuttle traffic off of smaller streets. Shuttles violating this restriction are subject to fines. While large shuttle travel on non-arterial streets dropped dramatically in the first five months of the current program, SFMTA continues to observe a limited number of violations each month. Many of these violations occur in areas with few Caltrans-designated arterial streets like Potrero Hill or the eastern Mission District.

This analysis estimates the miles of shuttle routes on non-arterial surface streets in San Francisco under the current program, the hub scenarios, and the Consolidated Network Scenario. The methodology was similar to the one used to calculate the annual miles driven on surface streets and freeways under Goal 2 with one difference. The previous calculation of "annual miles driven on surface streets" added the miles that each shuttle route would drive on surface streets, and multiplied by the total number of shuttle runs during the peak period as well as the number of periods per year. For this calculation, staff added the number of miles that each shuttle route would travel on non-arterial streets, and annualized the figure; but did not multiply by the total number of runs in the peak period.

The calculations show that the current Commuter Shuttle Program has more route miles than any of the hub scenarios or consolidated scenario. The Single-hub Scenario performed best under this metric with no miles traveled on non-arterial streets. While the Freeway-adjacent Scenario locates nodes close to on- and off-ramps, it is anticipated to have the most driving on non-arterial streets among all of the hub scenarios. This is likely due to the fact that one of the nodes in the Freeway-adjacent Scenario network requires two blocks of travel on non-arterial streets to reach a nearby arterial street. Similarly, there are nodes in the BART-oriented Scenario that also require a block or two of travel on non-arterial streets. The Consoidated Network Scenario was designed around high travel demand routes served by arterials, and therefore would result in minimal travel on non-arterial streets.

TABLE 14. Driving on non-arterial streets

	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
Approximate shuttle bus route miles traveled on non-arterial surface streets (Annually)	25,000	0	7,500	11,000	3,500
Percentage of non-arterial streets of all surface street travel	2.5%	0%	3.3%	10.1%	0.8%

Conclusion: With the exception of the Single-hub Scenario, the current program and all other scenarios require some travel on non-arterial streets. While the distances can be minimal—as little as a block or two—over the course of a year they aggregate to several thousand miles. Travel on non-arterial streets would decrease under all scenarios relative to the current program, although the decrease represents minimal reductions as a proportion of overall shuttle travel on streets.

However, if providers do not participate in the program, or participate but do not fully comply with the limitations on stop activity, driving on non-arterial streets would increase as compared to the "best case" scenario analyzed in this Study.

Unauthorized Stops

Objective: Minimize shuttle loading at unauthorized stops

Under California state law, buses are allowed to operate in San Francisco and to stop in legal curb space to load and unload passengers. Legal curb spaces include the dozens of white zones, commercial loading yellow zones, and unregulated curb space across the city. Commuter Shuttle Program operators are regulated by the California Public Utilities Commission, and local jurisdictions cannot require them to participate in an additional regulatory program.

The current Commuter Shuttle Program regulates shuttle operators that voluntarily apply for a permit. The permit program is appealing because shuttle operators get access to dedicated curb space for loading and unloading via authorized commuter-only shuttle zones or shared Muni zones. Permittees must operate in compliance with permit terms and pay fees for use of the network of designated stop locations. Because the program is voluntary, the final system must provide enough benefit to the operators for them to be willing to participate. Given that access to curb space is a limited resource, there is an incentive for operators to participate.

Prior to the establishment of the Commuter Shuttle Pilot program in August 2014 the SFMTA identified 250 locations where shuttles were loading and unloading within the city. Even after the establishment of the Commuter Shuttle Program, many shuttle program participants have continued to stop outside of the authorized commuter shuttle stop network, stopping legally in regular passenger loading white zones in areas like Glen Park and the Financial District where white zones where more convenient to their destination than any of the authorized commuter shuttle zones. Regular white zones are often full of passenger vehicles, preventing shuttles from reliably accessing the curb, so shuttle operators tend to prefer authorized shuttle-only loading zones when they are available. However, legal but unregulated stopping behavior in regular passenger loading white zones would likely expand if the shuttle stop network were further restricted under a hub scenario.

Under a hub scenario where the number and location of designated commuter shuttle loading zones is dramatically restricted, if the shuttle program is not meeting employers' needs, more shuttle operators may opt not to apply for a permit and instead operate outside of a regulatory Commuter Shuttle Program or they may choose to remain in the program but make unauthorized stops in order to continue serving existing riders.

While it is not possible to predict the extent to which providers would choose not to participate in the shuttle program and/or make unauthorized stops, it is reasonable to presume that all reduced service models would result in fewer shuttle vehicles being regulated by the program. It is also expected that shuttle operators would likely try to serve at least a portion of current riders outside of the Commuter Shuttle Program, both to provide better service to clients and to comply with transportation demand management requirements associated with the conditions of approval of developments outside San Francisco. Operation of shuttle vehicles outside the program would result in unauthorized stops, use of streets where vehicles in the program are prohibited from travelling, and no ability for SFMTA to require that those vehicles comply with the requirements of the shuttle program.

The expected rate of increase in stop events in locations outside of the authorized stop network is directly correlated with the decrease in the number designated shuttle zones and subsequent decrease in shuttle usage. As the number of shuttle zones and coverage area decreases, the number of riders that are willing to travel to the hubs decreases, resulting in an increase in unauthorized stops as employers will still seek to provide direct service to employees.

The Single-hub Scenario would result in the largest decrease in operator participation in the Commuter Shuttle Program. According to the results of the mode choice analysis, if shuttles were restricted a single hub located at the Temporary Transbay Center, 45% of current shuttle riders would choose to switch to another mode. This would result in the greatest potential for stops being made outside of designated shuttle zones or "unauthorized stops" of all of the scenarios. With only one location at which to conduct passenger operations, the Single-hub Scenario has this highest likelihood of shuttle provider non-participation of all of the scenarios analyzed and subsequent use of unauthorized stops.

The BART-oriented and Freeway-adjacent scenarios would see a smaller decline in shuttle ridership and thus a higher participation rate in the program. However, with no hubs in the half of the city north and west of Market Street, shuttle operators might find places to stop outside of the shuttle network, resulting in unauthorized stops, particularly in the northern and western areas of San Francisco.

The Consolidated Network Scenario has the largest geographic coverage of the city of the four scenarios, but with an 85% decrease in the number of designated stops compared to the current program, it would still lead to a decrease in participation in the program and thus result in more unauthorized stops than the current program but less than the other three scenarios. In this scenario, 24% of current riders would switch to another transportation mode.

TABLE 15. Effect on unauthorized stops

	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
Change in shuttle ridership	—	-45%	-27%	-28%	-24%
Unauthorized Stops	No Change	Many	Some	Some	Some

Conclusion: Data collected as part of the Commuter Shuttle Pilot Program found that providing more legal stop locations led to a decrease in shuttle activity at unauthorized stop locations. Conversely, reducing the number of legal stop locations would likely result in an increase in unauthorized shuttle stop activity. One feature that makes shuttles an attractive option is their convenience, and as they become less convenient, non-participation and/or unauthorized stops will increase.

GOAL 7: Support more focused enforcement, ease of administration and on-going oversight

Enforcement Needs

Objective: Reduced need for active enforcement

During the Commuter Shuttle Pilot program, the enforcement detail assigned to commuter shuttles consisted of 10 parking control officers (PCOs) for each weekday morning and each weekday evening period. The detail grew to 15 PCOs in the current program based on the demonstrated need during the Pilot. Currently PCOs assigned to the shuttle program enforce program rules and regulations in the network of designated zones across the city and in other locations where shuttles frequently operate.

All of the scenarios consolidate shuttle zones, meaning that shuttle volumes at node locations would be much higher than at current shuttle zones. Given this, enforcement officers would need to be stationed at hubs for the duration of the morning and evening periods to manage shuttle traffic while others would need to continue to patrol the city to cite shuttles making unauthorized stops. Further, staff recommends that in order to maintain the current levels of program compliance, SFMTA would need additional PCOs in all four scenarios, in addition to the 15 PCOs currently assigned to the Commuter Shuttle Program. This recommendation is necessary because all scenarios would result in an increase in unauthorized stops, as discussed in the previous section. If providers drop out of the program, no GPS data would be available to aid enforcement.

The Single-hub scenario would require the greatest net increase in enforcement resources of any scenario. Currently, AC Transit stations four supervisors to direct its vehicles around the Transbay Temporary Terminal. Under the Single-hub scenario, a similar number of enforcement officers would be needed to direct shuttles in the terminal itself. Several more would need to be stationed on surrounding blocks dedicated to shuttle service and at key intersections with high shuttle traffic. Finally, as this would have the highest level of unauthorized stops of the hub scenarios, the PCOs needed to patrol the rest of the city would be similar to the number on the shuttle detail in the current program.

Due to the high expected shuttle volumes at each hub in the BART-oriented Scenario, more than one PCO would be required at each hub. While unauthorized stop activity is expected to be lower than the Single-hub Scenario; a large number of additional PCOs would still be required to patrol the rest of the city for unauthorized stops. This would result in a total enforcement detail larger than that in the current program. Without GPS data indicating where shuttles are operating, targeting enforcement would be an on-going challenge.

The Freeway-adjacent Scenario would require a similar number of PCOs to the BART-oriented Scenario. The Consolidated Network Scenario would require a few full-time stationed PCOs at certain stops and a detail the size of that in the current program to patrol both designated and unauthorized stops across the rest of the city.

Conclusion: All scenarios would require a net increase in PCO levels compared to the current program. The specific configuration of a given scenario (number of nodes combined with likely unauthorized stops) would affect how much more of an increase in PCO resources is recommended beyond existing levels.

STUDY CONCLUSIONS

This study analyzed potential alternative models for the Commuter Shuttle Program. The scenarios sought to limit shuttle pick up locations, and the study assessed how alternative models would advance the goals of a Commuter Shuttle Program relative to the existing program. The analysis considered three hub scenarios (Single-hub, BART-oriented, and Freeway-adjacent), as well as a Consolidated Network Scenario consisting of up to 30 shuttle zones located throughout the city. This section summarizes the Study's findings.

Key Assumption: Shuttle Program Participation

The reduced-stop scenarios defined for this study presumed no changes in the number of shuttle operators that participate in the program and no changes in operations with regards to shuttle runs per AM peak period. It is possible that a program with significantly fewer authorized stop locations would see a drop in participation of one or more operators and/or a reduction in shuttle activity. However, there is no simple way to project any change in participation rate as a function of authorized stops. The findings and conclusions discussed below reflect an assumption that none of the current participating operators withdraw from the Commuter Shuttle Program.

FINDINGS

Mode Shift and Vehicle Miles Traveled (VMT)

Shuttle riders are forecast to make the greatest shifts in their mode choice under a Single-hub scenario with 45% of the current shuttle riders anticipated to shift to an entirely non-shuttle mode for their trip. This means that only about half of the current shuttle riders would continue taking the shuttle.

Under the BART-oriented, Freeway-adjacent, and Consolidated Network scenarios, about three-quarters of the current shuttle riders would be expected to continue commuting via shuttle, with about one quarter shifting to a different mode.

The model forecasts that nearly all, or approximately 90%, of those riders who shift modes are expected to switch to driving. This forecast holds true under all scenarios. Approximately 10% of current shuttle riders are forecast to switch to transit (e.g., Caltrain).

The increase in private driving trips would translate to an approximately eight-fold increase in VMT under a Single-hub scenario (relative to the VMT generated by the current shuttle person-trips), and a five-fold increase in VMT under the BART-oriented, Freeway-adjacent, and Consolidated Network scenarios.

At the same time, the number of shuttle-miles traveled on San Francisco surface streets would decrease overall by half (Consolidated Network Scenario) to 70% (Single-hub Scenario). The access routes serving each node would see increases in shuttle vehicles.

Of those current riders who continue using the shuttles, it is likely that some portion would drive to their shuttles and park nearby (in unrestricted street parking or paid parking), ride bicycles or scooters, or use TNCs or private transit.

Muni Conflicts and Peak Period Demand

Staff sought to identify node locations separate from Muni stops, to avoid potential for conflicts with Muni operations. About 70% of the current program's authorized stops are shared with Muni. A Single-hub, BART-oriented, and Freeway-adjacent scenario can be designed with little to no sharing of Muni stops; a Consolidated Network Scenario would likely result in some stops (e.g., 20%) shared with Muni.

All scenarios have higher potential than the current program to contribute to higher demand on Muni during the peak period, by potentially generating up to 4,100 additional transit riders, 3,000 of whom would travel during the morning peak period.

Parking Removal and Demand

The proposed hub scenarios differ in the extent to which they would need more or less on-street curb space during commute periods to provide sufficient on-street capacity for shuttle operations as compared to the current program. A single-hub scenario could only operate in an off-street location in order to accommodate the high number of buses picking up at any given time and across multiple hours. As such it would not necessitate parking removal, and could return some curb space currently used as shuttle stops to another use. One scenario, the Consolidated Network Scenario, would require additional curb space at each zone to be converted to shuttle operations because more vehicles would be accessing each stop simultaneously than under the current program; however, the total amount of space needed is about the same as the curb space required by the current program, and would not present a net increase in curb space required citywide but would still have areas near the hubs see reductions in parking availability.

All scenarios would generally involve a net increase in competition for unrestricted or all-day parking curb space. The BART-oriented Scenario could see the most concentrated increased competitiveness around the three hubs with unrestricted curb space nearby.

Safety

All scenarios would increase the risk for collisions, given the significant increase in surface street VMT generated by each. The Single-hub Scenario has the greatest potential to increase conflicts, as the overall number of vehicles on city streets would increase the most as a result of mode shifts from shuttles to driving. The remaining three scenarios would have similar reductions in safety outcomes. In consolidating operations in a reduced stop scenario, existing conflicts with shuttles would be more localized, with the consolidated system having impacts that were experienced in more neighborhoods. However, the entire city would be impacted by the increase in collision risk caused by the increase in number of vehicles driving on city streets.

Travel on Non-Arterial Streets

With the exception of the Single-hub Scenario, the current program and all other scenarios require some travel on non-arterial streets. While the distances can be minimal—as little as a block or two—over the course of a year they aggregate to several thousand miles. Travel on non-arterial streets would decrease under all scenarios relative to the current program, although the decrease represents a minimal reductions as a proportion of overall shuttle travel on streets.

However, if providers do not participate in the program, or participate but do not fully comply with the limitations on stop activity, driving on non-arterial streets would likely increase compared to the scenarios analyzed in this Study.

Program Participation

Feedback from current program participants noted concerns about a hub system but did not indicate whether or not they would maintain interest in participating in the program were it to take a hub form. However, since participation in the program in voluntary, the final system must provide enough benefit to the operators for them to be willing to participate. Given that access to curb space is a limited resource, there is an incentive for operators to participate. Under all scenarios, access to curb is greatly reduced and consolidated. As such, staff expects that some shuttle operators may opt out of the program completely or try to serve at least a portion of their current riders outside of the program.

Unauthorized Stops and Program Enforcement

The expected rate of increase in stop events in locations outside of the authorized stop network is directly correlated with the decrease in the number designated stops for shuttles and subsequent decrease in shuttle usage. As the number of shuttle zones and coverage area decreases, the number of riders that are willing to travel to the nodes decreases, likely resulting in an increase in unauthorized stops as employers will still seek to provide direct service to employees. Given that all scenarios have fewer authorized stops and will result in a mode shift away from shuttle usage as compared to the current program, unauthorized stops are expected to increase under all scenarios.

Each of the scenarios would require PCOs stationed at the node locations to guide shuttle loading and unloading operations, particularly given the increase in shuttle volumes at individual locations. In addition, given the increase in unauthorized stops expected in all scenarios, roaming PCOs would be needed. All scenarios would require a net increase in PCO staffing levels compared to the current program. The net increase in the number of PCOs required for each hub scenario ranges from 20% (BART-oriented) to an increase of 50% (Single-hub).

The increase in PCOs could be funded through an increase in program fees to cover these incremental costs. However, voluntary program participation is a consideration. If one or more operators withdraw from the program and return to using unauthorized stops the SFMTA may incur additional, unfunded costs associated with enforcing commuter shuttle activity due to an inability to collect enough fees to fund needed enforcement activity.

Program Growth

The current program has the most capacity to accommodate additional shuttle arrivals per hour. The Consolidated Network Scenario can accommodate roughly 45% additional shuttle arrivals each hour as compared to the current program. The other hub scenarios have some capacity to accommodate additional arrivals.

CONCLUSION

This study analyzed potential alternative models for the Commuter Shuttle Program. The reduced-stop scenarios sought to limit shuttle pick-up locations. The study sought to assess how alternative configurations would impact the efficacy of the shuttle program, traffic congestion, neighborhood safety, the environment, and public transportation.

The analysis identified three physically viable hub scenarios: a Single-hub Scenario operating at the Transbay Temporary Terminal; a BART-oriented Scenario; a Freeway-adjacent Scenario. The analysis also considered a Consolidated Network Scenario.

The hub scenarios present a number of tradeoffs in relation to the current Program. While vehicle miles traveled on streets throughout the city would decrease, the same number of shuttles would concentrate their operations on a small number of city streets. In addition, a substantial proportion of current riders would be expected to shift their travel to driving or to riding in TNCs to the hubs, increasing the vehicle miles traveled on city streets in private vehicles.

In analyzing the Single-hub scenario, it was determined that at this time, the only potential site for a hub operation would be the existing Transbay Temporary Terminal. As this location is in use until 2018 and already in the planning phase for multiple residential and open-space projects, this scenario would be impractical to implement. Even if the site were to become available, the Study found that it would likely be unsuccessful. With about half the riders abandoning the system, the Single-hub scenario would likely lead potential shuttle providers to return to the preprogram days of patching together unauthorized shuttle stops.

Voluntary participation and compliance rates are perhaps the greatest unknown under a hub system. One outcome of a hub system could be noncompliance with the program requirements, that is, increased unauthorized stop activity outside of zones or hubs, and the attendant inconveniences and safety hazards that have been observed to result from such activity. Another possible outcome is decreased participation by the shuttle providers in the program, which would result in unauthorized stop activity and would eliminate the SFMTA's ability to administer program requirements such as labor harmony, GPS tracking, vehicle model year requirements, and safety training. Since providers pay for the program by stop events at authorized zones, increased unauthorized activity or decreased participation would affect the SFMTA's ability to fund the program. At the same time, the analysis concluded that the scenarios would increase program costs by increasing enforcement needs. An increase in the fee per stop event could result in additional noncompliance with the voluntary program.

In conjunction with the findings from this analysis, the SFMTA will present a six-month status update of the current program.

PHOTO CREDITS

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TABLE 16. Summary

GOAL	OBJECTIVES	PERFORMANCE MEASURES	CURRENT PROGRAM	SINGLE-HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED NETWORK
1. Ensure that commuter shuttles do not adversely affect operations of public transportation in San Francisco	Minimize shuttle conflict with Muni and other vehicles	Percent of shuttle zones shared with Muni (current program) or percent on the same block face as Muni zones (scenarios)	72%	0%	0%	11%	20%
	Avoid exacerbation of existing Muni crowding	Transit crowding: Expected number of shuttle riders to access nodes by transit during morning peak period	1,640	4,120	3,431	4,566	2,262
2. Integrate commuter shuttles into the existing multi-modal transportation system		**MODE SHARE**					
		Shuttle trips	100%	55%	73%	72%	76%
		Drive trips	0%	41%	24%	25%	22%
		Transit trips	0%	4%	3%	3%	2%
		NUMBER OF TRIPS					
		Shuttle trips	8,200	4,500	6,020	5,930	6,230
		Drive trips	0	3,330	1,960	2,050	1,780
		Transit trips	0	370	220	220	190
		Vehicle Miles Traveled (VMT) by shuttles and other vehicles (Annually)	7,970,772	66,062,924	41,628,833	42,744,989	42,213,430
		Greenhouse Gas (GHG) emissions (Tons CO_2 annually)	15,412	38,671	27,515	28,034	28,034
	Provide hubs accessible by existing Muni	Total number of Muni arrivals at/near zones, 6:30–7:30 AM	4,015	51	316	331	486
		Average number of Muni arrivals at/near zones, 6:30–7:30 AM	36	51	63	63	37
	Reduce shuttle operations on surface streets	Estimated shuttle bus VMT on San Francisco surface streets (arterial and non-arterial streets) (Annually)	983,500	290,500	225,500	108,500	451,500
		Estimated shuttle bus VMT on San Francisco freeways (Annually)	765,000	998,500	754,500	862,000	844,000
	Support SFMTA's parking management efforts	Required parking space removal (number of on-street spaces—net reinstatement from current program)	AM: 89 PM: 70	0	95	152	AM: 236 PM: 228
		Stops/hubs that have unrestricted curb space nearby (within 3 blocks)	40	0	3	6	10

continued

GOAL	OBJECTIVES	PERFORMANCE MEASURES	CURRENT PROGRAM	SINGLE HUB	BART-ORIENTED	FREEWAY-ADJACENT	CONSOLIDATED ZONE NETWORK
3. Provide a safe environment for all street users in support of the City's Vision Zero safety policy	Reduce potential for collisions on city streets	Vehicle Miles Traveled (VMT) by shuttles and other vehicles	—	All scenarios would increase the risk for collisions because of the significant increase in surface street VMT that would be generated by each scenario. The Single-hub Scenario has the greatest potential to increase conflicts, as the overall number of vehicles on city streets would increase the most as a result of mode shifts from shuttles to driving. The Consolidated Network Scenario most closely resembles the current Commuter Shuttle Program, and distributes hubs more evenly throughout the City than the other three scenarios.			
4. Work collaboratively with shuttle sector to refine policies and address concerns and conflicts	Ensure that providers would continue to seek permits and participate in the regulatory program, rather than operate shuttles outside the program.	Employer/operator feedback	—	Current program participants voiced some concerns about a reduced-stop hub system, but would not indicate whether or not they would maintain interest in participating in the program were it to take a smaller form. If providers do cease to participate, do not comply with program requirements, or shift to smaller vehicles, increased unauthorized stopping and/or travel along non-arterial streets could occur.			
5. Establish a program structure that meets current needs and has the potential to evolve as the sector grows and evolves	Allow for program flexibility and expansion	Number of bus berths in scenario	AM: 108 PM: 101	36	26	37	56
		Scenario capacity: Maximum number of runs that could be accommodated per hour	AM: 648 PM: 606	216	156	222	336
		Potential for growth of program: Additional runs that can be accommodated beyond current peak hour demand of 128 runs	Yes, maximal +478	Yes, minimal +88	Yes, minimal +28	Yes, minimal +94	Yes, moderate +208
6. Facilitate a shuttle program that minimizes shuttle operations in neighborhoods	Decrease shuttle activity on non-arterial streets	Approximate shuttle bus route miles traveled on non-arterial surface streets (Annually)	25,000	0	7,500	11,000	3,500
		Percent of non-arterial streets of all surface street travel	2.5%	0%	3.3%	10.1%	0.8%
	Minimize shuttle loading at unauthorized stops	Change in shuttle ridership	—	-45%	-27%	-28%	-24%
		Unauthorized stops	No Change	Many	Some	Some	Some
7. Support more focused enforcement, ease of administration and on-going oversight	Minimize need for active enforcement	Change in minimum enforcement needs	15 PCOs in current program	+8	+5	+5	+3
		Qualitative assessment	—	Most intense PCO needs	More intense PCO needs	More intense PCO needs	Most similar to current program

Commuter Shuttle Hub Study

FINAL REPORT APPENDICES | NOVEMBER 2016

SFMTA
Municipal
Transportation
Agency

SAN FRANCISCO COUNTY TRANSPORTATION AUTHORITY

APPENDIX A: SUMMARY OF SUBMITTED NODE LOCATION SUGGESTIONS

NAME	LOCATION	FREQUENCY
Caltrain Station	700 4th St.	80
Transbay Terminal	200 Folsom	73
Glen Park BART Station	2901 Diamond	55
San Jose Ave.	Dolores and San Jose Ave.	34
Van Ness and Bay	Van Ness and Bay	33
Van Ness	Lombard and Van Ness	30
Castro Safeway	Church and Market	29
San Francisco DMV parking lot	1377 Fell	29
Noe Valley	24th and Church	27
16th St BART	16th St and Mission	25
Mission	18th and Mission	25
Mission	24th St and Valencia	25
Civic Center	8th St. and Market	23
Golden Gate Park	Stanyan and Waller	22
Castro	18th St. and Castro	20
Nob Hill/Lower Pacific Heights	Van Ness and Sacramento	20
Balboa Park BART station	Geneva and San Jose Ave.	17
Castro and Market	Castro and Market	17
Van Ness and Vallejo	Van Ness and Vallejo	17
Divisadero and Haight	Divisadero and Haight	15
Fort Mason Center	2 Marina Blvd.	15
Oak and Steiner	Oak and Steiner	14
Lower Haight	Divisadero and Oak	14
Marina / Cow Hollow	Lombard and Pierce	14
Stonestown Galleria	19th Ave and Winston	13
Alemany Farmers and Flea Market	100 Alemany Blvd.	12
Dolores Park	18th St. and Dolores	11
Noe Valley	25th St. and Castro	11
City Hall	Dr Carlton B Goodlett Pl and Grove	10
Gough St.	Geary and Gough	10
19th Ave. and Wawona St.	19th Ave. and Wawona	10
Park Presidio	Geary and Park Presidio Blvd	10
Sunset	19th Ave. and Kirkham	9
Alamo Square	Hayes and Pierce	8
7th St. and Hooper	7th St. and Hooper	8
Pacific Heights	California and Divisadero	8
Safeway on 16th Street (Potrero Hill)	16th and Potrero	7

NAME	LOCATION	FREQUENCY
16th St. and Sanchez	16th St. and Sanchez	7
Dolores Park	18th St. and Church	7
Lower Pacific Heights	Bush and Gough	7
Mission and 6th St.	Mission and 6th St.	7
Cesar Chavez and Valencia	Cesar Chavez and Valencia	7
Target parking lot	Geary and Masonic	7
Google San Francisco Office	Embarcadero and Harrison	6
Mission area	25th St. and Valencia	6
NOPA	Divisadero & Geary	6
North Beach	Columbus and Broadway	6
Panhandle	Fell and Masonic	6
29th St. and San Jose Ave.	29th St. and San Jose Ave.	6
15th St. and Church Stop	15th St. and Church	5
Dolores Park	19th St. and Dolores	5
Unknown	3rd St. and Fitzgerald	5
Castro/Divisadero	Divisadero and Eddy	5
Cesar Chavez	Cesar Chavez and Folsom	5
Ferry Building	1 Sausalito	5
Golden Gate Park (near Kezar Stadium)	Stanyan and Frederick	5
Golden Gate Park @ Haight	Haight and Stanyan	5
Safeway parking lot at Ocean Beach	48th Ave. and Fulton	5
Mission	Cesar Chavez and Mission	5
Bayview Opera House	3rd St. and Oakdale Ave	5
(if any) suggests this is not necessary	Geary and Masonic	4
20th St. and South Van Ness	20th St. and South Van Ness	4
Fell and Pierce	Fell and Pierce	4
CCSF - John Adams	Hayes and Masonic	4
Forest Hills Muni	352 Laguna Honda Blvd.	4
Golden Gate Park	Stanyan and Haight	4
Civic Center	9th St. and Market	4
Marina	Chestnut and Fillmore	4
(if any) suggests this is not necessary	Geary and Presidio	3
Mission San Francisco	16th St. and Dolores	3
Shell Station	16th St. and Guerrero	3
Sunset	19th Ave. and Judah	3
22nd St. Caltrain	22nd St. and Pennsylvania	3
Bayshore Caltrain Station	Tunnel Ave. and Lathrop	3
Bryant @ 22nd	22nd St. and Bryant	3
14th St. and Market	14th St. and Market	3
Civic Center	7th St. and Market	3

NAME	LOCATION	FREQUENCY
SF State	19th Ave. and Holloway	3
Duboce Triangle	Church and Duboce	3
Hayes and Laguna	Hayes and Laguna	3
Marina/Cow Hollow	Lombard and Fillmore	3
McAllister and Divisadero	McAllister and Divisidero	3
Safeway parking lot (Mission, 30th St., 16)	3350 Mission St	3
Mission	26th St. and Valencia	3
n/a	24th St. and Potrero	3
Van Ness (center)	California and Van Ness	3
Nob Hill	Clay and Van Ness	3
Oak and Masonic	Oak and Masonic	3
Ocean Beach Parking Lot	Fulton and Great Highway	3
Castro	Dolores and Market	3
Piers 30/32	Embarcadero and Bryant	3
Richmond	Geary and Arguello	3
SF Zoo	1 Zoo Rd	3
Union and Van Ness	Union and Van Ness	3
Along Van Ness	Washington and Van Ness	3
Potrero Hill	16th St. and Missouri	2
Potrero Hill	18th St. and Bryant	2
21st St. and Dolores	21st St. and Dolores	2
18th St. and Guerrero	18th St. and Guerrero	2
Bayshore Blvd. and Cortland Ave.	Bayshore Blvd. and Cortland Ave.	2
22nd St. and South Van Ness	22nd St and South Van Ness	2
AT&T Park parking lots	24 Willie Mays Plaza	2
Candlestick Point	1150 Carroll Ave.	2
18th St. and Market Muni station	18th St. and Market	2
Mission	21st St. and Valencia	2
Civic Center	Polk and Grove	2
Costco parking lot	10th St. and Bryant	2
Divisadero and Hayes	Divisadero and Hayes	2
San Francisco	3rd St. and Newcomb	2
empty lot	23rd St. and Valencia	2
Dolores Park	20th St. and Dolores	2
Fillmore	Geary and Fillmore	2
First Chinese Southern Baptist Church	Clay and Hyde	2
Haight-Ashbury	Buchanan and Market	2
Hayes Valley	Hayes and Octavia	2
Bayview Midpoint	3rd St. and Shafter	2
Dogpatch	3rd St. and 18th St	2

NAME	LOCATION	FREQUENCY
Lafayette Park	Gough and Sacramento	2
Bayview	3rd St. and Van Dyke	2
Impark Lot E #78	16th St and 3rd St	2
N/A	Divisadero and Fell	2
Noe Valley	24th St. and Dolores	2
Noe Valley	24th St. and Noe	2
North Beach	Columbus and Union street	2
Now Valley	24th St. and Castro	2
Pacific Heights	Divisadero and Sacramento	2
Carpark on Erie St.	Erie and Van Ness	2
Van Ness	Grove and Van Ness	2
Hayes Valley	Gough and Grove	2
3rd St. and Harrison	3rd St. and Harrison	2
Southeast SF	San Bruno and Paul	2
29th St. and Church	29th St. and Church	2
Inner Sunset	9th Ave. and Kirkham	2
Hayes Valley	Hayes and Van Ness	2
College Hill	Mission and Richland	2
West Portal	Ulloa and West Portal	2
Transbay Terminal	2nd St. and Mission	2
Hunter's Point	Spear and Fischer	1
Twitter Office	10th St. and Market	1
15th St. and Dolores	15th St. and Dolores	1
1601 Mariposa	Mariposa and Carolina	1
Down under Hwy 101	14th St. and Van Ness	1
16th St. and Capp	16th St. and Capp	1
Jackson Playground	17th St. and Carolina	1
Folsom St.	19th St. and Folsom	1
20th St. and Potrero	20th St. and Potrero	1
2130 Post	Post and Pierce	1
Mission	17th St. and Dolores	1
24th St. and Chattanooga	24th St. and Chatanooga	1
25th St. and Capp	25th St. and Capp	1
West side of town! We use them too.	19th Ave. and Sloat	1
30th St. and Church	30th St. and Church	1
Mission	16th St. and Valencia	1
Center of the Mission	18th St. and Valencia	1
Impark Lot #85 at 901 Illinois St	22nd St. and 3rd St.	1
41st Ave. and Geary	41st Ave. and Geary	1
Sunset	19th Ave. and Taraval	1

NAME	LOCATION	FREQUENCY
Potrero	17th and Mississippi	1
Geary and 18th Ave.	Geary and 18th Ave.	1
8th Ave. and Judah	10th Ave. and Judah	1
Alcatraz	2nd St. and Harrison	1
Avalon Hayes Valley	Oak and Octavia	1
Bay St. (South side)	Buchanan and Laguna	1
Dolores and 23rd St.	Dolores and 23rd St.	1
Potrero Hill	23rd St. and Kansas St	1
Parkside	23rd Ave. and Ulloa	1
Mission	19th St. and Valencia	1
23rd St. and South Van Ness	23rd St. and South Van Ness	1
Mendell Plaza	3rd St. and Mendell	1
Mission	18th St. and Harrison	1
Best Buy parking lot	Division and Harrison	1
Blood Centers of the Pacific Parking Lot	Masonic and Turk	1
Broderick St.	Broderick and Filbert	1
Buena Vista Park	Haight and Buena Vista	1
Bush and Gough	Bush and Gough	1
California and Arguello	California and Arguello	1
California and Fillmore	California and Fillmore	1
California and Polk	California and Polk	1
California and Presidio	California and Presidio	1
3rd St. and Gilman	3rd St. and Gilman	1
Castro	14th St. and Castro	1
17th St. and Potrero Avenue	17th St. and Potrero Avenue	1
Safeway Market St.	15th St. and Market	1
Cathedral of Saint Mary of the Assumption	Gough and Ellis	1
CCSF Parking Lots - North and West of Multi Use Bldg	Phelan and Ocean	1
Mission	19th St. and Mission	1
24th St. and South Van Ness	24th St. and South Van Ness	1
Cesar Chavez and Florida	Cesar Chavez and Florida	1
Cesar Chavez and Guerrero	Cesar Chavez and Guerrero	1
San Francisco	20th St. and Valencia	1
Cesar Chavez St.	Evans and Marin	1
Chestnut	Union and Divisadero	1
Castro	17th St. and Sanchez	1
Transbay terminal	1st St. and Mission	1
Mission Dolores	18th St. and Sanchez	1
Civic Center	Hyde and Grove	1
Cole Valley Hub	Cole and Carl	1

NAME	LOCATION	FREQUENCY
24th St. BART	24th St. and Mission	1
Cow Hollow	Green and Webster	1
Diamond Heights Shopping Center	5214 Diamond Heights Blvd.	1
Divisisadero/NOPA	Divisadero and Grove	1
Divisadero	Golden Gate and Divisadero	1
Divisadero and Turk	Divisadero and Turk	1
Inner Sunset	3rd Ave. and Hugo	1
Dogpatch	22nd St. and Indiana	1
Dolores	25th St. and Dolores	1
Mission Bay	3rd St. and Owens Street	1
Center of the Mission	18th St. and South Van Ness	1
Dolores St.	30th St. and Dolores	1
Van Ness and Broadway	Van Ness and Broadway	1
Duboce and Castro	Duboce and Castro	1
Duboce Park	Scott and Duboce	1
Embarcadero	Embarcadero and Washington	1
Embarcadero Center	Battery and Clay	1
Empty Building on Post	Post and Gough	1
Southeast Corridor	3rd St. and Palou	1
Excelsior	Vienna and Excelsior	1
Executive park	Executive Park Blvd. and Thomas Mellon Circle	1
Fell and Steiner	Fell and Steiner	1
Fillmore and Post	Fillmore and Post	1
Fillmore Center	Fillmore and Ellis	1
Folsom and 1st	Folsom and 1st St.	1
Frances Gorman	Franklin and Filbert	1
Freeway on ramps. Mission bay. Division street.	14th St. and Harrison	1
Geary and Laguna	Geary and Laguna	1
Potrero Hill	18th St and Connecticut	1
Geary Blvd.	Geary and Emerson	1
Golden Gate Park, JFK Drive	JFK Drive and Stanyan	1
Grace Cathedral	Taylor and Sacramento	1
Haight/Ashbury	Haight and Ashbury	1
Hayes Valley	Fell and Laguna	1
Hayes Valley	Gough and Oak	1
Nob Hill	Bush and Van Ness	1
Hayes Valley	Oak and Webster	1
Howard and 1st St.	Howard and 1st St.	1
Potrero Hill	18th St. and Pennsylvania	1
Inner Mission	24th St. and Bryant	1

NAME	LOCATION	FREQUENCY
Inner Sunset	11th Ave. and Lincoln	1
Lot E	3rd St. and South	1
Van Ness	17th St. and South Van Ness	1
19th Ave.	19th Ave. and Ocean	1
Potrero Hill	17th St. and Wisconsin	1
La Playa	Judah and La Playa	1
Laurel Village	California and Locust	1
Laurel Village	California and Laurel	1
Bayview	3rd St. and Underwood	1
Lower Haight	Fillmore and Page	1
Lower Haight	Haight and Fillmore	1
Lower Pacific Heights	Bush and Franklin	1
Lower Pacific Heights	Bush and Lyon	1
Lyon and Golden Gate	Lyon and Golden Gate	1
Marina	Lombard and Steiner	1
Marina	Lombard and Laguna	1
Marina	Octavia and Lombard	1
Marina	Divisadero and Jefferson	1
Marina	Bay and Fillmore	1
Marina Green parking lot	Scott and Webster	1
Marina Parking Lot	Fillmore and Marina Blvd.	1
Marina Safeway Area Along Marina Blvd	15 Marina Blvd.	1
Masonic and Fulton	Masonic. and Fulton	1
Mayfair Drive	Mayfair Drive and Spruce	1
McAllister and Fillmore	McAllister and Fillmore	1
16th St.	16th St. and South Van Ness	1
Pennsylvania and 17th St.	Pennsylvania and 17th St.	1
La Playa	48th Ave. and Taraval	1
4th St. and Mission4	4th St. and Mission	1
Bayview District	3rd St. and Williams	1
3rd St. and 23rd St.	3rd St. and 23rd St.	1
888 Brannan	8th St. and Brannan	1
16th St.	16th St. and Carolina	1
Mission	24th St. and Rhode Island	1
N/A	Webster and Ivy	1
NE Bernal Heights	San Jose and Guerrero	1
No. 3 Jackson	Jackson and Baker	1
Nob Hill	Broadway and Polk	1
Nob hill	California and Taylor	1
Nob hill	Fillmore and Washington	1

NAME	LOCATION	FREQUENCY
Nob Hill	Franklin and Bush	1
Nob Hill	Hyde and Pine	1
Van Ness	Chestnut and Van Ness	1
Noe Valley	24th St. and Diamond	1
Noe Valley	24th St. and Sanchez	1
Noe Valley	24th St. and Vicksburg	1
None	525 Rhode Island	1
None	Baker and Pacific	1
None	Franklin and Sutter	1
Nopa	Fell and Shrader	1
NOPA	Hayes and Baker	1
North Beach	Broadway and Columbus	1
Oak and Laguna	Oak and Laguna	1
Oak and Pierce	Oak and Pierce	1
Ocean Beach	Great Highway and Lincoln Way	1
Octavia and Oak	Octavia and Oak	1
Outer Richmond	42nd Ave. and Fulton	1
Outer Sunset	30th Ave. and Taraval	1
Pacific Heights	Jackson and Steiner	1
Pacific Heights	Union and Fillmore	1
Palace of Fine Arts	Lyon and Bay	1
Palou and Jennings	Palou and Jennings	1
Parade Ground / Main Post	Graham and Sheridan	1
Carroll Ave.	3rd St and Carroll	1
Hayes Valley	Franklin and Market	1
Pier 70	20th St. and Illinois	1
Pioneer Monument	Fulton and Hyde	1
Inlet on Division under the freeway	Division and South Van Ness	1
Portola	Felton and Hamilton	1
Portola	San Bruno Ave. and Felton	1
Portola	San Bruno Ave. and Silver	1
Civic Center	7th St. and Mission	1
16th St.	16th St. and Connecticut	1
South Mission	26th St. and Guerrero	1
Inner Sunset	7th Ave. and Irving	1
8th Ave. and Judah	8th Ave. and Judah	1
Inner Sunset	8th Ave. and Lawton	1
Dogpatch	3rd St and Cesar Chavez	1
Mission	Market and Guerrero	1
Potrero Hill/Bayview	Cesar Chavez and Kansas	1

NAME	LOCATION	FREQUENCY
Potrero-Mission-SoMa	Vermont and Division	1
Powell and Union	Powell and Union	1
Presidio	Letterman Drive and Presidio Blvd.	1
Presidio Gate	Lyon and Lombard	1
Russian Hill/North Beach	Union and Columbus	1
Safeway	O'Farrell and Webster	1
Civic Center	Market and Van Ness	1
Bus terminal at Beale	Beale and Mission	1
In front of Zynga on 8th St.	8th St. and Townsend	1
3rd St. and Evans	3rd St. and Evans	1
San Francisco	Bush and Leavenworth	1
San Francisco	Fillmore and Broadway	1
San Francisco	Polk and Post	1
San Francisco	Webster and Lombard	1
30th St. and San Jose	30th St. and San Jose	1
SF office	Spear and Folsom	1
SF Public Library/Bill Graham Auditorium	Grove and Larkin	1
Lake Merced	19th Ave. and Junipero Serra	1
SFPUC	Golden Gate Ave. and Polk	1
Potrero Ave.	26th St. and Potrero	1
Bayview Heights	3rd St. and Ingerson	1
SoMa	4th St. and Berry	1
SoMa	5th St. and Berry	1
SoMa	6th St. and Natoma	1
SoMa	Brannan and Delancey	1
Southeast Mission	25th St. and Potrero	1
Speakeasy Brewing	Evans and Keith	1
St. Dominic's Church	Bush and Scott	1
Stanyan	Stanyan and Hayes	1
Stanyan and Fulton	Stanyan and Fulton	1
19th Ave. and Noriega	19th Ave. and Noriega	1
Sunset	Judah and Sunset Blvd	1
Sunset Circle	Lake Merced Blvd. and Sunset Blvd.	1
The Mission	Alameda and Treat	1
The parking lot at The Presidio Social Club	563 Ruger	1
Bayview District	3rd St. and Paul	1
Silver Terrace	3rd St. and Bayview	1
Mission/Chavez	Mission and Valencia	1
Van Ness Muni Station	Mission and Van Ness	1
Turk and Gough/Franklin	Turk and Gough	1

NAME	LOCATION	FREQUENCY
Castro	Market and Divisadero	1
Silver Terrace	3rd St. and Revere	1
Upper Mission	14th St. and Church	1
USF Hub	Masonic and Golden Gate	1
Market St.	Market and Grant	1
North Point and Van Ness	North Point and Van Ness	1
Van Ness and O'Farrell	O'Farrell and Van Ness	1
Van Ness and Pacific	Pacific and Van Ness	1
North SF lower Pacific heights	Pine and Van Ness	1
Van Ness at Sacramento	Sacramento and Van Ness	1
SF	Turk and Van Ness	1
West Portal	Claremont and Ulloa	1
West Portal	Portola and O'Shaugnessy	1
Octavia and Market	Octavia and Market	1
Western Addition	Divisadero and Post	1
Marina	Fillmore and Jefferson	1
Marina	Octavia and Francisco	1
Marina	Francisco and Van Ness	1
Marina	Capra and Scott	1
Marina	Broderick and North Point	1
Marina	Lombard and Baker	1

SUGGESTED LOCATIONS OUTSIDE OF SAN FRANCISCO

NAME	LOCATION	FREQUENCY
Cow Palace	Geneva Ave. and Castelo St.	14
Millbrae BART Station		12
Daly City BART Station	Daly City BART Station	10
South San Francisco Caltrans Station	Dubuque Ave.	2
Mountain View		2
San Francisco airport		2
Oakland	West Grand and Myrtle	1
19th St. BART	Oakland	1
San Bruno BART Station		1
Hayward Hills	Hayward BART Station	1
Daly City	Hillsdale and Serramonte	1
Silicon Valley		1
Tanforan parking lot	San Bruno	1
Oakland	4th St. and Martin Luther King Jr. Way	1
Stockton CA	March Lane and Pacific Ave.	1
Menlo Park Caltrain Station	Menlo Park Caltrain Station	1

APPENDIX B: SUMMARY OF COMMENTS RECEIVED

1. Overall Breakdown

OVERALL BREAKDOWN OF COMMENTS RECEIVED	NUMBER OF COMMENTS
Total Reponses Received	1684
Total Comments Received	1084
Individuals that oppose the hub system	182
Percentage of opposition of total comment	17%
Individuals that support for hub system	71
Percentage of support of total comment	7%

2. Negative Comments: Popular Themes

POPULAR THEMES OF NEGATIVE COMMENTS RECEIVED	NUMBER OF COMMENTS
Longer Travel Time	85
• Current travel time is already very long	
• Would likely drive to work after implementation	
• Would result in congestion, more traffic, and pollution	
More Crowded Near Node	10
• More congestion near node location (Buses, Lyft/Uber/Taxi to drop off or pickup)	
• Cause delays	
• Would become difficult to park near node	
Current Shuttle System works very well	11

3. Support Comments: Popular Themes

POPULAR THEMES OF SUPPORTIVE COMMENTS	NUMBER OF COMMENTS
Limit activity in neighborhoods/on small streets	33
• Keep shuttles on arterials • Presence in neighborhoods leads to displacement/gentrification	
Centralized Locations/Single-Location	15
• Riders should access shuttles at one/few location(s)	
Safety concerns of current program	11
• Shuttles are danger to pedestrians, cyclists, elderly, and disabled.	

4. Different voices from the public

Group 1: Current Shuttle User

- Time concern; Buy a car and drive to work instead; then more congestion, traffic, pollution

Group 2: Residents live near the current shuttle stops

- Safety caused to the neighborhood; drive up the price

Group 3: People live in SF but not using shuttle

APPENDIX C: ONE-LEG JOURNEY ANALYSIS METHODOLOGY

Step 1. Approximated shuttle user origins

Assumption: Majority of people live in walking distance from current shuttle locations.

Source: A study by UC Berkeley researches says "this assumption is borne out by the survey data as well: 76% of shuttle riders lived within 15 minutes of their shuttle stop, and a commensurate 80% of shuttle riders reported walking to their shuttle stop." (Dai and Weinzimmer 2014)

Assigned a given shuttle location's actual boardings per peak to Traffic Analysis Zone (TAZs) that are contained in the walking-distance buffer ("origin TAZs") of that given shuttle location. We can use a quarter-mile buffer.

If there are multiple origin TAZs contained in the buffer, we

1. **Either** assumed uniform distribution and divide number of boardings by the number of origin TAZs, which gives us the number of shuttle users residing in a given origin TAZ.
2. **Or** assigned actual boardings to origin TAZs based on total population in each TAZ.

One embedded assumption here is that stop X serves the same amount of riders in the morning and afternoon peaks.

Step 2. Calculated percentage of current users who can still access nodes

Identify unique TAZs where suggested nodes are located. Call them destination TAZs.

Given a destination TAZ, we identified all TAZs that can access the given destination TAZ via a transit ride without transfer and less than 30 minutes using Transit Skim Matrix files.

Sums of all riders who reside in these found TAZs were compiled (given numbers calculated in Step 1). Divide it by the total current shuttle users and get the percentage of current users who can still access commuter shuttle under the hub scenario via one-seat ride that is less than 30 minutes.

For example, given destination TAZ A (where a suggested node is located inside), we find that people who live in TAZ B through K can access TAZ A via <30-minute one-leg journey. Given Step 2, we know that there are 100 current shuttle users residing in TAZ B through K. Thus 100/8500 = 1.1% of current users can access nodes given our screening criteria.

APPENDIX D: THRESHOLDS FOR CAPACITY SCREENING

Assumptions:

- Existing program has 128 runs during the peak shuttle hour from 6:30–7:30 am
- Number of runs within the peak hour have an approximate 10-minute frequency between the runs and allows for a 3-minute dwell time. This equates to approximately 6 runs possible per berth per hour. This conservative estimate reflects uncoordinated arrival scheduling of buses and longer dwell times at nodes due to expectation that more people are boarding at fewer stops.
- About 109 runs (85% of all runs) occur in the northeast quadrant of the city (north of 24th Street and east of Divisadero street). About 19 runs (15% of all runs) occur in the remainder of the city.

SCENARIO		
Single-hub		
Peak hour load of single node	128	
Berths needed for single node	21	
	NE QUADRANT (109 runs, 85% load)	**REST OF CITY** (19 runs, 15% load)
BART 5		
Number of nodes	4	1
Peak hour load of each node	27	19
Berths needed per node	5	3
BART 8		
Number of nodes	6	2
Peak hour load of each node	18	10
Berths needed per node	3	2
Freeway 5		
Number of nodes	4	1
Peak hour load of each node	27	19
Berths needed per node	5	3
Freeway 15		
Number of nodes	13	2
Peak hour load of each node	9	10
Berths needed per node	1	2
Consolidated 16		
Number of nodes	14	2
Peak hour load of each node	8	10
Berths needed per node	1	2
Consolidated 30		
Number of nodes	26	4
Peak hour load of each node	4	5
Berths needed per node	1	1

SINGLE-RUN* (ON-STREET) CONFIGURATION THRESHOLDS

Berths aligned nose to tail in a single line. Assumes parallel street parking and no bulb-outs at intersection.

BERTHS/ BAYS	ACCESS**			DISTANCE
	FLAT		SAW-TOOTH †	
	INDEPENDENT	STACKED ‡		
1 Bus	107 ft	N/A	85 ft	Length
2 Buses	204 ft	172 ft	150 ft	Length
3 Buses	301 ft	237 ft	215 ft	Length
4 Buses	398 ft	302 ft	280 ft	Length
5 Buses	495 ft	367 ft	345 ft	Length
6 Buses	592 ft	432 ft	410 ft	Length
7 Buses	689 ft	497 ft	475 ft	Length
8 Buses	786 ft	562 ft	540 ft	Length

* Assumes 40 or 45 ft buses.
** Distances indicated are of continuous curb lengths.
† The inside edge of saw-tooth bays would cut a minimum of 8 ft (width) into existing street curb/sidewalk. Access to bay is directly from travel lane, without parking.
‡ Stacked configuration does not allow for independent access of individual bus berths.

DOUBLE-RUN (OFF-STREET) CONFIGURATION THRESHOLDS

Two parallel lines of berths. Assumes off-street configuration with flow-through access to and from city streets (no turn around)..

BERTHS/ BAYS REQUIRED	BERTHS/ BAYS PER RUN	ACCESS*			DISTANCE
		FLAT		SAW-TOOTH †	
		INDEPENDENT	STACKED ‡		
2 Buses	1 Bays	165 ft	N/A	185 ft	Length
3 Buses	2 Bays	262 ft	230 ft	250 ft	Length
4 Buses	2 Bays	262 ft	230 ft	250 ft	Length
5 Buses	3 Bays	359 ft	295 ft	315 ft	Length
6 Buses	3 Bays	359 ft	295 ft	315 ft	Length
7 Buses	4 Bays	456 ft	360 ft	380 ft	Length
8 Buses	4 Bays	456 ft	360 ft	380 ft	Length
Facility depth		72 ft	72 ft	88 ft	Width

* Distances indicated are of continuous curb lengths. Saw-tooth bays would be set back a minimum 8 ft in to center platform.
† Stacked configuration does not allow for independent access of individual bus bays.
‡ Off-street facility assumes the following widths:
24 ft platform
2 ft perimeter barrier (to wall or fence)
11 ft passing lane
10 ft berthing lane for flat bays
11 ft berthing lane for saw-tooth bays
8 ft deep saw-tooth

APPENDIX E: MODE CHOICE MODEL METHODOLOGY

OBJECTIVE

Commuter Shuttle Hub Study adopts a simple multinomial logit model to estimate the shift of current shuttle users' mode choices to other modes under different hub scenarios. The model considers three modes: drive-alone, transit, and shuttle, and the prediction of choice of travel mode is based on relative changes in different mode utilities. The model coefficients are adapted from the SFCTA's CHAMP activity-based travel demand model work trip mode choice component.

DATA

Mode Choice Model Data Requirement

The key economic idea underlying a mode choice model is that an individual makes choices based on the relative utility of available modes. Mode utility can be influenced by many factors, among which travel time and travel cost are typically the most important ones. Individual or household attributes may also affect mode utility since people perceive the same choices differently.

To apply a simple multinomial logit model for the base case and for each of the four alternatives, the data required included 1) travel impedances, such as travel time and cost, of three modes for the same trip reflecting origin, destination, and time-of-day, and 2) travel demand estimates such as trips by origin, destination and time-of-day, and including decision maker characteristics. However, the only data source of the model we were able to obtain is the boarding and routing information provided by commuter shuttle operators.

Commuter Shuttle Data

SFMTA requested shuttle service and travel demand information from all commuter shuttle operators in the city of San Francisco for the purpose of Commuter Shuttle Hub Study.

Travel Demand Data

The travel demand data used in this analysis was provided by shuttle operators to SFMTA and included information on boardings and alightings by shuttle route and stop location, and by time of day. No information on current shuttle riders' true origins or destinations was provided, nor were any traveler attributes provided, such as socio-demographic attributes describing income levels, household sizes, or car ownership. No shuttle user residential location was provided and approximately 80% of routes provided have no information on specific route destinations, i.e. employer addresses. For records without a specific destination or employer information, city, county or a general area where the employer is located was given. As a result, the mode choice model's sensitivity is constrained by this absence of information about the true origins, destinations or individual characteristics and perceptions of travel alternative options.

TRAVEL IMPEDANCES

Base Scenario (Current Program)

Trip origin, destination, time-of-day, and mode are required for calculating travel impedances. Because no information on shuttle users' true origins and destinations were provided, stop locations were assumed to be origins for each trip and work locations were imputed based on top employers in the given geography (city or sub-county district in most cases). The Google Maps Directions API was used to calculate travel impedances for each mode given a specific set of origin, destination, time of day, and route.

API outputs include a range of attributes, from which variables such as in-vehicle time, walking access time, number of transfers, etc., were extracted based on mode. Table E1 (next page) shows extracted variables for each mode. For the drive-alone mode, in-vehicle time and travel distance were extracted from API outputs. Travel distance was used to estimate out-of-pocket travel costs for the drive mode. Shuttle travel times were estimated based on specific routes reflecting street usage restrictions within San Francisco, and out-of-pocket costs were assumed to be free based on being considered employee benefit. Transit has the greatest number of travel impedance components. Access time refers to walking time from origin to initial transit stop and egress time is walking time from last transit stop to destination. Wait time includes both waiting at the initial transit stop and intermittent stops if there are transfers.

TABLE E1. Variables Extracted for Each Mode from Google Maps Directions API

	DRIVE-ALONE	TRANSIT	SHUTTLE
In-vehicle travel time	Yes	Yes	Yes
Access Time	—	Yes	—
Egress Time	—	Yes	—
Wait Time	—	Yes	—
Number of transfers	—	Yes	—
Travel Cost	Yes	Yes	—

Since API-generated outputs consider historical route traffic conditions, the estimated travel impedances vary by time of day in morning peak period. For example, output shows that it takes almost 20 minute longer for someone to drive from Van Ness Ave. and Union St. to Apple Campus in Cupertino during 7:30 am to 8:30 am than before 7:00 am. This greatly improves the model data quality.

Proposed Scenarios

Travel impedances were estimated for three modes under all four proposed scenarios. To systematically estimate travel impedances of the shuttle mode under different scenarios, several assumptions were made. First, all existing runs of different routes persist in all scenarios since there is no information how commuter shuttle operators and/or employers will change their routes in response to the program. In other words, any current commuter shuttle user can find a node that is the origin of the route they were previously using. Second, under scenarios, routes will serve one and only one node location in San Francisco, given that no reasonable assumptions can be made about how commuter shuttle operators will optimize their routes to serve several nodes. Given these assumptions and SFMTA's input on where large-size vehicles can or cannot travel in the city, specific routings of commuter shuttles are determined each different scenarios.

TABLE E2. Shuttle Travel Impedances

PORTION OF TRIP	AVAILABLE MODE	TRAVEL IMPEDANCES
Origin to Node	Transit	Wait time at node
		Access Walking Time
		Wait Time (tranfer and initial wait)
		Number of Transvers
		Egress Walking Time
		Generalized cost
	Walking	**Walking Time**
Node to Work Location	Shuttle	In-vehicle Time

Under all four scenarios, transit and driving travel impedances stay the same since origins, destination, and time-of-day don't change. However, people may experience different shuttle travel impedances. Accessing new nodes via transit and walking were both considered. (See Table E2). A "generalized cost" of accessing a node via transit was calculated and compared with travel impedance of accessing a node via walking (shown in bold in Table E2). This generalized cost reflects a weighting of the different components of travel. For example, time spent waiting at transit stops is typically considered more burdensome than an equivalent amount of time in-vehicle, and thus weighted more heavily. The mode with the lowest generalized costs was chosen as the mode for a accessing node.

MODEL APPLICATION AND OUTPUT

The mode choice model adopts the coefficients used in the SF-CHAMP work trip mode choice model (shown in Table E3, next page). These coefficients are applied consistently across the base scenario and four proposed scenarios. The model produces estimates of the percentage of current shuttle users who would switch to driving or transit if a given commuter shuttle hub scenario were to be implemented.

Two other metrics were calculated based on mode shift predictions. One is vehicle-miles-travelled (VMT). VMT includes both VMT by shuttles and VMT by autos. The other measurement is greenhouse gas (GHG) emission (CO2 only). GHG emissions for shuttles under different scenarios reflected both distance travelled as well as vehicle types provided by operators and data from previous pilot program environmental impact analysis. The measurement also includes GHG emission by autos, based on the auto trip distances and assuming the overall passenger vehicle fleet mix.

TABLE E3. Coefficients in SF-CHAMP work trip mode choice model are used in this study.

VARIABLES	UTILITY COEFFICIENTS
InVehicleTime	-0.016
WaitTime	-0.035
DestWalkTime	-0.085
OrigWalkTime	-0.028
XferWalkTime	-0.078
OPCIncome60k	-0.00073
TransitXfers	-012

APPENDIX F: SUMMARY OF INTERVIEWS

RIDERSHIP AND SERVICE CHANGES SINCE PILOT:

The intercity operators experienced no change to ridership due to the changes. One operator noted some unhappiness by some of their riders upon the removal or relocation of some stops but no noticeable changes in ridership. The other cited that focusing service on arterials most affected drivers who lost access to places to layover and bathrooms under the new routing.

The intracity operator was very candid with the challenges faced since the change of the program. The company had to convert to smaller vehicles (35 feet or shorter) because their service area has few arterials that are allowed for travel by larger shuttles (greater than 35 feet in length). This has resulted in doubling the number of shuttle vehicles from 2 to 4 and hiring additional drivers. They perceive that they are no longer able to drop passengers off directly on Market St. where many of the riders connect to BART, although SFMTA has established shuttle zones at Market Street near the Civic Center BART station. She noted that congestion in South of Market (SoMa) has meant longer travel times to the new shuttle zones on Mission Street. Their riders have been extremely unhappy with the changes in service, and she estimated a 5-10% decrease in ridership from July to August 2016.

OPERATIONS UNDER SCENARIOS:

Single-hub: The intercity operator with a large scale commuter shuttle operation, was most concerned with shuttle vehicle congestion at all nodes resulting from many shuttles trying to access the curb at the same time, but projected that this would be especially true for the Single-hub Scenario. The other intercity operator was concerned with rider access to a single node location, especially by bicycle or transit.

BART-oriented Scenario: The intracity operator conceptually liked the idea of this scenario, likely because the primary purpose of their shuttle operations is to connect with riders using regional transit. For this scenario to be successful, they suggested that zones be placed close to the station entrances and be enforced to prevent other vehicles from using them.

Freeway-adjacent Scenario: Two operators had concerns with this scenario. The large scale, intercity operator suggested that shuttle riders may not be able to easily get to the locations by transit. The intracity operator reiterated their experience with congestion in SoMa, and suggested that this scenario would only be successful if nodes were off-street.

Consolidated Network Scenario: The large scale, intercity operator cited that queuing occurs at existing stops and could get worse under this scenario.

IF FEWER RIDERS WOULD IMPACT OPERATIONS:

Operators could not definitively say how they or their clients would seek to change operations. The small, intracity operator is currently undergoing route and schedule changes because of the challenges they have been experiencing under the current iteration of the shuttle program. Similarly, the small, intercity operator anticipated adjusting routing under these conditions.

The large, intercity operator stated that they try to maximize riders in vehicles and any changes in operations would be dependent on how low ridership dropped. As indicated in the Commuter Shuttle Program Mid-Term Evaluation, average occupancy rates are currently 60% for intercity operators and 68% for intracity operators.

WILLINGNESS TO PARTICIPATE:

If operators chose not to participate in the shuttle program, they could still operate shuttles within the city but could not use designated shuttle-only zones or nodes to pick up or drop off passengers, and therefore would have a limited number of locations in which they could conduct operations legally.

All operators cited an expectation that their clients would continue to participate in the shuttle program in the future, but participation in a hub system would be dependent on which type would be chosen and the requirements for using the system. Additionally, operators were concerned that a hub system would increase rider dissatisfaction and sensitivity to travel times, and potentially lead to shifts to driving.

For the intracity operator, most of the scenarios (except the BART scenario) were to some degree incompatible with the goal of connecting riders to regional transit.

The operator of the large scale intercity operations reiterated concern with congestion and queuing at nodes, and related implications on safety.

The other intercity operator was concerned with the lack of routing flexibility under a hub system, and suggested that if the hub program is too challenging, shuttle providers may shift to smaller vehicles to travel on non-arterial streets.