LOMBARD PAID RESERVATIONS SYSTEM

DRAFT CONCEPT OF OPERATIONS

JUNE 21, 2019

wsp

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PREPARED FOR THE SAN FRANCISCO COUNTY TRANSPORTATION AUTHORITY

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WITH SUPPORT FROM CHS CONSULTING

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1 INTRODUCTION

1.1 DOCUMENT PURPOSE

This Concept of Operations describes the recommended operational concept for a system to manage vehicular demand on the 1000 block of San Francisco's Lombard Street. This document provides a summary of the alternatives evaluated and recommended approach for the operations of the system, which is referred to as the Lombard Paid Reservations System. This document is intended to serve as a starting point for further development of the project.

1.2 BACKGROUND

Lombard Street's landmark "Crooked Street" segment, located at the 1000 Block of Lombard Street between Hyde and Leavenworth streets, attracts approximately 2.1 million visitors per year. However, the 1000 Block and surrounding area is predominately residential in nature and not intended to accommodate the increasing volume of visitors to the landmark Crooked Street. The increased volume of visitors has not only resulted in vehicular and pedestrian congestion beyond what the transportation infrastructure can handle, but has negatively impacted the surrounding neighborhood residents and greater traffic circulation in the area. Several of these impacts are identified below:

- Daily vehicle queues at the entrance of the Crooked Street can last up to 10 hours per day, impacting vehicle circulation in the surrounding neighborhood;
- During peak periods, vehicle queues can extend as far west as Van Ness Avenue, impacting traffic circulation in the surrounding neighborhoods and on US 101, which runs on Van Ness Avenue and Lombard Street near the project site;
- Heavy pedestrian volumes result in sidewalk overcrowding in the area, inducing pedestrian and vehicle conflicts that result in traffic obstructions and degraded pedestrian safety;
- General congestion at the entrance to the Crooked Street has impacted the safe operation of the historic cable cars that run on Hyde Street; and
- Has generally degraded the quality of life in the surrounding neighborhoods due to littering, loitering, and noise and air pollution.

1.3 PROJECT GOALS

In March 2017, the San Francisco County Transportation Authority (Transportation Authority) issued *Lombard Study: Managing Access to the "Crooked Street" Final Report* (2017 Study). The 2017 Study goals were informed by onsite observations of traffic circulation, traffic volume counts, intercept surveys, and interviews with local residents as well as community groups and businesses. A key recommendation of the 2017 Study was to advance the feasibility evaluation of a pricing and/or reservation system that would manage Crooked Street access. As a result, the Transportation Authority initiated the Lombard Crooked Street Pricing and Reservation Study with the goal of developing a solution that best meets the following six key project goals that were carried over from the 2017 Study:

- Managing pedestrian congestion
- Managing auto congestion

- Ensure traffic safety
- Maintain livability of the surrounding neighborhood
- Preserve tourism at a sustainable level
- Implement a financially viable solution

Table 1 lists the six project goals and their respective metrics for effectiveness, along with minimum and ideal targets for meeting each metric. These metrics and targets served as the basis for the evaluation of alternatives described in Chapter 3.

Table 1: Crooked Street Pricing and Reservation Study Project Goals and Metrics

Goal	Metric	Target	
		Minimum	Ideal
Manage automobile congestion	Time vehicle queue extends west past Larkin Street (1 block) in each hour of the week	Time vehicle queue extends past Larkin is no more than 15 total min in any given hour	Vehicle queue does not extend beyond 1100 block of Lombard Street
Maintain the livability of the surrounding neighborhood	Revenue generated	Revenue beyond operating costs greater or equal to current cost of services (PCOs, ambassadors)	Revenue beyond operating costs greater or equal to cost of expanded services such as PCOs, Police Officers, and related to manage impact of visitors on neighborhood
Manage pedestrian congestion	Percentage of pedestrians lingering in intersection crosswalks for excessive periods of time (i.e., crossing significantly more slowly than a typical walking speed [3 ft/s])	Less than 15 percent of pedestrians linger in crosswalks for excessive periods of time	Less than 10 percent of pedestrians linger in crosswalks for excessive periods of time
Ensure traffic safety	Extent to which pick-ups/ drop-offs block cable cars, pedestrians/ crosswalks, or automobiles	Pick-ups and drop-offs do not block travel lanes or sidewalks more than 15 total min in any given hour	All pick-ups and drop-offs do not block travel lanes or sidewalks
Implement a financially viable solution	Revenue generated	Revenue covers basic operations and maintenance costs of the pricing and reservations system	Revenue beyond operating costs greater or equal to cost of expanded services such as PCOs, Police Officers, and related to manage impact of visitors on neighborhood
Preserve tourism at a sustainable level	Number of visitors per day	Number of visitors that allows the system to meet other minimum targets, given proposed improvements	Number of visitors that allows the system to meet other ideal targets, given proposed improvements

Source: SFCTA and Arup, 2019

2 EXISTING CONDITIONS

This section provides a summary of the existing conditions and a brief overview of surveys, data collection, and other studies that informed the basis of the proposed concept of operations for the Lombard Paid Reservations System.

2.1 SETTING

The Crooked Street is located along the 1000 block of Lombard Street, between Hyde and Leavenworth streets, in the primarily residential Russian Hill neighborhood. This segment of Lombard Street is a one-way eastbound residential street with signature switchbacks, landscaping, and vistas that draws as many as 2.1 million visitors per year and up to 17,000 visitors per day. Vehicular access to the Crooked Street is only permitted at the intersection of Lombard and Hyde streets from eastbound Lombard Street and northbound Hyde Street; left-turns from southbound Hyde Street onto the Crooked Street are prohibited at all times and right-turns from northbound Hyde Street on the Crooked Street are prohibited at all times except for residents. The Powell/Hyde Cable Car operates on Hyde Street where Hyde Street intersects Lombard Street at the Crooked Street segment. Also, as the 2017 Study indicated, while there is currently a restriction in the area for vehicles with the capacity for 8 or more passengers, observers have noted a number of tour bus operators ignoring these regulations on occasion.

2.2 DATA COLLECTION

The study team conducted a variety of data collection efforts to inform the recommended approaches to manage demand on the Crooked Street. These collection efforts included:

- Summer 2015:
  - Camera-based data collection was used to collect vehicle and pedestrian behaviors between 9:00 a.m. and 8:00 p.m. Friday through Sunday.
    - Pedestrian volumes entering/exiting the Crooked Street
    - Vehicle volumes entering/exiting the Crooked Street
    - Instances of pedestrian blockages preventing vehicles from entering the Crooked Street
    - Instances of illegal left-turns onto the Crooked Street from southbound Hyde Street
    - Instances of pedestrian overcrowding on sidewalks and in the roadways
  - Vehicle profiles were collected to determine the occupancy and origin of vehicle driving down the Crooked Street
  - Intercept Surveys (15 questions) of visitors on foot
  - Field observations on parking conditions and safety

- August 10 through October 16, 2018:
  - Video camera observations of vehicle queues along Lombard Street, upstream of the Crooked Street where conducted between August 17 and August 19, 2018

- Motionloft[1] video detection to report pedestrian and vehicle volumes, and dwell times at the intersections of Lombard/Hyde and Lombard/Leavenworth were collected between late August and mid-October, 2018
- Traffic travel time data from the Google Directions API to supplement the traffic counts directly taken by the Motionloft cameras was conducted between August 10 and September 28, 2018.
- Intercept surveys targeting motorists visiting the Crooked Street.

Additionally, in June 2014, the San Francisco Municipal Transportation Agency (SFMTA) conducted a trial closure (to vehicles) of the Crooked Street, which was instituted between the hours of noon and 7:00 p.m. each day to understand traveler behavior. The trial resulted in a general reduction of vehicle queues approaching the Crooked Street. However, counts collected before and after the closure suggested that the closure of the Crooked Street resulted in a temporal shift in traffic volumes and modes, rather than an actual reduction in trips to the landmark street.

2.3 SUMMARY OF FINDINGS

Previous studies completed between 2000 and 2016, as documented in the 2017 Study, established key information regarding existing traffic and pedestrian deficiencies in the study area. Data collected in 2018 generally supported previous findings and provided further insight into traffic and pedestrian characteristics by time of day and day of the week. As a result of these previous studies, it was identified that pedestrian congestion in proximity to the Crooked Street was similar to that of a downtown area, not a residential neighborhood. Further analysis determined the peak period for pedestrian activity in the area generally starts as early as 9:00 a.m. and continues to 6:00 p.m. Pedestrian congestion was observed not only on the Crooked Street, but also at all four corners and crosswalks where the Crooked Street intersects both Hyde and Leavenworth Streets. During the peak period, pedestrian congestion has resulted in spillover into adjacent roadways and crosswalks, especially at the intersection of Leavenworth and Lombard.

In addition, vehicle congestion has negatively impacted vehicle circulation and resident access in the surrounding neighborhoods. The Crooked Street operates one-way eastbound, requiring vehicles to enter from the Hyde Street intersection. During peak periods, significant queues develop at the entrance to the Crooked Street, extending along Lombard Street as far west as Van Ness Avenue. As noted in the 2018 data collection summary , during these peak periods, it can take over 45 minutes to traverse the three block stretch of Lombard, between Van Ness Avenue and Hyde Street during the busiest periods. These vehicle queues not only impact local vehicle circulation and resident access on Lombard, but also cause spillback issues and further congestion on Larkin, Polk, Van Ness, Chestnut, and other neighborhood streets. Additional vehicle loading and parking activities on surrounding streets have contributed to the congestion and have led to instances of double-parking, parking on sidewalks, and vehicles blocking crosswalks.

Prior SFCTA review of traffic safety and collision data did not reveal abnormally high collision rates. However, based on intercept surveys and interviews, residents and other stakeholders described the Crooked Street and surrounding area as unsafe and stressful to navigate for both vehicles and pedestrians. Further concern has been raised regarding traffic and pedestrian safety around Yick Wo Elementary School, located near the intersection of Lombard and Jones streets (approximately one block east of the Crooked Street).

[1] Motionloft video detection technology uses proprietary sensors to capture real-time traffic data that can quantify the difference between pedestrians and vehicles, allowing for the collection of vehicle and pedestrian counts simultaneously.

The 2017 Study documented feedback from Crooked Street area residents that have expressed concerns about ongoing congestion and visitor behavior within the area. Many residents have cited excessive noise, pedestrian overcrowding, robberies, trespassing, littering, and excessive air pollution. Compounding these conditions, the Crooked Street is currently regulated by several entities including the SFMTA, Mayor's Office of Economic and Workforce Development (who administers the Lombard Street Community Ambassador Program), and the San Francisco Police Department (SFPD). By contrast, other popular attractions around the Bay Area with similar visitor volumes are typically managed by a single authority that manages programs and strategies to mitigate impacts from visitors.

Responses to the intercept surveys administered in 2018 revealed the following characteristics of those visiting the Crooked Street by vehicle:

- Over 70% of vehicles were observed to have 3 or more passengers. The average observed vehicle occupancy was 3.65 people.
- Only 4% of respondents indicated they were visiting from San Francisco. 30% were visiting from another state and 25% were visiting from outside the U.S.
- The majority of visitors (70%) planned their trip to the Crooked Street as part of their overall visit to San Francisco.
- Just less than half of the respondents indicated they would be likely to drive down the Crooked Street if reservations were required. If reservations were to be priced, nearly 60% indicated a willingness to pay $5 and 40% indicated a willingness to pay $10.

2.4 RECOMMENDED STRATEGIES

The 2017 Study recommended a variety of improvement strategies that could be implemented in the short-term, as well as mid-term recommendations that would require further study, outreach, design, and / or legislation before more comprehensive solutions could be devised. The following summarizes short- and mid-term strategies identified in the 2017 Study.

2.4.1 SHORT-TERM STRATEGIES

The 2017 Study noted that the most effective solutions would likely take significant time to develop and implement, and thus suggested several short-term solutions to address the challenges identified in the area. Two potential short-term strategies were proposed:

- Deploy more SFMTA Parking Control Officers (PCOs) to increase the issuance of tickets for violations of unlawful behavior or moving violations. Previous programs such as the Ambassadors program launched in 2015 have found difficulty in establishing a permanent source of revenue.
- Re-engage the tourism industry to advise tourists that the area is within a residential neighborhood, encourage visitors to arrive via alternative modes of transportation, advise visitors of vehicle and pedestrian congestion, and to remind visitors to observe posted signs and regulations.

2.4.2 MID-TERM STRATEGIES

Mid-term strategies are focused on improving signage and traffic engineering interventions in the area. Two potential mid-term strategies were proposed:

- Include new wayfinding signs to direct visitors to the proper areas, add new signs to provide estimated wait times for vehicle queues on Lombard Street (particularly on the 1200 block),), make the "No Right Turn"

restriction from northbound Hyde Street permanent (except to residents), add new centerline striping on Lombard Polk and , create pedestrian refuge areas, add raised sidewalk extensions, and introduce vehicle barriers.

- Implement a reservation and pricing system, which is the focus of this Concept of Operations Report. This would require the creation or designation of a single agency with the authority to manage and maintain the Crooked Street. Furthermore, state legislation would be required to enact such a system, which is currently being addressed by state and local leaders with the introduction of Assembly Bill 1605 (AB 1605) that would grant San Francisco the power to enact a paid reservation system.[2] This report later identifies several technical and operational characteristics of the selected alternative.

[2] Source: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB1605, accessed April 2019.

3 ALTERNATIVES EVALUATION

This chapter gives an overview of the alternative concepts and business rules that were evaluated, and summarizes the rationale for the selection of the preferred concept for the Lombard Paid Reservations System. Several operational alternatives were evaluated to determine the recommended use of pricing and reservations to meet the goals established for the project. Additionally, an evaluation of business rules was performed leading to a preliminary recommendation for parameters including hours of operation and price level. This chapter concludes with the rationale for the operations of the Lombard Paid Reservations System to rely primarily on the use of staff as opposed to relying on a purely automated system.

3.1 OPERATIONAL ALTERNATIVES

This section describes four operational alternatives that were evaluated for the Crooked Street. The alternatives represent different ways that pricing and reservations could be used to manage vehicle demand. Each alternative was evaluated against the goals as further described in the following sections.

3.1.1 PRICING ONLY

A pricing-only approach would seek to manage congestion by relying on a pricing mechanism to control the number of vehicles entering the Crooked Street. As identified previously in the 2017 Lombard Study, it is assumed such a system would operate all-electronically, with pricing that follows a variable scheme according to demand and time of day. Prices would be adjusted to rise and fall relative to periods of peak and off-peak congestion, and could be adjusted accordingly to historical hourly vehicle demands and flows by time of day and day of week. However, because there would be no reservation mechanism to manage vehicular congestion, this system would not limit the number of vehicles arriving to the Crooked Street, but would instead rely solely on pricing to manage overall vehicular demand.

The pricing-only alternative overall is expected to have moderate effectiveness in meeting the primary goals of the study. In terms of managing automobile congestion, while fees would have the potential to shorten long vehicular queues entering the Crooked Street, there would be no management or limit on the number of vehicles arriving in the neighborhood before making a decision to drive the street based on the pricing at the time, leaving the potential for congestion on Lombard and nearby streets if more vehicles than there is capacity for arrive in a short period of time.

In terms of the goal of implementing a financially viable solution, the pricing only alternative could be effective in raising revenue and has the potential to cover the associated operational costs. All motorists entering the Crooked Street (with the potential exception of residents of the street itself and Montclair Terrace) would pay to travel down the Crooked Block, which would enable funding of operations, enforcement of the roadway, and ongoing facility maintenance. The pricing only alternative would only be moderately effective in maintaining livability of the surrounding neighborhood, given that while pricing would generate revenue, the system may not be sustainable due to the inability to manage vehicle arrivals. The alternative could be set up to be self-sustaining financially, allowing for sufficient revenue for system upgrades. Lastly, meeting the goal of preserving tourism at a sustainable level of visitors per day would have moderate success, given that a variable pricing system may be less easily understood and friendly to tourists.

3.1.2 RESERVATION ONLY

A reservation-only approach would manage congestion by controlling how many vehicles would be able to enter the Crooked Street within a given time period. Under this alternative, it is assumed that there would be no fee to make a reservation. The reservation-only alternative is expected to be less effective than a pricing-only alternative in meeting the primary goals of operating the Crooked Street system, with the exception of managing automobile congestion. Motorists would be able to reserve a specific time of day to arrive and travel the street, which would facilitate management and reduction of vehicle queues leading to the Crooked Street.

In terms of the goal of implementing a financially viable solution, the reservation-only alternative would, by definition, not have an associated fee. As a result, no funds would be collected to manage the reservation system, which in turn would create an additional cost center with no obvious source of revenue to support this increased expenditure. The reservation-only alternative would only somewhat meet the goal of maintaining livability of the surrounding neighborhood, as while the system may be effective in managing the flow of vehicles on the Crooked Street, the absence of revenue generated by the reservation system would create new, additional costs to a location that is already challenging for the City to maintain in terms of enforcement and maintenance. Lastly, while the reservation-only alternative would likely be effective in meeting the goal of preserving tourism at a sustainable level by managing tourist entries at this location, this benefit would be offset by the costliness of enforcing and maintaining the reservation system without any dedicated revenue to operate it.

3.1.3 PRICING PLUS PAID RESERVATION

An alternative that combines the pricing only with paid reservations approaches was also evaluated. This concept, would require motorists to pre-purchase a reservation at a set price or would allow motorists without a pre-purchased paid reservation to arrive at the Crooked Street and pay a higher, variable price. The price for motorists who arrive without a reservation would need to be high enough to ensure that the system is not compromised by too many motorists arriving without reservations, and consequently forming long vehicle queues that would delay traffic in the surrounding area, including those attempting to arrive for their pre-purchased paid reservation time. The uncertainty about whether large numbers of motorists would decide to arrive without a reservation and pay the higher price may call into question the ability of this alternative to effectively manage congestion.

From the perspective of financial viability, this alternative could raise more revenue than the paid reservation approach. However, the goals of maintaining livability and preserving tourism may be compromised as a result of allowing vehicles to arrive at any time. This could result in needing to charge very high prices for those who show up without a reservation while putting at risk the enjoyment of the Crooked Street for those who do make reservations, creating a negative experience for all visitors.

3.1.4 PAID RESERVATION

A fourth alternative considered by the project team is a paid reservation system, which requires motorists to pre-purchase a reservation at a set price. In terms of collectively meeting the primary goals of the project, this alternative performs the best. Not only does this alternative have the potential to manage vehicle queueing through the reservation system, but it also has the potential to generate revenues that can go towards operating and maintaining the system and addressing the impacts of tourism on the neighborhood.

Of all four alternatives, the paid reservation alternative would best meet the goal of maintaining neighborhood livability. Paid reservations simultaneously manage vehicular traffic while generating a dedicated source of revenue to maintain the system and address neighborhood impacts from tourism. This alternative has an edge over a pricing-only

alternative for this specific goal, as the pricing-only alternative would be less effective in terms of managing the timing and grouping of vehicle arrivals. Lastly, in terms of preserving sustainable tourism, the paid reservation alternative would enable tourists to plan their trips in advance and substantially reduce the uncertainty of waiting in congestion to drive down the Crooked Street. Similar to the other two alternatives requiring payment, depending on the pricing of the paid reservation some tourists could be deterred from visiting by car (though could continue to visit at no cost and without a reservation by transit, foot, or another method).

3.1.5 QUALITATIVE EVALUATION

Each of the four potential operational approaches was qualitatively evaluated against the established project goals in an initial screening exercise. During the evaluation, it was determined that the goals of managing pedestrian congestion and ensuring traffic safety were more appropriate for quantitative evaluation and were not considered at this step. Table 2 summarizes the results of the qualitative evaluation – red shading indicates the approach did not meet the stated goal, yellow shading indicates the approach was questionable in meeting the stated goal, and green shading indicates the approach met the stated goal. As shown, the paid reservation approach was found to meet each of the goals while the other three approaches failed to meet at least one of the goals.

Table 2: Qualitative Evaluation of Pricing and Reservation Alternatives

		Operational Approaches		
Goal	**Pricing Only**	**Reservation Only**	**Pricing Plus Paid Reservation**	**Paid Reservation**
Manage Automobile Congestion Eliminate long queues near Lombard Street	Price could shorten queues, but vehicles will still arrive unmanaged.	Vehicles are given a timed reservation, matching arrivals to the capacity of the street. Queuing and congestion will be managed.	Non-reservation price could deter arrivals without a reservation, but vehicles will still arrive unmanaged. Unmanaged arrivals could undermine the efficacy of the reservation component	Vehicles are given a timed reservation, matching arrivals to the capacity of the street. Queuing and congestion will be managed.
Implement a Financially Viable Solution Cover the costs of existing staffing at the site	All vehicles (within hours of operation) would pay, providing funds for existing site operations, enforcement and maintenance.	No funds would be collected for site operations, enforcement, and maintenance.	All vehicles (within hours of operation) would pay, providing funds for existing site operations, enforcement and maintenance.	All vehicles would pay, providing funds for existing site operations, enforcement and maintenance.
Maintain the Livability of the Surrounding Neighborhood Create a self-sustaining system and generate revenue for upgrades	Revenue would be generated, but livability could be compromised due to uncertainty about managing vehicle arrivals and reduction in congestion.	While the system may manage vehicle arrivals, the absence of revenue would not provide for further investments in livability improvements.	Revenue would be generated, but livability could be compromised due to uncertainty about managing vehicle arrivals and reduction in congestion.	Paid reservations provide the most flexibility to manage vehicle arrivals while generating additional revenue for investments in livability improvements.
Preserve Tourism at a Sustainable Level Preserve the number of visitors per day	Not having the ability to plan a trip in advance may not be the friendliest option for tourism and the price would likely need to be high to deter visitation above capacity, but revenue would be generated to fund resources for the site.	Visitors can reserve a time and plan their trip in advance, but no revenue would be generated to fund resources for the site.	Allowing visitors to arrive without a reservation could compromise the integrity of the reservation system and create confusing rules, regulations, and expectations for visitors.	Visitors will be provided with a clear set of expectations and be able to plan trips in advance. Revenue would be generated to fund resources for the site.

3.2 BUSINESS RULE ALTERNATIVES

This section summarizes the methodology and data that was used to inform preliminary business rule recommendations for the operations of the Lombard Paid Reservations System. The preliminary business rules are described in Chapter 4.

3.2.1 HOURS OF OPERATION

Two alternatives were proposed for determining the hours of operation for the Lombard Paid Reservations System, which are defined as the hours during which paid reservations would be required.

The first alternative proposed to limit operational hours to periods when there is high demand. Based on data collected at the Crooked Street, it was revealed that vehicle queues generally start each day around 10:00 a.m. and dissipate by approximately 8:00 p.m. However, the hours of operation may need to include shoulder periods before and after the periods of high demand. Also, seasonal adjustments to the hours of operation may need to be considered. During the period when daylight savings time ends (November through March) and hours of daylight accordingly reduce, the necessary daily time window for the pricing and reservation system could also be reduced given the fact that peak vehicular activity at the Crooked Street generally occurs during daylight hours. Limited hours of operation would seek to ensure that vehicular demand is managed during the busiest periods and would keep operational costs down.

The second alternative proposed all day hours of operation. This would ensure that vehicle demand is managed at all times but would have a higher operational cost.

3.2.2 PRICING

Similar to hours of operation, two alternatives were proposed for pricing, which is defined as the amount that would be charged for a reservation.

The first alternative proposed to implement a pricing scheme that reflected demand. Data revealed generally higher demand on weekends and holidays as compared to non-holiday weekdays. Furthermore, Saturday through Monday queue lengths are nearly double the maximum queue lengths experienced on Tuesdays through Fridays, as shown in the average weekly profile shown in Figure 1 for the three blocks upstream of the Crooked Street entrance between Hyde Street and Van Ness Avenue. The 2017 Lombard Study also identified that 97% of visitors to the Crooked Street are either “very” or “somewhat” flexible in the time that they could visit the street. Given these data, an initial recommendation is to set a higher price for reservations on a Saturday, Sunday and holidays, and allow a lower cost for reservations made for non-Holiday Mondays through Fridays to encourage visitors who can shift their day of visit to a less crowded day to do so. Using data collected from the survey of visitors in cars to the Crooked Street regarding their willingness to pay, for the purposes of this analysis the rate for this alternative was set at $5 weekday and $10 weekends & holidays.

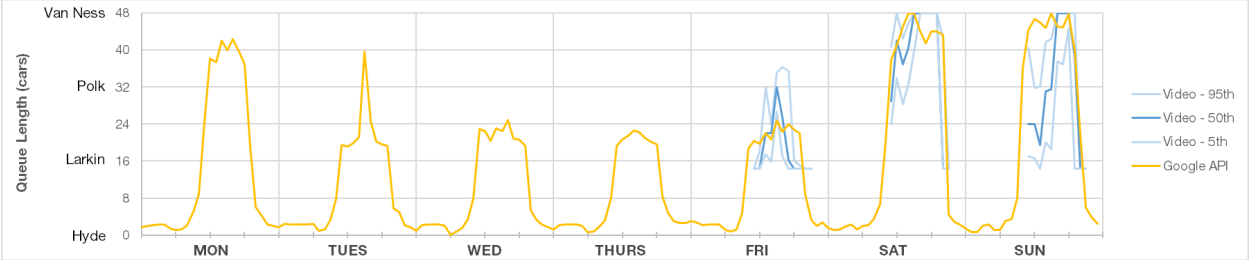

Figure 1: Vehicle Queues Upstream of the Crooked Street (Source: SFCTA and Arup, January 2019)

A second alternative proposed to implement a flat price for any reservation. This approach may allow for a simpler message to the public but would not incentivize reservations during periods of lower demand. Again using willingness to pay data from the survey of cars on the Crooked Street, this rate was set at $5.

3.2.3 DAILY RESERVATION SLOTS

Daily observed vehicle volumes indicate that the vehicle processing capacity of the Crooked Street is around 220 vehicles per hour (vph) as illustrated in Figure 2. To account for statistical uncertainty, it is anticipated that the arrival rate to the Crooked Street would need to be no greater than 210 vph in order to maintain an average queue length of eight vehicles, which is half of the estimated 16-vehicle queue length that can be accommodated along the upstream, eastbound Lombard block between Hyde and Larkin Streets approaching the Crooked Street.

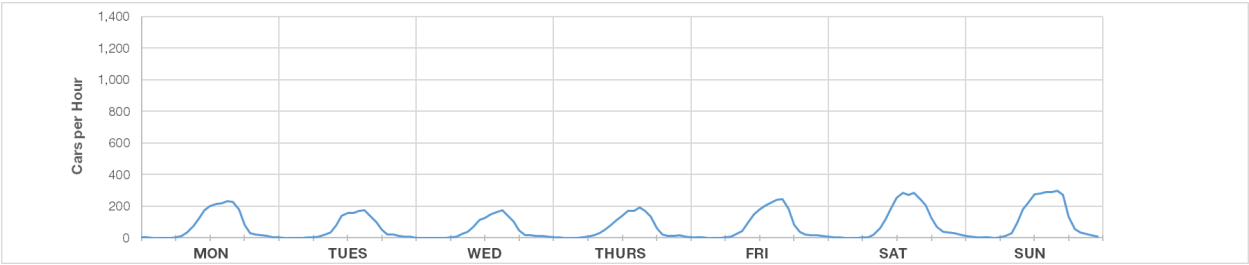

Figure 2: Crooked Street Average Weekly Traffic Profile (Source: SFCTA and Arup, January 2019)

An important consideration relative to setting the number of daily time slots is how those slots will be incremented. For example, slots could be offered in 30-minute increments and slots could be issued in overlapping increments. The increment should allow sufficient time for motorists to arrive at the Crooked Street but should not be so large to create significant unpredictability in the expected number of vehicle arrivals at any given time.

3.2.4 BUSINESS RULE SCENARIOS

Two scenarios were preliminarily defined for financial modeling purposes with assumptions about hours of operation, price and number of reservations. The financial modeling was informed by responses to a stated preference survey that provided willingness-to-pay and mode shift data. Table 3 below summarizes the two scenarios, which are further described in the following sections.

Table 3: Scenario Comparison

	Scenarios		
	Existing Conditions	**Scenario 1**	**Scenario 2**

Hours of Paid Reservation Operation	No Reservation	24 hours / 7 days per week	9:00 a.m. – 9:00 p.m. every day
Reservation Price	No Reservation	$5 All Times	$10 Sat, Sun, holidays $5 All Other Times
Reservation Slots	Not Applicable	40 reservations per 30-minute interval	40 reservations per 30-minute interval

SCENARIO 1

Under Scenario 1, the paid reservation system would operate 24 hours a day and seven days per week, with a reservation price of $5 all day. 24-hour operation would ensure the Crooked Street entry is managed at all times. A total of 40 reservation slots would be offered per 30-minute time interval, with time intervals staggered every 15 minutes, as it allows a sufficient time window for visitors driving to arrive at the Crooked Street entrance (while also allowing for early and late arrivals) and complete their travel down the street. Further, the staggering of time intervals every 15 minutes avoids clustering of vehicle arrivals.

SCENARIO 2

Scenario 2 would operate the same as Scenario 1 in terms of the number of reservation slots offered, 30-minute visitation interval, and staggering of intervals every 15 minutes. However, under Scenario 2 the hours of operation of the paid reservation system and the price of reservations would vary. The system would operate between 9:00 a.m. and 9:00 p.m., seven days per week. Remaining off-hours each day would allow free, unreserved access to the Crooked Street. As an initial measure, the price for a reservation under this scenario would be set at $10 on Saturdays, Sundays, and holidays, and $5 all other days of the week. The intent of this price differential is to encourage drivers to visit on off-peak days when the demand is lower, i.e. Tuesdays through Fridays, or to visit the Crooked Street by another mode such as walking, bicycling, and transit if visiting on the highest demand days.

3.2.5 EXEMPTIONS

Crooked Street residents and guests visiting these residents will be exempt from obtaining a paid reservation and will be able to access the Crooked Street anytime without a reservation.

The possibility of allowing exemptions for other motorists, including San Francisco residents and taxis, is accounted for in the proposed program design, although this study does not make a recommendation in these areas. Data indicates less than 7 percent of all daily vehicles using the Crooked Street are registered in San Francisco, and very few taxis or TNCs currently travel down the street during peak times. Although resident vehicles make up a small fraction of the total number of vehicles using the Crooked Street, exempting these vehicles creates a need for a process to enroll and/or verify that anybody claiming the exemption is truly a resident.

3.3 SYSTEM IMPLEMENTATION

Two options were evaluated to implement the Lombard Paid Reservations System. Preliminary efforts indicated the potential for a fully automated solution relying on license plate cameras to implement the pricing and reservation system. However, after further evaluation, the study team identified several concerns with the fully automated approach, and recommend withdrawing it from further consideration as the initial operating concept.

This section summarizes the rationale for the decision to move away from a purely automated approach and for the decision to instead rely on the presence of staff to verify reservations.

3.3.1 FULLY AUTOMATED SOLUTION

A fully-automated solution would rely on technology to detect vehicles using the Crooked Street. This solution would use cameras to capture license plates for all vehicles traveling on the Crooked Street. Vehicles that are detected but are not matched to a reservation would be subject to a violation penalty or fee, with the exception of vehicles designated as being exempt based on business rules. This solution could be used under both the 24/7 scenario and the 9:00 a.m. to 9:00 p.m. scenario.

3.3.2 STAFFED SOLUTION

A staffed solution would rely on personnel, rather than technology, to verify that vehicles using the Crooked Street have made a reservation and to allow designated exempt vehicles to travel without a reservation. With this solution, staff would determine whether users made a reservation by visible observation or by utilizing hand-held devices. Non-exempt users without a reservation would be directed away from the Crooked Street. This solution could only be used under the 9:00 a.m. to 9:00 p.m. scenario, as 24/7 staffing would be costly and inefficient.

3.3.3 EVALUATION

An assessment of the fully automated and staffed solutions was conducted from the perspective of how users would be expected to interact with each system. This interaction was divided into three stages - pre-arrival, arrival, and post-arrival – as further described below.

PRE-ARRIVAL STAGE

The pre-arrival stage involves all the activities that must take place prior to a user arriving at the Crooked Street. This includes the process for making a reservation and the process to register exempt users. The primary concern in the pre-arrival stage from a system operator perspective is the ability to reliably register and identify exempt users, including residents and guests; from the visitor/customer perspective, ease of use and quality of user experience are also a key concern.

A fully-automated solution introduces several challenges during the pre-arrival stage. Residents would be required to register their vehicles with the system, provide proof of Crooked Street residency, and update their registration any time they change vehicles to avoid being issued a violation penalty or fee. This could be seen as a burden by residents and could require significant administrative involvement and oversight. In addition, residents would be required to register their guests' trip or ask their guests to register their trips themselves. In either scenario, the process of onboarding residents and guests will be cumbersome and, if ignored or forgotten, both user classes are at risk of being issued a violation penalty or fee. Handling unknown license plate information is also a challenge with a fully-automated solution. Tourists traveling via rental vehicle or by taxi/shared vehicle may not have license plate information in advance of their trip. This will require an additional step in the reservation process for tourists who need to update their registration to include license plate information. If not completed within a designated time frame, tourists would be at risk of being issued a violation penalty or fee.

The concerns associated with reliably processing exempt users in an automated solution are largely mitigated with a staffed solution. Most importantly, the potential of charging exempt users is removed when there are staff on site to confirm and direct traffic. And having staff on-site significantly reduces the administrative burden associated with verifying proof of exemption.

ARRIVAL STAGE

The arrival stage involves the arrival of vehicles at the Crooked Street. The primary concern in the arrival stage is the ability to effectively and expeditiously manage vehicle arrivals. In a fully-automated solution, when visitors arrive at the Crooked Street, license plate cameras would detect, identify, and verify reservation, exemption, or violation status of vehicles entering the system. There is no mechanism to manage those who arrive outside of their reservation window or those who arrive without a reservation at all, except the risk of receiving a violation penalty or fee. Without the ability to manage when vehicles arrive, the integrity of the reservation system would be compromised. Rule-abiding customers who register, pay, and arrive on time may find that there is a queue on Lombard Street and that it is lengthier than expected. This could introduce difficulties in guaranteeing reservation times, result in the issuance of violation penalties or fees for vehicles that arrive outside of their reservation window, and ultimately compromise the ability to provide a reliable experience for paying customers. The handling of the arrival of service/delivery vehicles is also challenging in an automated solution. The license plates for these vehicles would have to be entered into the system in some way to avoid them being issued a violation penalty or fee.

The ability to manage vehicles that arrive outside of their designated reservation time or arrive without a reservation is preserved in a staffed solution. Staff on-site can validate and direct non-reserved visitors away from the Crooked Street, while also managing early and late arrivals with discretion. The presence of staff on-site ultimately provides a safeguard to manage vehicle arrivals, which is a clear advantage over the fully-automated solution. Staff can also allow service/delivery vehicles to access the Crooked Street.

POST-ARRIVAL STAGE

The post-arrival stage involves all the activities that must take place after users visit the Crooked Street. The major concern in the post-arrival stage is the cost associated with violation processing, which could be significant with a fully-automated solution that relies on the issuance of violation penalties or fees to deter visitors from showing up without a reservation. The process of capturing and reviewing license plate images, performing lookups through DMV to obtain addresses, issuing violation penalties or fees, adjudicating disputes, and ultimately collecting violation revenue can be expensive, potentially in the range of $50,000 to $75,000 per month based on preliminary estimates. Additionally, the fully-automated solution introduces the potential of issuing violation penalties or fees to exempt users.

In a staffed solution, visitors arriving without a reservation are directed away from the Crooked Street. Violations would be minimized, and only issued to those who disobey staff and PCO instructions and travel down the Crooked Street. These violations would be issued on-site by appropriate enforcement officers depending on enabling legislation.

3.3.4 RECOMMENDATION

Based on the concerns presented in this section, a staffed solution is the recommended alternative for the Lombard Paid Reservations System. The main factor behind this recommendation is the inability for a fully-automated solution to manage visitors during the arrival stage, which is a potential fatal flaw for the system. In addition, there is interest to deploy a system in a timely manner. A fully-automated solution would require a prolonged schedule for system readiness, including increased time for procuring a system operator, designing system infrastructure, installing system equipment, and testing for fully-automated operations.

4 OPERATING CONCEPT

This chapter describes how the Lombard Paid Reservations System will operate. As discussed in the previous chapter, the Lombard Paid Reservations System would use paid reservations to manage vehicle demand and deploy on-site staff to facilitate system operations. The following sections describe the operating system business rules, user interactions with the system, and preliminary concepts for staffing and traffic management.

4.1 BUSINESS RULES

This section provides details on the business rules that will govern the use and operation of the Lombard Paid Reservations System. Ultimately, the intent of the business rules is to guide the development of the technical requirements and standard operating procedures for the system. The following sections define the preliminary business rules that have been developed for the Lombard Paid Reservations System.

4.1.1 USER CLASSIFICATION

Three (3) types of users have been defined according to the different ways that each user may interact with the Lombard Paid Reservations System. These user types are categorized as Type A, Type B and Type C. Type A and Type B are required user types. Type C is dependent on future business rules decisions, and may or may not be included in the final Lombard Paid Reservations System. Table 4 provides a definition of the motorists that belong in each user type.

Table 4: Lombard Paid Reservations System User Types

User Classification	
Type A Exempt from payment and reservation requirement	**Decal or Pass Required** • Residents of the 1000 block of Lombard Street and Montclair Terrace • Guests of residents of the 1000 block of Lombard Street and Montclair Terrace **Decal or Pass Not Required** • Emergency service vehicles (e.g., police, fire, ambulance) • Paratransit vehicles • Marked delivery vehicles (e.g., UPS, FedEx) • Marked utility vehicles (e.g., AT&T, Comcast) • All others exempt from vehicle registration in California
Type B Required to make a paid reservation	• Visitors of the Crooked Street who are accessing the street for recreational purposes, including TNC vehicles and their passengers (unless passengers are in possession of a resident pass).
Type C No-cost reservation required	This user type is being defined so as not to preclude the possibility of exempting certain users from making a paid reservation, should such future business rule decisions be enacted. Examples of users that may be considered for this exemption include: • Taxis registered in the City of San Francisco • Promotional offers for San Francisco Residents

Type A defines motorists who are exempt from making a paid reservation, which includes residents of the 1000 block of Lombard Street and Montclair Terrace and those that are visiting these residences. Type A motorists are divided into two groups as follows:

- Residents and their guests – Those whose residences are accessible from the Crooked Street will need to be easily recognizable by staff for unhindered access. These residents will be issued a visibly recognizable form of identification as further described in **Section 4.2**. Similarly, guests who have arranged to visit residents on the Crooked Street will need to be identifiable by staff to access the Crooked Street without a paid reservation and will also be issued a form of identification that can be displayed.
- Visitors in commercial and government vehicles – There are many types of vehicles that can be expected to need access to the Crooked Street for which it would be impossible to pre-plan their arrivals and issue visible identification ahead of time. These generally include marked vehicles that are providing services to residents. Because these vehicles are likely to be plainly identifiable by staff, they will not be expected to carry any form of identification.

Type B defines motorists who are required to book a reservation and pay online. Type B users will account for most visitors of the Crooked Street, including tourists, transportation network company vehicles, and all other visitors not defined as Type A or Type C.

Type C is a user class reserved to allow for the potential to allow certain users to obtain no-cost reservations. The decision to include this user classification in the ultimate Lombard Paid Reservations System is dependent on future business rules. The Type C classification could accommodate users such as taxis registered in San Francisco and San Francisco residents. Introducing a no-cost reservation option to the Lombard Paid Reservations System will require several additional considerations, such as limiting the number of available no-cost reservation slots and introducing mechanisms to verify that those who make a no-cost reservation meet the specified criteria.

4.1.2 HOURS OF OPERATION

The hours of operation for the Lombard Paid Reservations System define the periods when staff will be enforcing the requirements for access to the Crooked Street. Based on historical data, Crooked Street visitors have been shown to queue as early as 10am, with queues dissipating by approximately 8pm on all days of the week. These data points establish a baseline for the proposed hours of operations shown in Table 5 below. It should be noted that this data was collected during summertime. The system operator may elect to adjust the hours of operation seasonally to reflect daylight hours, which generally align with peak vehicular activity on the Crooked Street.

Table 5: Lombard Paid Reservations System Proposed Hours of Operation

Hours Operation
9am – 9pm
Seven (7) days a week

The proposed hours of operations include an additional 1-hour cushion on either side of the expected morning and evening queues, with the intent of proactively managing vehicle arrivals before and after anticipated influxes. In addition, given that on-site staff will facilitate daily operations, establishing reasonable working hours is imperative. The proposed 12-hour period satisfies both points.

4.1.3 PRICING

Data collected by SFCTA revealed a high demand for the Crooked Street on weekends and holidays. In some cases, the queue lengths on these days were double the maximum queue length experienced on typical weekdays. These findings informed the recommended tiered pricing for the paid reservation system, shown in Table 6 below.

Table 6: Lombard Paid Reservations System Proposed Reservation Prices

Pricing	
$5	Non-Holiday Weekdays
$10	Weekends and Holidays

The proposed prices were guided by a survey conducted on the Crooked Street, which found that 59% of respondents were willing to pay a reservation price of $5, and 41% were willing to pay $10. In another survey, 97% of visitors to the Crooked Street indicated that the time of their visit was either very (82%) or somewhat (15%) flexible. The intent of the price differential between weekdays is to encourage potential visitors with flexibility in their schedule to visit during off-peak days. Ultimately, input from visitors must be balanced with the system's need to recover its cost of operations (including verifying reservations and traffic management) when setting the final price levels.

4.1.4 RESERVATION SLOTS

Based on preliminary data collected by SFCTA, it is estimated that the arrival rate of vehicles to the Crooked Street should be no greater than 210 vehicles per hour (vph) to maintain an average queue length of 8 vehicles, which is half of the 16-vehicle queue capacity upstream of the Crooked Street. In addition, a 30-minute time slot staggered every 15 minutes was recommended to allow for adequate arrival and passage time and to avoid vehicle clustering. An example of the proposed reservation slots during a one-hour time window is shown below in Table 7.

Table 7: Lombard Paid Reservations System Proposed Reservation Slots

Reservation Slots				
8:45 – 9:15	9:00 – 9:30	9:15 – 9:45	9:30 – 10:00	9:45 – 10:15
40	40	40	40	40

As shown in the table above, five 30-minute time intervals span each hour, with 40 reserved slots proposed per time interval. Assuming half of the visitors arrive during time intervals one and five, the total estimated hourly arrival is 160 vehicles. This recommendation is smaller than the maximum estimated processing capacity of 210 vph, but allows the system to comfortably accommodate early and late arrivals.

Ultimately, these recommendations ensure the system mitigates clustered arrivals, allocates an adequate time for arrival and passage through the Crooked Street, and accounts for visitors who may arrive during an allowable early and late time frame.

4.2 TRAFFIC MANAGEMENT

Implementation of the Lombard Paid Reservations System will require revisions to traffic circulation, parking, and on-site staffing on the streets surrounding the Crooked Street. These revisions are illustrated below in Figure 3.

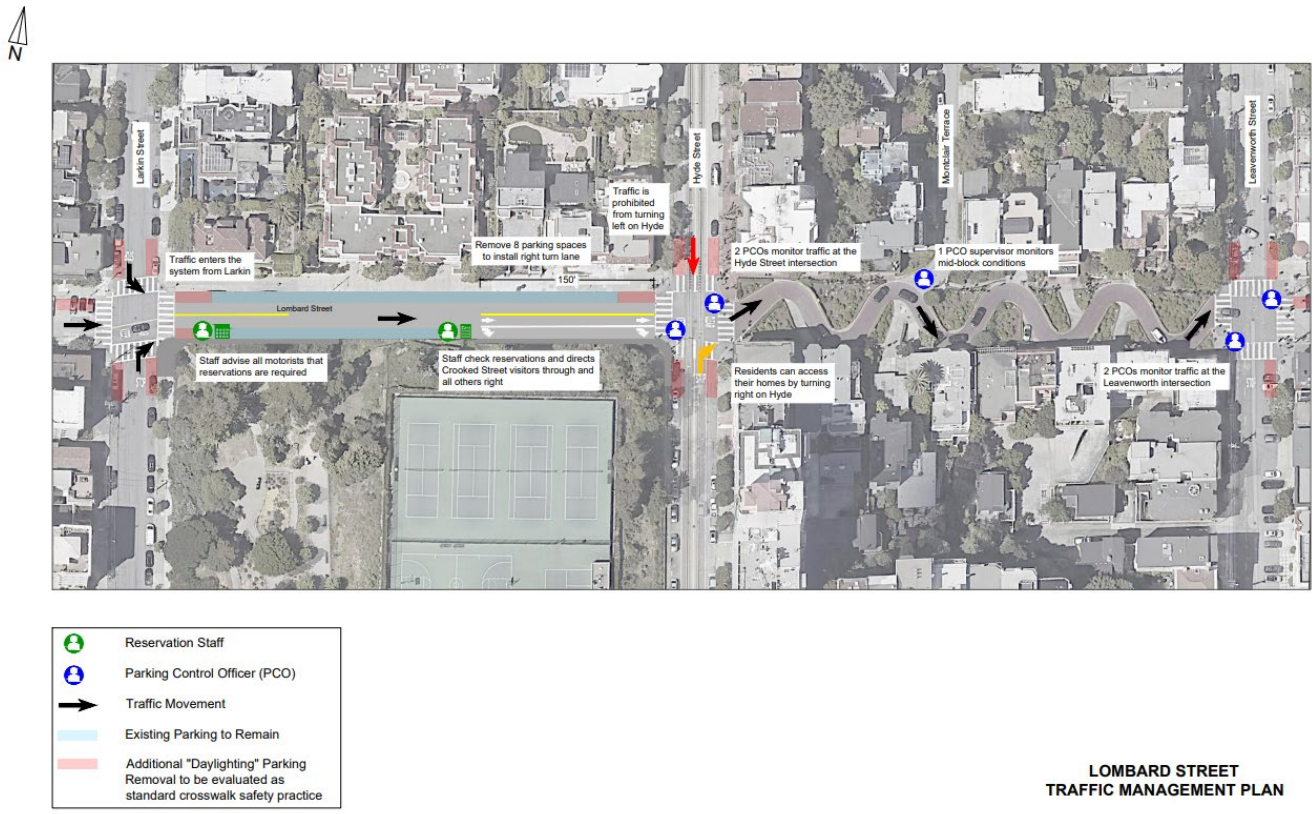

Figure 3: Lombard Paid Reservations System Traffic Management Plan

Currently, on peak weekends and holidays, the Crooked Street is staffed with five Parking Control Officers (PCOs). The implementation of the Lombard Paid Reservation System anticipates that this level of staffing will continue on peak weekends and holidays, and that PCO staff will be on site to cover the full hours of operation of the system. Fewer officers may be needed on site on weekdays and lower volume seasons. In addition to these PCOs, two or more personnel will be added on site dedicated to the management and verification of reservations, guest passes, and other ticketed entries. These staff positions are represented in the diagram above. Staffing is discussed in more detail in Section 4.4.

Changes to traffic and parking regulations as illustrated in Figure 3 are summarized as follows:

- Throughout the area and on major arterials, signage will be posted advising that Lombard Crooked Street is closed to traffic, except with reservations.
- At Lombard & Larkin, a reservation staff member will be posted during hours of operations with a movable sandwich sign again advising the Lombard Crooked Street is closed to traffic, except with reservations. This staff member will not check tickets or reservations, but will offer guidance and assistance to those who need more information on how to make a reservation (either through an in-person conversation or by distributing cards with information in multiple languages). While this staff member should attempt to deter vehicles without reservations proceeding eastbound on Lombard from Larkin, those that choose to do so may continue.
- Approximately mid-block on Lombard Street, a second reservation staff member will be equipped with a handheld device that can be used to scan tickets and verify reservations. Beyond this staff position, parking on the south side of the street will be restricted, resulted in a net loss of approximately eight parking spaces. Eastbound Lombard Street will become two lanes – the curb lane (formerly parking) will be right turn only onto Southbound Hyde, with the center lane designated as straight ahead only. Vehicles with valid reservations will be directed into the straight ahead lane to proceed down the Crooked Street, while vehicles without valid reservations will be directed to the right turn only lane. During hours of operation, cones will be set up between the lanes to prohibit lane changes after verification.

- At the intersection of Lombard and Hyde, PCOs will direct traffic as appropriate by the lanes – straight ahead or right turn – on eastbound Lombard Street. Additional PCOs will direct vehicles out of the area when they reach Lombard and Leavenworth at the bottom of the Crooked Street.

All vehicles bound for the Crooked Street during the operating hours of the system will be required to approach via the Lombard/Larkin intersection. The existing restrictions on right turns and left turns from Hyde onto the Crooked Street will remain in place, except for residents of the Crooked Street and Montclair Terrace who will continue to be able to access the Crooked Street by making a right turn from northbound Hyde. User interactions with the system are detailed in the following sections.

During the development of this traffic management plan, the study team determined that there are existing pedestrian accessibility deficiencies along the south side of the 1100 block of Lombard Street. In particular, the sidewalk is interrupted mid-block by a large retaining wall for approximately 120 feet, or 1/3 of the total length of the block. At each end of the block, the existing sidewalk does not meet accessibility standards of six feet of clearance, with widths varying from 3.5 feet at the western end of the block to 4.5 feet at the eastern end of the block. The study team evaluated the potential to correct these deficiencies and complete the sidewalk, but found that significant design challenges and potential costs would be incurred, particularly around utility relocation. As a result, the study team recommends that this sidewalk be brought up to standard outside of the implementation of the Crooked Street Paid Reservation System.

As shown in the traffic management diagram, the study team also recommends that the SFMTA evaluate the potential for crosswalk daylighting at Lombard & Larkin, Lombard & Hyde, and Lombard & Leavenworth intersections to improve pedestrian visibility and safety.

4.3 USER INTERACTIONS WITH THE SYSTEM

The following section is intended to describe the ways in which motorists visiting the Crooked Street will interact with the Lombard Paid Reservations System. These interactions are presented in two distinct stages:

- Pre-Arrival Stage – this stage defines all necessary steps motorists are required to complete prior to arriving at the Crooked Street.
- Arrival Stage – this stage defines all interactions motorists are required to engage in while visiting the Crooked Street.

4.3.1 PRE-ARRIVAL STAGE

The expectations of users during the pre-arrival stage are described below.

TYPE A USERS

Residents of the Crooked Street will be required to have system authorized identification. This identification is defined as a resident decal and/or pass, which contains a unique code that can be verified by staff and used for inventory management. To obtain a resident decal, residents are required to register through an online system (further described in **Chapter 6**). After registering online, the system operator will verify the information and either approve or deny residents the ability to set-up an online user account. Through their online user account, residents can request a resident decal and/or pass by mail.

Guests of Crooked Street residents will also be required to have system authorized identification. This identification could take the form of a printed guest pass or could be displayed via smartphone. The pass will contain a unique code that staff can use for inventory control and to verify that the pass is valid. It is recommended that guest passes be made available in two forms:

1. Casual – for infrequent visitors.

2. Frequent – for residents who require frequent visits for home health care service, in home child care, or employees of family childcare homes.

The system operator may elect to assign a small cost to guest passes to cover the administrative expense of approving and issuing the pass.

There are several ways in which infrequent guest passes may be issued. However, for inventory management purposes and to prevent the potential for fraud, it is recommended that guest passes be requested and distributed via residents. The number of guest passes will be limited per residence and will have an expiration date. The method by which residents obtain guest passes could be accomplished in the following ways:

1. Residents procure one-time or one-day guest passes on behalf of their guests through an online portal provided by the Lombard Paid Reservations System. The guest will then be sent an electronic notification with instruction on how to access the pass. The number of guest passes issued to each household may be limited within certain timeframes (e.g. 45 passes per household per 30-day period).

2. Each household on the Crooked Street and Montclair Terrace may procure a predetermined and limited number of physical one-time or one-day use guest passes each year (e.g. 45 passes per household per 30-day period). Each pass issued must have a date indicated to enforce a predetermined expiration.

Infrequent visitor passes may be used by the recipient in any vehicle, including a personal vehicle, taxi, TNC, rental car, or any other vehicle that may legally access the Crooked Street

Passes for frequent visitors may be issued through the same methods of above, but would be valid for unlimited multiple uses over a predetermined timeframe (e.g. one year), subject to renewal and reverification. The number of frequent visitor passes issued to each household may be limited to prevent abuse.

Visitors in commercial and government vehicles will not be required to have system authorized identification, and therefore are not required to interface with the system prior to arrival.

TYPE B USERS

Type B visitors will be required to book a reservation and pay online prior to arriving at the Crooked Street. All Type B visitors will use the online system to book and pay for a reservation, and will receive an electronic ticket containing a unique code which can either be printed or displayed via smartphone. The ticket will include all necessary reservation details for inventory control and will indicate the assigned 30-minute reservation slot. At the site, the ticket serves as the form of identification necessary for staff to validate motorists and usher arrivals.

TYPE C USERS

Type C visitors, if allowed, will require unique considerations to validate that they qualify for a non-paid reservation. One requirement for taxis, if they were to be permitted to make non-paid reservations, may be that they are registered in the City of San Francisco, which may require staff to verify taxi licenses upon arrival. If San Francisco residents were to be eligible for non-paid reservations, there would need to be a credible and efficient way to validate residency. The following are examples of how this could be accomplished:

- A predetermined but limited number of tickets are distributed to all San Francisco library branches, which are available for residents to check-out and use for the day. Since the library already validates residency, the onus would not be on reservation staff on-site to do any verification.
- San Francisco residents who book a reservation online are given a “resident ticket”, which signifies to reservation staff that the resident booked a non-paid reservation, and they must show their license or ID to reservation staff on site for for validation.

To avoid the potential for users to abuse non-paid reservations, it will be necessary for the system operator to establish business rules to combat misuse, including limiting the number of available non-paid reservations, limiting individuals/groups from obtaining multiple non-paid reservations, and carefully choosing the necessary validation requirements.

4.3.2 ARRIVAL STAGE

The expectations of users during the arrival stage are described below.

TYPE A USERS

Motorists with valid resident decals will continue to be permitted to turn right on Hyde Street to access the Crooked Street. If a motorist claims to be a resident but does not have a resident decal, the PCO stationed at the intersection of Hyde Street may request to see the motorist's driver's license or ID to validate residency on the 1000 block of Lombard Street or Montclair Terrace. Over time, PCOs may become familiar with residents and may adopt an informal approach, such as waiving in known vehicles at their discretion.

Visitors with guest passes will be required to access the Crooked Street by entering the system at Larkin Street. As shown in the traffic management plan, visitors will be approached by reservation staff near the east leg of the intersection. Reservation staff will utilize handheld devices capable of scanning the guest pass and providing an indication that the guest pass is valid. If the match is negative, the guest will be denied entrance and directed into the right turn lane, where they are instructed to turn right onto Hyde Street. If the match is positive, the guest is directed into the through lane, awaiting access to the Crooked Street.

Emergency service vehicles are permitted access to the Crooked Street under any circumstance, at any time, without any interface with on-site staff.

Commercial and government vehicles access the Crooked Street by entering the system at Larkin Street. Because commercial and government vehicles will arrive without system authorized identification, reservation staff on the east leg of the intersection will be responsible for asking the driver a predetermined list of questions, including purpose, point of contact, and expected duration on the Crooked Street. The system operator will determine the criteria necessary for allowing or denying entrance to the Crooked Street. If allowed, the visitor is directed into the through lane, awaiting access to the Crooked Street. If denied, the visitor is directed into the right turn lane, where they are instructed to turn right onto Hyde Street.

TYPE B AND TYPE C USERS

Type B and Type C visitors access the Crooked Street by entering the system at Larkin Street. As shown in the traffic management plan, visitors will be approached by reservation staff near the east leg of the intersection. Reservation staff will utilize handheld devices capable of scanning reservation tickets and providing an indication that the visitor is either permitted or denied entrance onto the Crooked Street. If the match is negative, the visitor is denied entrance and directed into the right turn lane, where they are instructed to turn right onto Hyde Street. If the match is positive, the visitor is directed into the through lane, awaiting access to the Crooked Street. Additional protocol may be required if Type C visitors are required to provide identification on-site.

An allowable time threshold or "grace period" will be defined to establish the amount of time before or after a defined reservation window during which a Type B and C user will still be allowed access to the Crooked Street. If a visitor arrives within the grace period, they will be permitted to proceed. But visitors that arrive outside of the grace period will be denied entrance and instructed to turn right onto Hyde Street. Vehicles that arrive too early will be instructed to return during their reservation window, while vehicles that arrive too late will forfeit their ability to travel down the Crooked Street or will be required to make a new reservation.

4.4 STAFFING

Based on the traffic management plan, procedures outlined in the sections above, and preliminary conversations with Parking Control Officers (PCOs) who currently staff the Crooked Street, the staffing levels shown in Table 8 have been recommended for the initial operation and enforcement of the Lombard Paid Reservations System.

The ultimate staffing level may vary from this recommendation depending on future needs and decisions. The following sections describe the roles of each of the different staff types.

Table 8: Preliminary Staffing Level Recommendations

Staffing Levels			
Parking Control Officers (PCOs)	Reservation Staff	Ambassadors	SFPD Officers
Up to 5	2	2	Up to 2

4.4.1 PARKING CONTROL OFFICERS (PCOS)

The primary role of PCOs is to efficiently direct motorists in and out of the Crooked Street. Two (2) PCOs are recommended at top of the Crooked Street, at the intersection of Lombard and Hyde Street, to direct visitor and pedestrian traffic at the entrance of the Crooked Street. Another two (2) PCOs are recommended at the bottom of the corridor, at the intersection of Lombard Street and Leavenworth, to direct visitor and pedestrian traffic at the exit of the Crooked Street. The remaining PCO is recommended as a floating supervisor, who's primary role is to monitor midblock issues and provide support as needed on either ends of the Crooked Street. The floating supervisor can also manage pedestrian issues along the Crooked Street, such as visitors blocking driveway access. This level of staffing represents a recommendation for the busiest days and hours of operation (such as holidays and summer weekends) and is based on the current staffing provided on busy summer weekends by SFMTA. This staffing recommendation may be reduced to appropriately match demand on less busy times of day or days of the year.

4.4.2 RESERVATION STAFF

The primary role of reservation staff is to manage visitors arriving with a reservation, including verification of reservations and identification of vehicles that have a valid reservation and those that do not have a valid reservation. It is envisioned that these staff will have the ability to verify the validity of reservations via handheld devices or some other method (see Chapter 6). One reservation staff member is recommended on the east leg of the intersection of Lombard and Larkin Street to advise motorists that reservations are required to travel the Crooked Street. A second reservation staff member is recommended to complete verification of reservations as vehicles arrive mid-block on the 1100 block of Lombard Street, advising those with reservations to join the through lane and those without that they must use the right turn only lane to turn south onto Hyde Street. Both positions may require additional staff members during times of busy demand.

4.4.3 SAN FRANCISCO POLICE OFFICERS

The primary role of SFPD officers is to monitor traffic and pedestrian safety, while also providing support to PCOs if necessary. SFPD officers will also be responsible for issuing citations to motorists who disregard the operating procedures of the Lombard Paid Reservations System. Up to two SFPD officers are recommended – one at the top of the Crooked Street and another at the bottom. This level of staffing for SFPD may not be warranted on all days of the week or hours of the day, and should be matched with the observed demands of the system.

4.4.4 AMBASSADORS

The primary role of ambassadors is to serve as advisors to pedestrians traveling near the Crooked Street. One ambassador is recommended on either end of the Crooked Street, and is expected to be available to answer questions and provide helpful advice to tourists.

5 FACILITY DESIGN

This section highlights the preliminary facility and signage concepts that may be applied to the design of the Lombard Paid Reservations System. The material in this section does not represent final design decisions. The intent of the section is to provide initial concepts that can be used to guide the development of the final design of the facilities near the Crooked Street. These may include restroom and storage facilities for staff and signage.

5.1 FACILITIES FOR STAFF

There are ongoing discussions within SFCTA and SFMTA regarding restroom and storage area access for staff that will be employed on-site. Currently, PCOs who work on Lombard Street check-in at an off-site facility, leave their personal belongings, and utilize a city vehicle to travel to the site. Scheduled and unscheduled restroom breaks are accomplished taking the city vehicle to a nearby public restroom, oftentimes near the Fisherman's Wharf area.

This concept of operations does not envision the need to construct new facilities as part of this project, but is the project team is evaluating options to accommodate staff closer to the Crooked Street. A new public park is under construction near the intersection of Hyde and Bay Street, which is about two blocks from the entrance of the Crooked Street. The new park will likely include public restroom facilities, which may be of use to staff on-site.

5.2 SIGNAGE

An effective signage and communication plan is essential to communicating to visitors in cars that reservations are required to drive the Crooked Street well ahead of the Lombard/Larkin or Lombard/Hyde intersections. The system operator will need to coordinate signage content and locations with the SFMTA upon adoption of the final traffic management plan.

5.3 COMMUNICATIONS

To avoid the need for the installation of communications infrastructure, the Lombard Paid Reservations System will utilize wireless communications and cloud computing to support operations. On-site equipment utilized by staff to verify reservations will rely on broadband cellular networks to communicate information. Staff may also utilize two-way radios to communicate with one another if needed. Cloud computing will be used for data storage and computing resources needed for the reservation and payment system, which eliminates the need for physical servers and associated infrastructure.

6 SYSTEM ARCHITECTURE

This chapter describes the system elements that will be implemented to manage the Lombard Paid Reservations System. A preliminary system architecture diagram is shown in Figure 3, which conceptually illustrates the envisioned components.

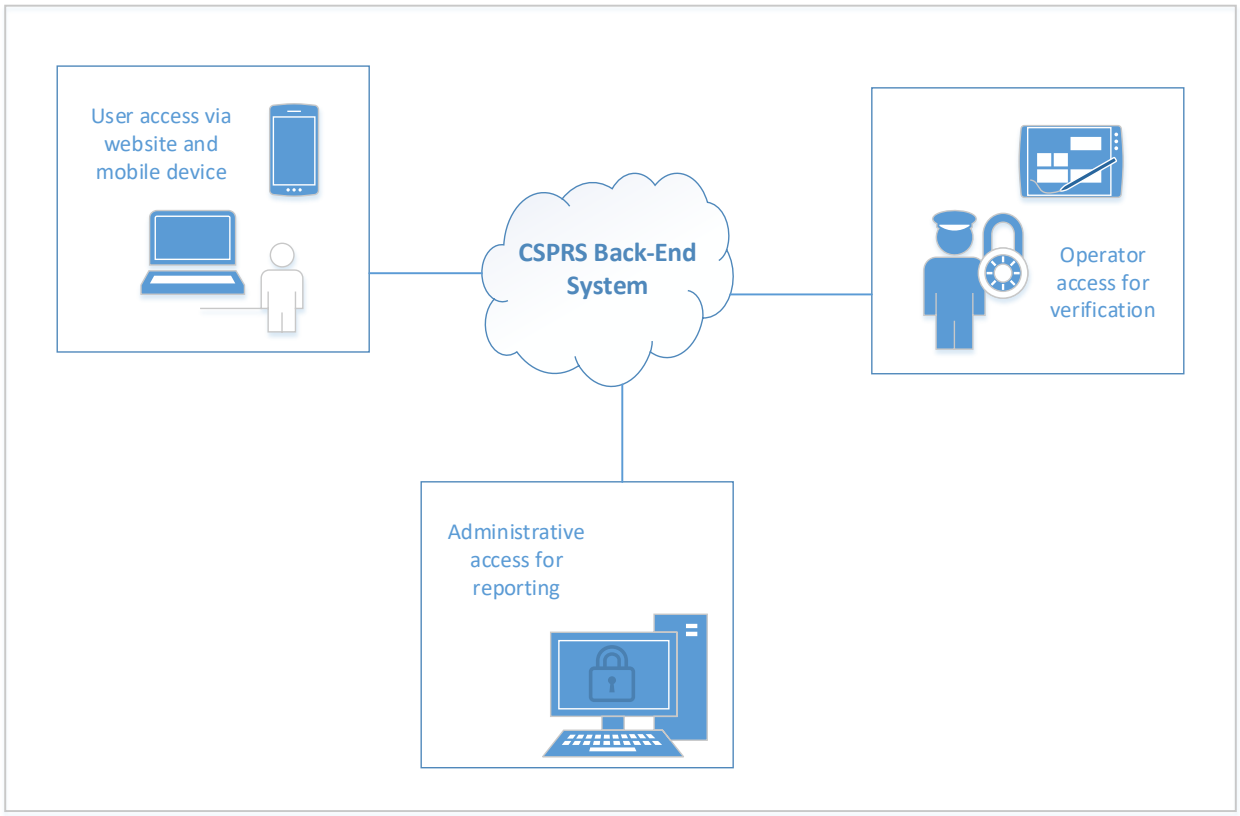

Figure 4: Crooked Street Paid Reservation System Architecture

6.1 BACK-END SYSTEM ELEMENTS

A back-end system will be required to operate the Lombard Paid Reservations System. It is envisioned that the back-end system will be cloud-based and therefore will not require the physical installation of servers and communications infrastructure. The back-end system will provide the computing and storage capabilities required to manage the Lombard Paid Reservations System, including the following functionalities:

- Create and maintain database for paid reservations
- Create and maintain database for resident decals and guest passes
- Collect payment revenue
- Report on performance and finances

The back-end system will provide three types of access, including:

1. User access for residents, recreational visitors and exempt vehicles to make and pay for reservations and to request exemptions

2. Administrative access to change parameters and report information
3. Operator access to verify reservations and exemptions

These elements are further described in the following sections.

6.2 USER ACCESS

A website will be designed to serve as the primary interface for Type A, B and C with functionality to allow each distinct user type to interact with the system as appropriate. The website will be required to:

- Meet all industry standard encryption and payment requirements;
- Meet all rules and policies for protecting Personally Identifiable Information (PII);
- Offer information in multiple languages;
- Be accessible via desktop and mobile device; and
- Be ADA-compliant.

The user website functionalities for each distinct user type are described below.

6.2.1 TYPE A – RESIDENTS AND GUESTS

Residents will be able to use the website to request new or replacement resident decals and guest passes. The website will direct residents to a unique page to make the request and may ask for the following information:

- Contact information (including name, email, and phone number)
- Driver's License or other ID number
- Vehicle license plate number(s)
- Address, including proof of address if not current on Driver's License or other ID (e.g. utility bill, lease, mortgage statement, etc.)

Upon entering the required information, the website will query the back-end system to check whether the number of resident decals or guest passes associated with the user does not exceed a defined threshold. If so, a process will be triggered for issuance of the resident decal or guest pass.

The website will also provide information for other Type A users, such as delivery vehicles and other vehicles that may need to access the Crooked Street for non-recreational purposes. Information for these users will be provided via FAQs and instructions.

6.2.2 TYPE B – RECREATIONAL VISITORS

The website will include all elements necessary to provide a fully functional platform for recreational visitors of the Crooked Street from the initial landing page to the reservation confirmation page. The website will take Type B users through the following steps:

1. A button on the landing page will direct recreational users to the area of the website where they can make a reservation (see example in Figure 4).
2. Users will be presented a calendar or a dropdown list showing dates for which reservations are available. The price for reservations will also be shown if prices differ by date.
3. After selecting a date, users will be shown the arrival times that are available for the particular date chosen.

a. If the date chosen does not have the desired arrival time available, the user will be given an option to select a new date.

4. After selecting an arrival time, the user will be taken to a confirmation page showing the date, arrival time and price of the reservation. The options to purchase the reservation or to start over will be displayed along with an expiration timer that will release a hold on the reservation once the countdown expires.
5. After selecting the option to purchase the reservation, the user will be required to enter billing information, including name, address, and credit card information.
6. Upon confirming that the payment was accepted, a page will be displayed indicating that the reservation was successfully purchased along with the unique reservation identifier. The user will have the option to print or email the confirmation page.
7. The system will make a record of the paid reservation that can be accessed by operators for verification on site.

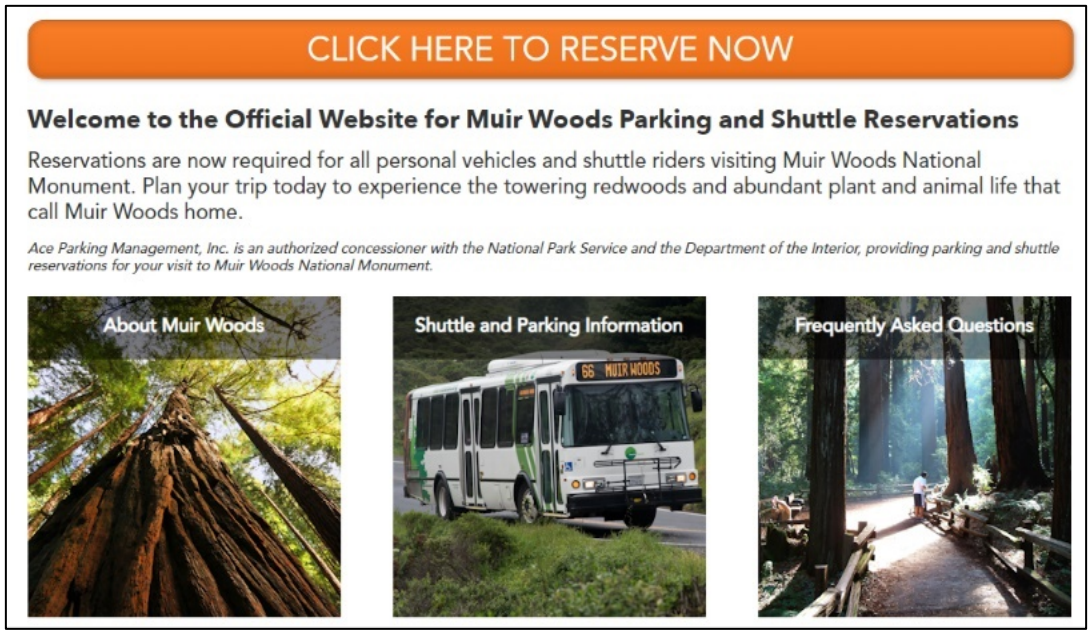

Figure 5: Example Muir Woods Website Screenshot (https://gomuirwoods.com)

Depending on final business rules, the website may also automatically e-mail a reminder of upcoming reservations (including visitor guidelines and suggestions) or allow users to cancel and/or refund a reservation. If cancellation is permitted, the cancellation policy may specify the number of days prior to a reservation that the reservation can be canceled or refunded.

To prevent fraud and abuse of the reservation system, the website will have the ability to limit the number of reservations made using the same IP address or credit card.

6.2.3 TYPE C – USERS EXEMPT FROM PAYMENT

If decided that certain users such as San Francisco residents are to be exempted from paying for a reservation, the website will need to direct these users to a unique page to make a non-paid reservation.

Depending on the verification method used, the website may need to include FAQs and instructions to make sure these users know how they are expected to obtain a non-paid reservation. Users who make a non-paid

reservation would likely follow the same steps described above for paid reservations, with the exception of the step to provide payment.

6.3 ADMINISTRATIVE ACCESS

Restricted access to the back-end system will be provided to allow for a variety of top-level administrative functions, including the ability to change configurable system parameters and to query the system for reporting purposes.

A preliminary list of parameters that will be configurable by administrators is shown below. Chapter 7 further describes how these parameters can be changed to affect performance of the system.

- Paid reservations:
  - Duration of reservation intervals
  - Amount of overlap between reservation intervals
  - Percentage of reservations to be released at specific times (e.g., 75% of reservations released one month prior, 20% of reservations released one week prior, and 5% of reservations released day of)
  - Number of reservations available within each reservation interval
  - Number of reservations permitted per unique user
- Hours of operation:
  - Beginning and ending times for each day of the week for which reservations will be made available
- Price:
  - Reservation price by time of day and by day of week

Administrators will also have access to reporting capabilities. The system will provide two types of reports: canned reports and ad-hoc reports. Canned reports include predetermined reports that are thought to be needed on a recurring basis and once configured can be easily generated by the system. Ad-hoc reporting allows administrators to specify a set of parameters used to query the system's database. Report information may be provided in the form of downloadable data sets or may be presented in a dashboard format.

6.4 ON-SITE OPERATOR ACCESS

Depending on the final design of the system and the need for verification, the back-end system will also provide access for system operators for the purpose of confirming reservations. This access may be provided via handheld devices that allow staff to input or scan unique reservation codes presented by users to pull up information that staff can use to verify the user. These devices could also allow data to be stored and transmitted to the back-end system for inventory management purposes. The following scenarios provide examples of how the on-site system could be used by staff to verify reservations.

- Type A Users (Residents) –If residents arrive without a decal, the handheld devices could also be used to pull up records of Crooked Street residencies to validate the arrival.
- Type A Users (Guests) – If needed, staff could use handheld devices to input or scan the codes on guest passes. The handheld devices will query the back-end system and provide staff with confirmation that the pass is valid. This functionality may be particularly useful to track the expiration date of guest passes.

- Type B and Type C Users (visitors with reservations) – The handheld devices could be used to verify the reservations presented to staff. Staff would use the handheld devices to key in or scan the unique reservation code and would be presented with information about the reservation, including whether the reservation is valid and whether the user has arrived within the designated window for their reservation.

In addition to aiding staff with verification of reservations, the handheld devices may also be used to collect and report information about the performance of the system as further described in the following section.

7 PERFORMANCE MONITORING

Once in operations, the Lombard Paid Reservations System will need to be monitored on an ongoing basis to ensure that the system is operating effectively. A robust performance monitoring regime will be established to ensure that performance metrics are regularly collected, monitored and reported so that action can be taken by the entity responsible for oversight. This chapter identifies the areas in which system performance should be monitored as well as the system parameters that can be changed to improve performance, with the intent of informing the future development of the technical requirements of the system.

7.1 DATA COLLECTION

Routine data collection will be required to monitor the performance of the Lombard Paid Reservations System. This data collection could be made part of the responsibility of on-site staff, collected automatically through the day-to-day operations of the system, and should be verified and audited via as-needed data collection teams composed of staff or contractors for the system administrator. The following is a preliminary list of data that is thought to be needed for performance monitoring purposes:

- Queue length
- Number of arrivals that are:
  - Without reservations
  - With reservations, but arrivals are outside of reservation window
- Number of reservations that are made but not used (no shows)
- How far in advance are reservations are being made
- If reservations are selling out, how far in advance they are selling out
- Time distribution of arrivals within reservation windows
- Number and type of citations issued at or around the Crooked Street, if any

7.2 CONFIGURABLE PARAMETERS

The Lombard Paid Reservations System will include configurable parameters that can be adjusted while the system is in operation to tweak the overall performance. The following list attempts to summarize these parameters into four (4) major categories:

- Pricing
  - Price for reservation slots by time of day and day of week
  - Price based on how far in advance the reservation is made
- Reservations
  - Time interval for reservation slots
  - Number of paid reservations offered per reservation slot
  - Amount of time between successive reservation slots (slots could be overlapping or could be spaced apart)
  - The amount of time before or after a reservation during which staff will allow the user to enter

- The system should allow for a specified percentage of reservations to be released at specified periods of time in advance of the reservation date
- Number of reservations a unique user is able to make during a given time frame (e.g. two reservations per calendar year)

- Hours of Operation
  - The hours during which reservations will be offered should be configurable by day of the week and by season
- Staffing
  - The number of on-site staff should be configurable by hour of day, day of week and by season

7.3 OPERATIONAL SCENARIOS

The subsequent sections cover potential scenarios that illustrate how the parameters described above can be utilized to manage the performance of the system. In addition, the last section introduces a series of recommended enforceable parameters that are aimed to safeguard the system from misuse.

7.3.1 QUEUE LENGTH

One objective of the Lombard Paid Reservations System is to ensure that queues do not extend beyond Larkin Street. As such, queue length will be a critical metric in defining the success of the system. The following reservation and staffing parameters could be adjusted to manage queues most effectively:

- Reservation slots offered per time frame:
  - The number of reservations offered per defined time interval could be lowered to limit the number of vehicles permitted to arrive at the site during any particular time frame if queue management becomes an issue.
  - Conversely, if it is found that a greater number of vehicles can be reliably accommodated per hour, the number of reservations offered per defined time interval could be increased to optimize the system.
- Reservation slot time parameters:
  - If it is found that vehicles are not arriving evenly across the recommended 30-minute time slot (e.g., most vehicles arrive within the first 10 minutes), the time interval for the reservation slots could be shortened to 20-minute or 15-minute increments. This adjustment may add additional predictability in vehicle arrivals, allowing staff to more effectively manage validating and routing motorists in a timely manner.
  - Similarly, the way in which reservations are staggered could be adjusted to allow less overlap between successive reservation slots. For example, instead of allowing reservation slots offered to overlap by 15 minutes, the overlap could be removed entirely to ensure that vehicle arrivals during one reservation slot do not adversely impact the previous reservation slot.
- Number of staff on site:
  - If vehicle queueing is a result of staff unable to manage vehicle arrivals in a timely manner, adding additional staff is another solution. If multiple staff members are responsible for verifying reservations, vehicle wait times could shorten and result in shorter queues. This solution may also provide balance if lowering the number of reservation slots is viewed as having a negative impact on tourism.

7.3.2 RESERVATION BOOKING

The Lombard Paid Reservations System will utilize an online system to manage and assign visitor reservations. The online reservation system should be designed to ensure the system is fairly distributing reservations to the public, and aiming to sell all available reservation slots within a reasonable time frame. The following are examples of system parameters that could be adjusted to improve the utilization of reservations.

- Adjusting the reservation price:
  - If particular time periods are found to be underutilized, the price of these slots could be lowered in an effort to attract more people to reserve during these times, provided that the price decrease does not compromise the ability of the system to cover operational costs. The recommended pricing provided in Section 4.1.3 is a baseline recommendation only. During operations, the system metrics may show that a lower price is necessary to book all available reservation slots, especially during off-peak times.
  - Conversely, if it is found that demand for particular time periods is so high that reservations sell out weeks or months in advance, the price of reservations could be increased. This may be more prominent during weekends and reservation slots during the middle of the day. Raising the price during periods of high demand may also have the effect of incentivizing some visitors to purchase cheaper reservation slots during less busy times.
- Staggering the availability of reservations:
  - Reservations may be released in groupings to ensure that reservations do not sell out too far in advance – an example being releasing 75% of bookings three (3) months in advance, and releasing the final 25% during the week or day-of the reservation. The percentage of reservations to release at specific times may need to be adjustable to obtain the ideal distribution and availability of reservations.

7.3.3 ARRIVALS WITHOUT RESERVATIONS

Recent surveys found that 75% of Crooked Street visitors are not from the Bay Area. These visitors present a significant challenge for the system, especially when it comes to informing and educating visitors of the new reservation requirements. One of the larger concerns is the potential for frequent arrivals of uninformed visitors without reservations, and their collective potential to slow down the system and create a negative experience for paying visitors. To track this issue, it is recommended that the number of vehicle arrivals without reservations be monitored on an ongoing basis. The following are example actions that could be taken to manage these concerns:

- Add more staff on-site:
  - Additional staff may be necessary to screen vehicles in advance of the Crooked Street entrance. Additional staff members could serve as additional resources to ensure visitors have a reservation prior to reaching the entrance and to direct vehicles that show up without a reservation away from the Crooked Street. If accomplished successfully, visitors without reservations would be directed out of the area as early and as often as possible.
- Increase marketing investments:
  - Additional funds for marketing and outreach materials could be made available to further educate visitors about the requirement to obtain a reservation before arriving at the Crooked Street. This type of outreach could be targeted to San Francisco tourism companies and other entities in the tourism industry. Metrics collected by the system can inform whether it may be necessary to ramp up these investments over time, or decrease them if there is no longer an apparent benefit.

- Allow on-site Payment:
  - Though it comes with significant operational and functional challenges, another potential solution is to allow vehicles that arrive without a reservation to pay on-site. The price charged for on-site arrivals would have to be higher than the paid reservation price and high enough to ensure that the vast majority of visitors choose to use the paid reservation system. The on-site payment approach has many drawbacks and is therefore only suggested if all other options are of no avail. The biggest drawback is the risk that vehicles showing up without a reservation could compromise the wait times of those who took the effort and paid to make a reservation, which could destabilize the paid reservation system entirely. The intent of the reservation system is to manage visitor frequency and subsequently vehicle queueing, which may no longer be possible if random, unexpected vehicle arrivals are permitted. There are also additional system components necessary to allow for on-site payment, including on-site payment processing or the potential for cash transfer between staff and visitors. These considerations will either incur additional operating costs, or introduce new opportunities for users to violate the system. For these reasons, this solution is not recommended.

7.3.4 NO-SHOWS AND EARLY/LATE ARRIVALS

Visitors who book a reservation through the online system may not arrive at the Crooked Street at all. There is also the potential that visitors arrive either early or late to their reservation. Depending on the frequency of these behaviors, the system parameters or business rules may need to be adjusted. The performance monitoring regime for the system should ideally record all no-show, early, and late occurrences, with the intent of tracking visitor behavior and optimizing the system. The following examples illustrate a few ways the system parameters and business rules could be adjusted depending the arrival patterns observed:

- Adjusting the grace period:
  - As discussed in Section 4.3.2, the preliminary recommendation is for there to be an allowable early/late arrival time, referred to as the grace period, during which staff would still permit vehicles access. Based on preliminary discussions with the National Park Service regarding the Muir Woods Reservation System, early arrivals were often observed. If this trend was also apparent at the Crooked Street, early arrivals on the Crooked Street may stall the processing speed of reservations from the previous time slot even though some slots are held back to account for a certain number of such arrivals. Similarly, vehicles arriving within the grace period may stall the processing speed of the subsequent time slot. To combat these potential issues, it may be necessary to narrow the grace period for early/late arrivals.
  - Conversely, if many vehicles arrive outside of the grace period, the system operator may elect to increase the grace period. It should be noted that increasing the grace period must be evaluated to ensure it does not adversely affect the operation of the neighboring time windows, or visitor adherence to their agreed upon reservation slot.
- Increasing reservation slots offered per time frame:
  - If the system records a significant number of no-shows during a specific weekday or time window, it may be possible for the system to increase the number of available reservation slots during these times. Similarly, if the system tracks a significant number of disallowed late arrivals, the operators may elect to increase the number of available slots knowing a certain percentage of visitors will arrive late and be denied entrance to the Crooked Street. In either scenario, the operator must ensure the reservation slots made available never exceed the processing capacity of the street, and that all changes adhere to the primary mission of the reservation system, which is to manage vehicle congestion and shorten the queues on Lombard Street to provide a smooth, predictable experience for both residents and visitors.

7.3.5 ENFORCEMENT CONSIDERATIONS

The Lombard Paid Reservations System may face challenges associated with misuse and deliberate violation. To combat these potential issues, the system will need to be designed to a reasonable, enforceable level. The following parameters have been identified as baseline recommendations for the system:

- Resident Decal/Pass:
  - The decal/pass is valid for a one (1) year period
  - The decal/pass must include an identifier that can be used to verify the validity of the decal.
  - Households on the Crooked Street and Montclair Terrace are allocated four (4) resident decals each, individually assigned to one (1) unique vehicle license plate.period.
  - The pass must include an identifier that can be used to verify the validity of the pass.
  - The number of passes issued per residence/household will be limited.
- Frequent Guest Pass:
  - The pass is valid for a one (1) year period.
  - The pass must include an identifier that can be used to verify the validity of the pass.
  - The number of passes issued per residence/household will be limited.
  - Frequent Guest Passes may be limited to a specific individual, a specific vehicle, or neither.
- Reservations – Type B and Type C:
  - Reservations are only valid during the assigned 30-minute reservation, plus or minus the 15-minute grace period.
  - Reservations must include an identifier that can be used to verify the validity of the reservation.
  - Once processed, the system shall have a way of marking the reservation as used and not allow it to be used more than once.
  - The system shall have ways to ensure that individuals are not able to purchase multiple reservations. This could be accomplished by putting a limit on the number of reservations that can be obtained from an individual IP address, credit/debit card number, and/or billing address.
  - If a decision is made to allow Type C visitors (those who must reserve but not pay), the system shall have a way of verifying that individuals who reserve Type C reservations meet the exemption requirements. This may involve integration with databases of exempt users or verification of exempt status by staff on site. If verification is done on site, staff must be provided a list of items that can be used to prove the exemption and a process to follow if verification is unclear.

8 ROLES AND RESPONSIBILITIES

The implementation and operation of the Lombard Paid Reservations System will require collaboration between several stakeholders, including the system operator and supporting San Francisco agencies. This section describes the roles and responsibilities each entity will have during the development and operational phases of the Lombard Paid Reservations System.

8.1 SYSTEM OPERATOR

The system operator will be the agency responsible for delivering the system and conducting day-to-day operations of the Lombard Paid Reservations System. Enabling legislation for the program (AB 1605, Ting, 2019) calls for the San Francisco Board of Supervisors to designate the agency or board that would act as the system operator and would go into effect on January 1, 2020. The system operator cannot be identified until this legislation is approved by the California Assembly, Senate, and Governor, and this action is taken by the Board of Supervisors. Until then the SFCTA will be the lead agency advancing implementation. Potential system operators include each agency listed below, and the system operator role will require the coordination with all of the described stakeholders in this chapter. Roles and responsibilities for the system operator may include:

- Designing, implementing, operating and maintaining the online/phone system
- Operating and administering the on-site operations of the system
- Monitoring and reporting on system performance
- Collection and distribution of operating revenue
- Protecting personally identifiable information

Pending future decisions, the system operator may enter into an agreement with private contractors to provide all or some of the system elements.

8.2 SAN FRANCISCO COUNTY TRANSPORTATION AUTHORITY

The San Francisco County Transportation Authority (SFCTA) is responsible for planning, funding, and delivering transportation projects throughout San Francisco. SFCTA is governed by a board consisting of the 11 members of the San Francisco Board of Supervisors, sitting as Transportation Authority board members..

SFCTA has been the lead agency of studies conducted over the past five years on the Crooked Street, leading the *Lombard Study: Managing Access to the "Crooked Street" Final Report* and several data collection efforts to better understand the concerns of residents and the characteristics of visitors. Together, these efforts have led to the development of the pricing and reservation system outlined in this report. The role of SFCTA in the implementation and operation of the Lombard Paid Reservations System is not yet defined, and may change throughout the development of the project. SFCTA's current roles related to the Lombard Paid Reservations System include:

- Overseeing the development of the Lombard Paid Reservations System Concept of Operations
- Assisting with state legislation that would allow the Lombard Paid Reservations System.

8.3 SAN FRANCISCO MUNICIPAL TRANSPORTATION AGENCY

The San Francisco Municipal Transportation Agency (SFMTA) is responsible for managing all ground transportation in San Francisco. SFMTA is led by a 7-member board and over 4,500 staff members, headquartered at 1 Van Ness Avenue in San Francisco.

SFMTA has been a key stakeholder and contributor throughout the development of the initial Crooked Street studies and throughout the development of the pricing and reservation system outlined in this report. The role of SFMTA in the Lombard Paid Reservations System is not yet defined, and may change throughout the development of the project. SFMTA's current roles related to the Lombard Paid Reservations System include:

- Providing input on the development of the Lombard Paid Reservations System Concept of Operations
- Providing parking control officers (PCOs) to manage vehicle and pedestrian congestion around the Crooked Street
- Managing and updating signage and parking restrictions near the Crooked Street

Pending future decisions, SFMTA may be required to enter into an agreement with the system operator to provide these services.

8.4 SAN FRANCISCO POLICE DEPARTMENT

The San Francisco Police Department (SFPD) is responsible for the safety and well-being of residents in San Francisco. SFPD roles related to the Lombard Paid Reservations System will likely include:

- Coordinating response functions related to incidents/disruptions on the Crooked Street
- Performing on-site enforcement of the system
- Enforcing motor vehicle violations

Pending future decisions, SFPD may be required to enter into an agreement with the system operator to provide these services.

8.5 SAN FRANCISCO DEPARTMENT OF TECHNOLOGY

The San Francisco Department of Technology (SFDT) is responsible for providing technology services to San Francisco agencies. The role of SFDT in the Lombard Paid Reservations System is not yet defined, and may change throughout the development of the project. SFDT roles related to the Lombard Paid Reservations System may include:

- Providing infrastructure and connectivity for system components reliant on technology

8.6 SAN FRANCISCO PLANNING DEPARTMENT

The San Francisco Planning Department (SF Planning) sets the framework for San Francisco's land use and plays a significant role in community planning and development activities in the city. SF Planning is the entity that may

guide the environmental clearance process for the system. Though the role of SF Planning in the Lombard Paid Reservations System is not yet defined, SF Planning roles related to the Lombard Paid Reservations System may include:

- Providing environmental clearance for new, on-site infrastructure, including signage and traffic changes

8.7 SAN FRANCISCO PUBLIC WORKS

San Francisco Public Works (SFPW) is responsible for planning, financing, and delivering public infrastructure projects in San Francisco. If on-site facilities were either modified or constructed as part of the project, SFPW would need to be engaged in the project. Given that these facilities may or may not be required, the role of SFPW in the Lombard Paid Reservations System is not yet defined. SFPW roles related to the Lombard Paid Reservations System may include:

- Providing permits for construction of new facilities

8.8 REQUIRED AGREEMENTS

The stakeholders involved in the Crooked Street project have been working to establish the foundation for a paid reservation system. One of the larger parts of this effort has come in the form of initiating legislation that allows the ability to conduct a reservation and pricing program on the Crooked Street. On April 16th, 2019, the San Francisco Board of Supervisors passed a resolution of support for AB 1605. The bill is now making its way through the state legislative process.

In addition to authorizing legislation, other example required agreements are likely to include:

- Cost and revenue sharing amongst entities providing services for the Lombard Paid Reservations System
- Provision of services from vendors/contractors to deliver and operate the Lombard Paid Reservations System

APPENDIX

APPENDIX

A-1 TITLE