Memorandum

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To	Andrew Heidel, Camille Guiriba (SFCTA)	Date	January 10, 2019
Copies		Reference number	262316
From	Megan Gee, Justin Walker (Arup)	File reference	4-05
Subject	Lombard Crooked Street Data Collection- Data Collection Summary		

As part of the Lombard Crooked Street Reservation and Pricing Study, this memorandum summarizes findings from data on pedestrian and car traffic collected on and around the Lombard "Crooked Street" from August 10, 2018 through October 16, 2018.
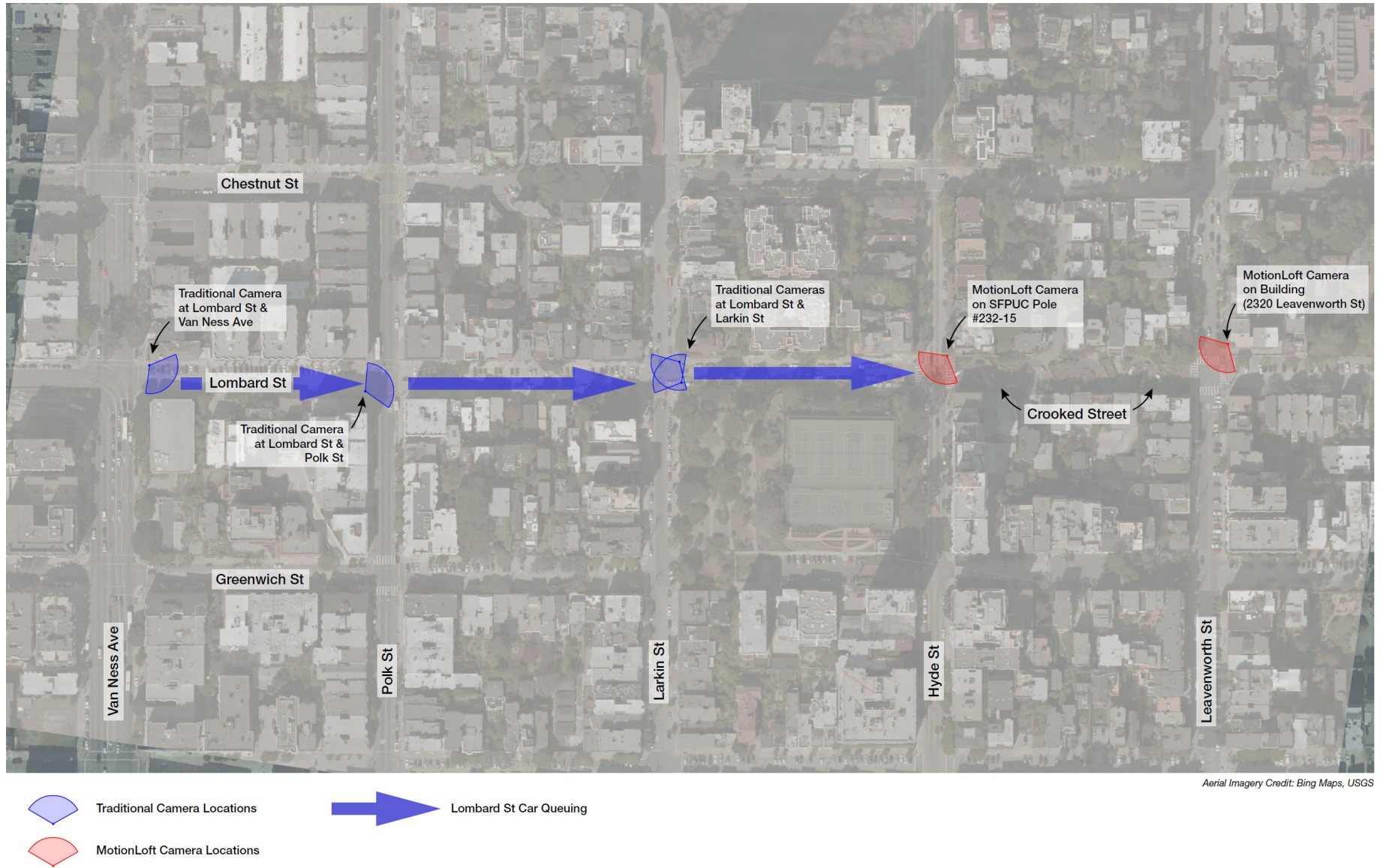
Data collection included:
- Video cameras observing car queuing along Lombard St. upstream of the Crooked Street
- Motionloft video detection devices to report pedestrian and vehicle volumes and dwell times taken via Motionloft at two intersections
- Traffic travel time data from the Google Directions API to supplement the traffic counts directly taken by the Motionloft cameras
- Intercept surveys targeting both motorists visiting the Crooked Street

Summary findings from the intercept survey are separately discussed in the memorandum "Intercept Survey Findings Summary."

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1   Data Collection Elements

Figure 1 summarizes the overall collection effort by data source.

Figure 1- Data Collection Summary

Primary video observation of car queuing was performed on Friday, August 17 through Sunday, August 21. (As part of a previous effort to validate travel time and queuing data reported via the Google Directions API, preliminary queuing video was also taken on Saturday, August 4; this video data is not used as part of the analysis discussed in this memo.)

Motionloft cameras gathered continuous data on pedestrian and car traffic from late August through mid-October (the exact duration varied slightly by location and mode, as noted in Figure 1).

Figure 2 shows the location of traditional and Motionloft cameras as placed in the field for this data collection exercise.

The project team also harvested real-time travel time estimates via the Google Directions API for each relevant roadway link in the project study area between August 10th and September 28th, with some gaps in coverage (owing to technical difficulties originating from the API itself). The most useful data was reported between August 10th and September 3rd.

The project team administered intercept surveys in the field to motorists visiting the Crooked Street on Saturday, August 7 and Sunday, August 8. Greater discussion and summary findings from the intercept survey are separately discussed in the memorandum "Intercept Survey Findings Summary."

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Figure 2- Camera Detector Locations for Pedestrian and Car Detection

Aerial Imagery Credit: Bing Maps, USGS

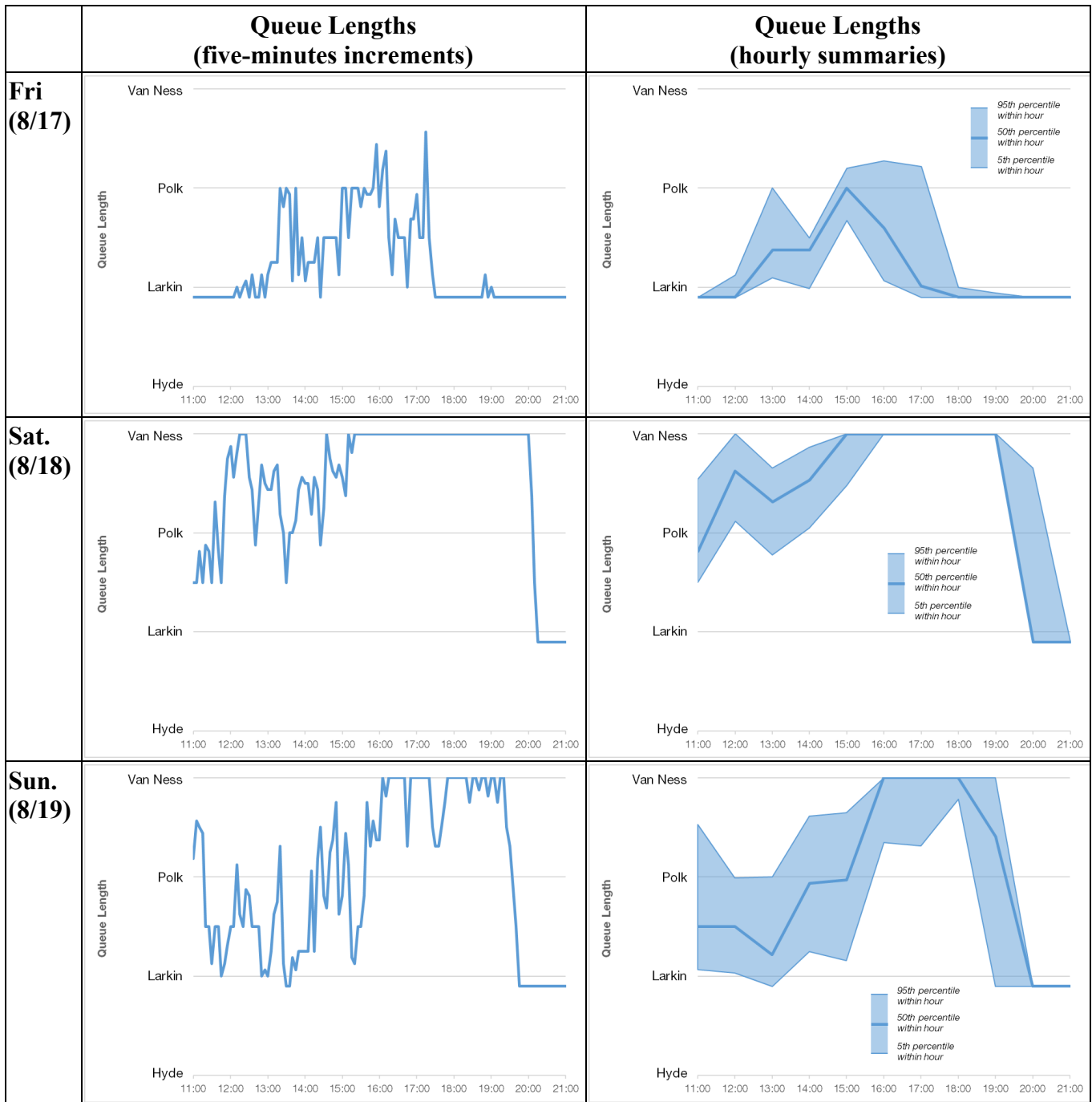Traditional Camera Locations — Lombard St Car Queuing

MotionLoft Camera Locations

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2   Video of Car Queuing

Conventional cameras placed in the field (see Figure 2) between Lombard St between Van Ness Ave and Larkin St. observed queuing from 11 AM to 9 PM on three dates:

- Friday, August 17
- Saturday, August 18
- Sunday, August 19

The project team observed the video and manually recorded queue lengths. Table 1 shows both raw observations of car queue length (reported in five-minute increments) and queue lengths aggregated by hour. Note that these video observations are bounded by a minimum reported queue length (e.g., not reaching Larkin St.) and a maximum queue length (e.g., extending beyond Van Ness Ave). Queue lengths for when the queues did not reach Larkin St. are estimated by cross-referencing this video data with Google Directions API data (see Section 4).

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Table 1- Video-Observed Car Queue Lengths on Lombard St

	Queue Lengths (five-minutes increments)	Queue Lengths (hourly summaries)
Fri (8/17)		
Sat. (8/18)		
Sun. (8/19)		

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3   Motionloft Pedestrian and Car Volumes

Motionloft cameras gathered continuous data on pedestrian and car volumes at the intersections of Lombard St & Hyde St and Lombard St & Leavenworth St from late August through mid-October (the exact observation period for each camera varied slightly).

Table 2 shows pedestrian volumes reported by Motionloft cameras at the two intersections. (In the case of Lombard St & Leavenworth St, pedestrian volumes are reported as either passing through the eastern crosswalk or the northern crosswalk, the two crosswalks observed by a Motionloft camera.) Table 3 shows car volumes reported by Motionloft cameras at the two intersections.

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Table 2- Motionloft-Reported Pedestrian Activity

Lombard St & Hyde St	
Lombard St & Leaven-worth St	

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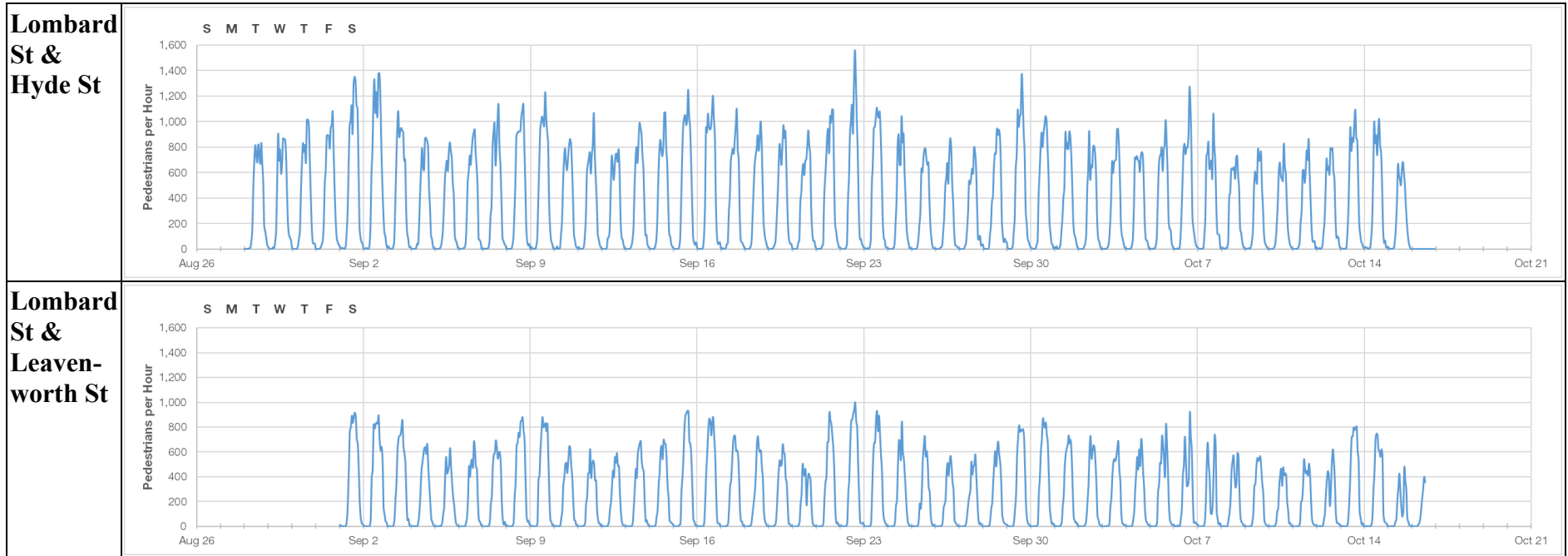
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Table 3- Motionloft-Reported Car Activity

Lombard St & Hyde St	
Lombard St & Leaven-worth St	

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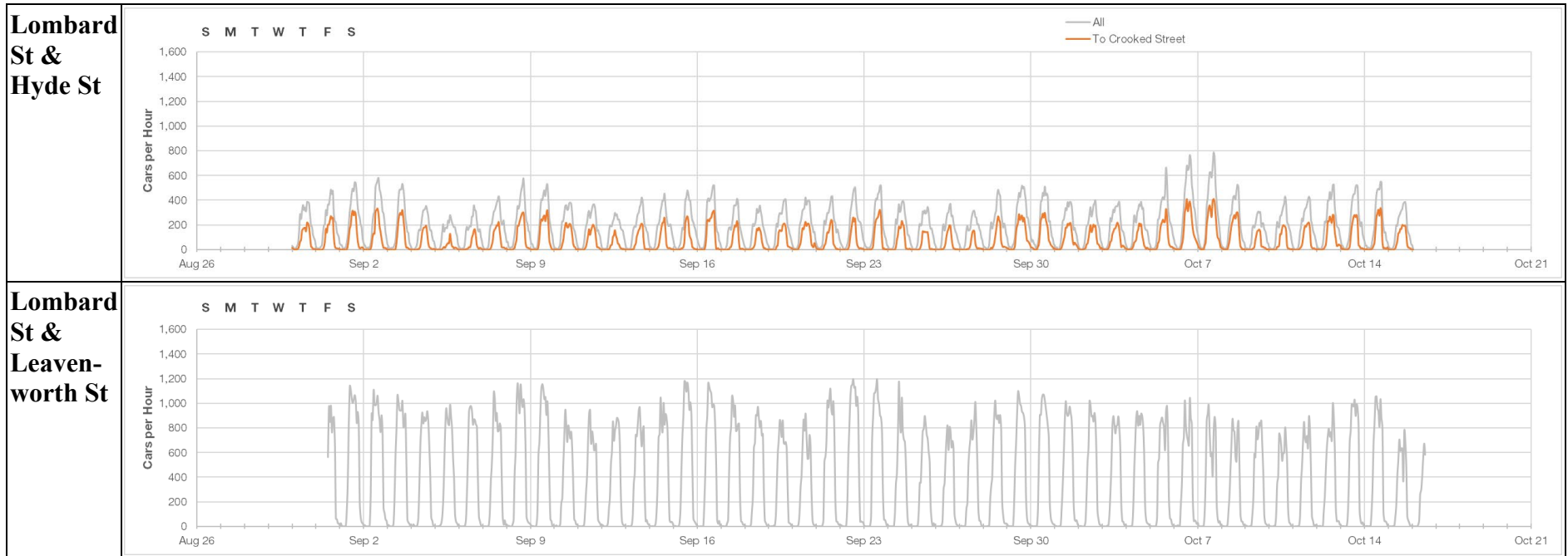
4   Motionloft Pedestrian Behavior

Motionloft cameras also reported detailed information on pedestrian behavior within the intersections of Lombard St & Hyde St and Lombard St & Leavenworth St.

The following figures are visual representations of the pedestrian data collected via the Motionloft cameras. Figures 3 and 4 show "pedestrian tracks" indicating the paths of all observed pedestrians during the course of a typical hour. Figures 5 and 6 are heatmaps that summarize the pedestrian track information and indicate the relative intensity of pedestrian activity throughout each intersection. Representative times are shown for each intersection in the interest of visual clarity.

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Figure 3- Example Pedestrian Tracks- Lombard St & Hyde St
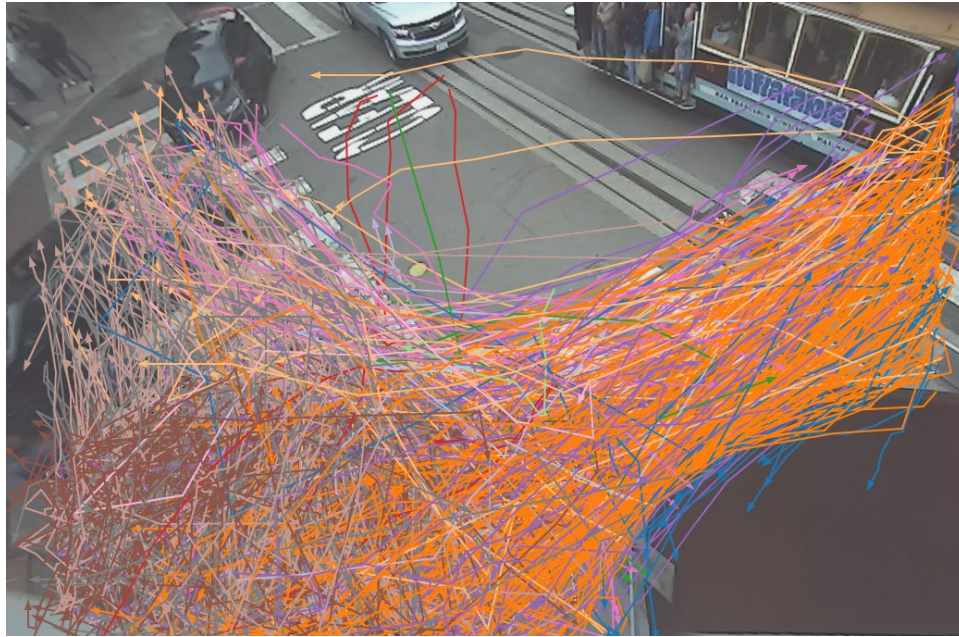
Tracks above represent pedestrian movements between 2 PM and 3 PM on Saturday, September 15, 2018.

**Figure 4- Example Pedestrian Tracks- Lombard St & Leavenworth St**
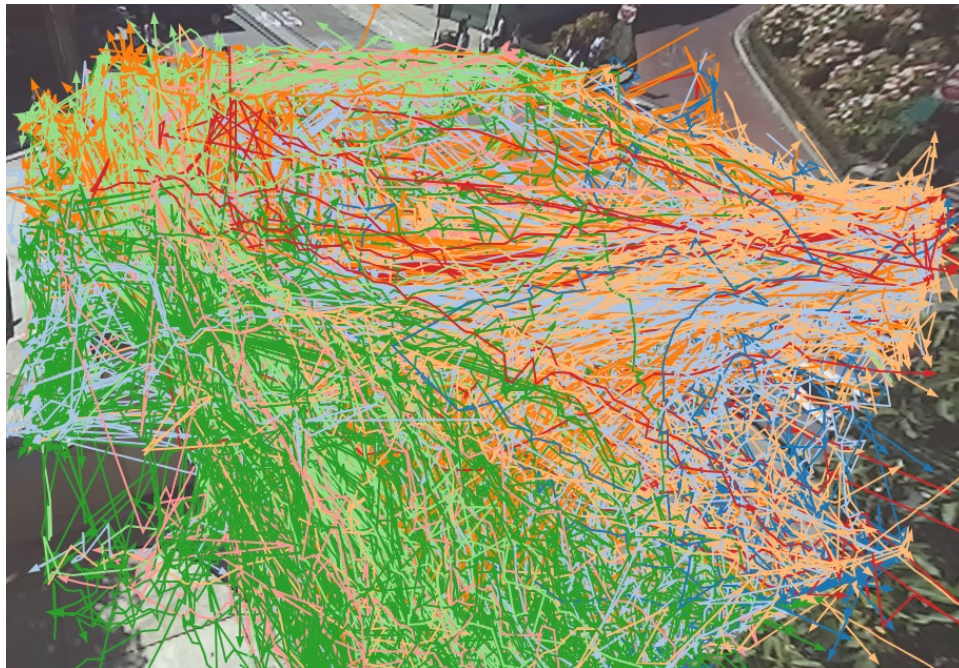
Tracks above represent pedestrian movements between 2 PM and 3 PM on Saturday, September 15, 2018.

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Figure 5- Pedestrian Activity Heat Map- Lombard St & Hyde St
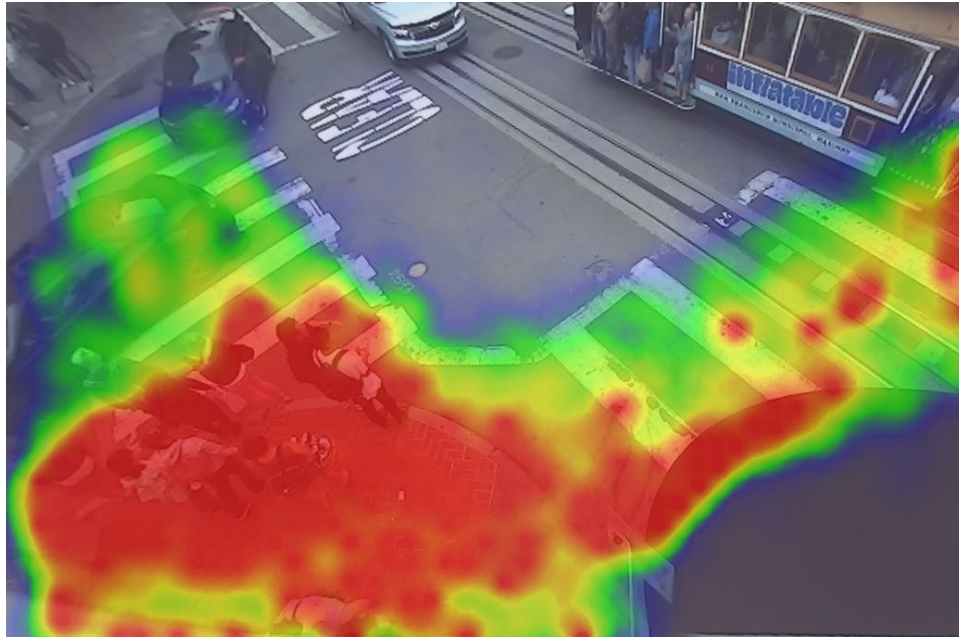
Tracks above represent pedestrian movements between 2 PM and 3 PM on Saturday, September 15, 2018.

Figure 6- Pedestrian Activity Heat Map- Lombard St & Leavenworth St
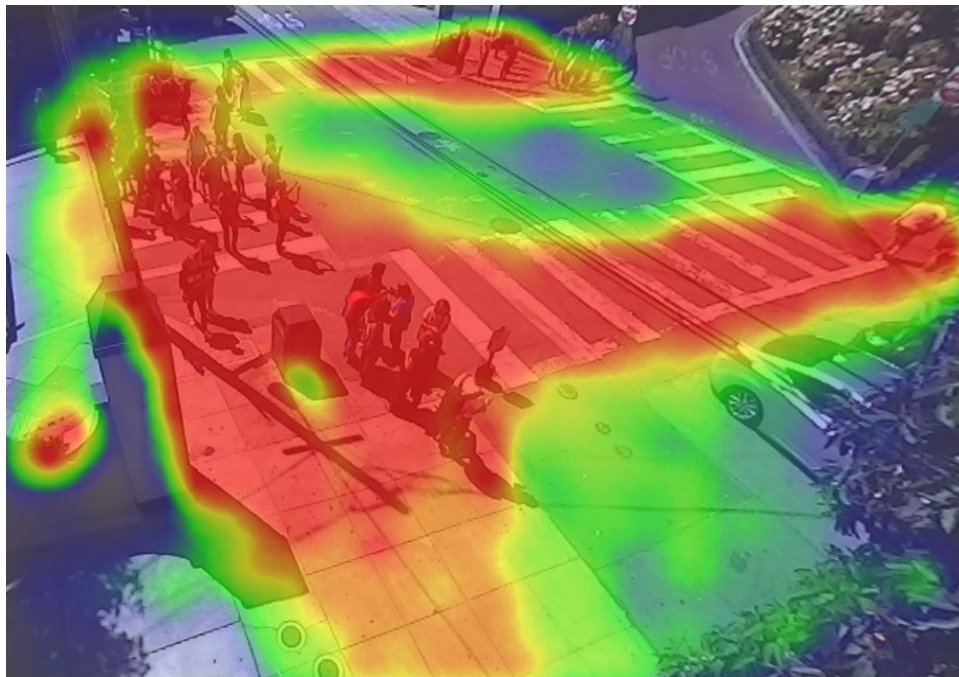
Tracks above represent pedestrian movements between 2 PM and 3 PM on Saturday, September 15, 2018.

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The eastern crosswalk at the intersection of Lombard St and Hyde St and the eastern crosswalk at the intersection of Lombard St and Leavenworth St each are key conflict points adjacent to the Crooked St. These crosswalks serve large volumes of crossing pedestrians and cars entering or exiting the Crooked Street. The Motionloft cameras reported existing conditions of these key. Figure 7 shows the average hourly pedestrian occupancy of the eastern crosswalk at the intersection of Lombard St and Leavenworth St.

Figure 7- Lombard St & Leavenworth St Eastern Crosswalk Average Hourly Pedestrian Occupancy
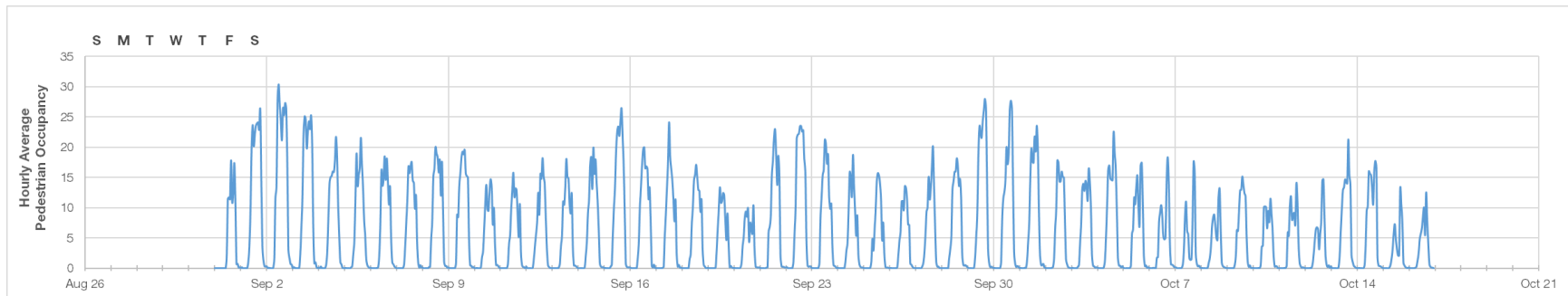
The project team also observed and analyzed the average occupancy time (and crossing time) in each of the two crosswalks on a typical Saturday (September 15, 2018).

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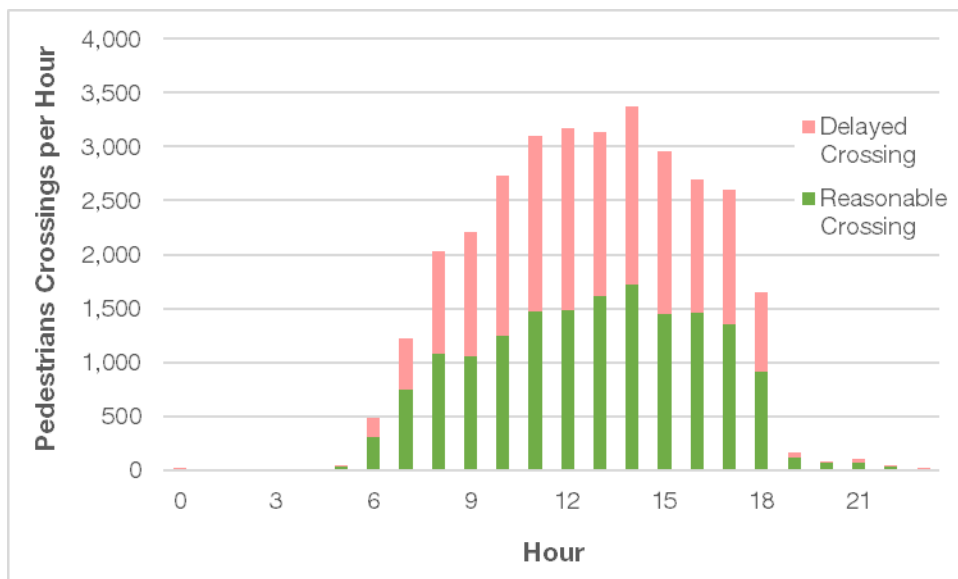
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At the eastern crosswalk of Lombard St & Hyde St, a pedestrian traveling at the benchmark speed of 3 ft/sec can traverse the Motionloft-detected portion of the crosswalk in 8.2 seconds. As shown in Figure 8, the vast majority of pedestrians (over 84%) crossed this crosswalk in a timely manner (in under 10 seconds) without blocking the crosswalk unnecessarily.

**Figure 8- Average Crosswalk Occupancy Time –
Lombard St & Hyde St Eastern Crosswalk**
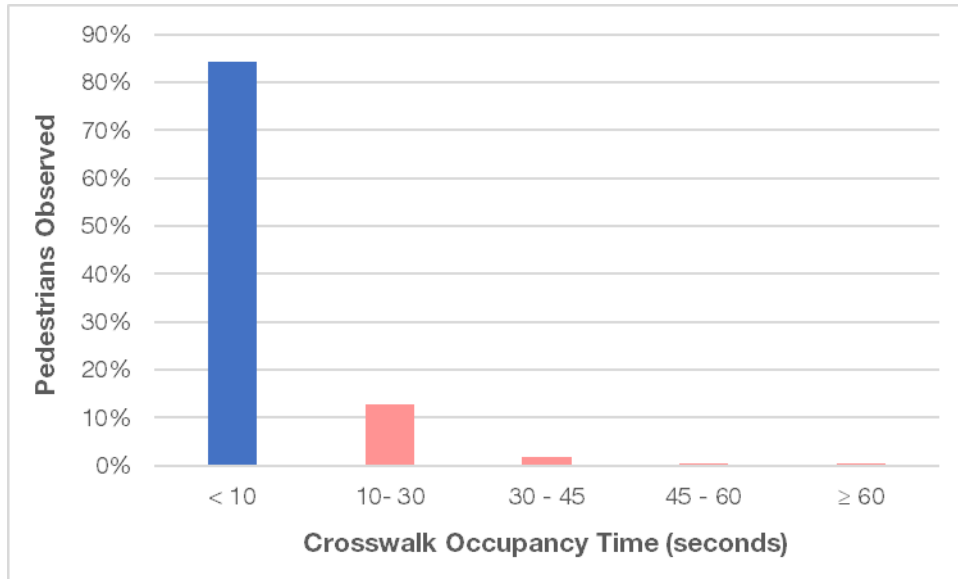
Crosswalk occupancy observed throughout all of Saturday, September 15, 2018.

**Figure 9- Crosswalk Crossings per Hour –
Lombard St & Hyde St Eastern Crosswalk**
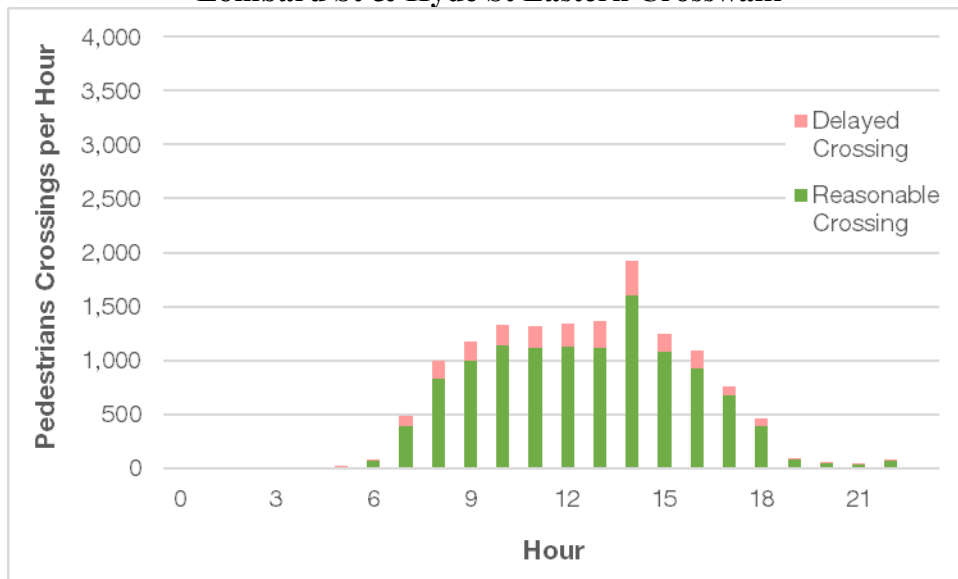
Crosswalk occupancy observed throughout all of Saturday, September 15, 2018.

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At the eastern crosswalk of Lombard St & Leavenworth St, a pedestrian traveling at the benchmark speed can traverse the Motionloft-detected portion of the crosswalk in 13.3 seconds. As shown in Figure 10, only approximately half of pedestrians (approximately 51%) crossed this crosswalk in a timely manner (in under 10 seconds) without blocking the crosswalk unnecessarily. The median observed crossing time is 15 seconds and the average observed crossing time is 25 seconds.

**Figure 10- Average Crosswalk Occupancy Time –
Lombard St & Leavenworth St Eastern Crosswalk**
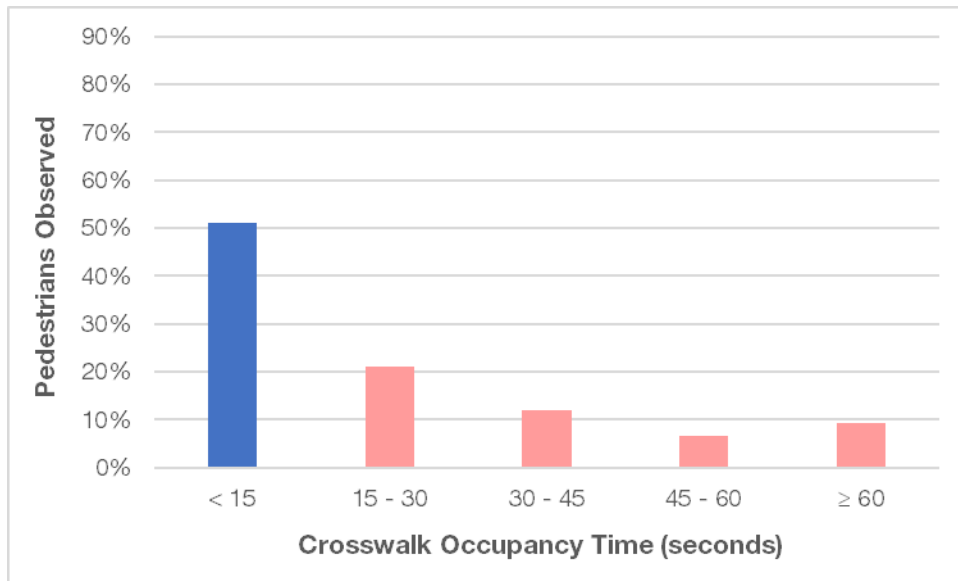
Crosswalk occupancy observed throughout all of Saturday, September 15, 2018.

**Figure 11- Crosswalk Crossings per Hour –
Lombard St & Leavenworth St Eastern Crosswalk**

Crosswalk occupancy observed throughout all of Saturday, September 15, 2018.

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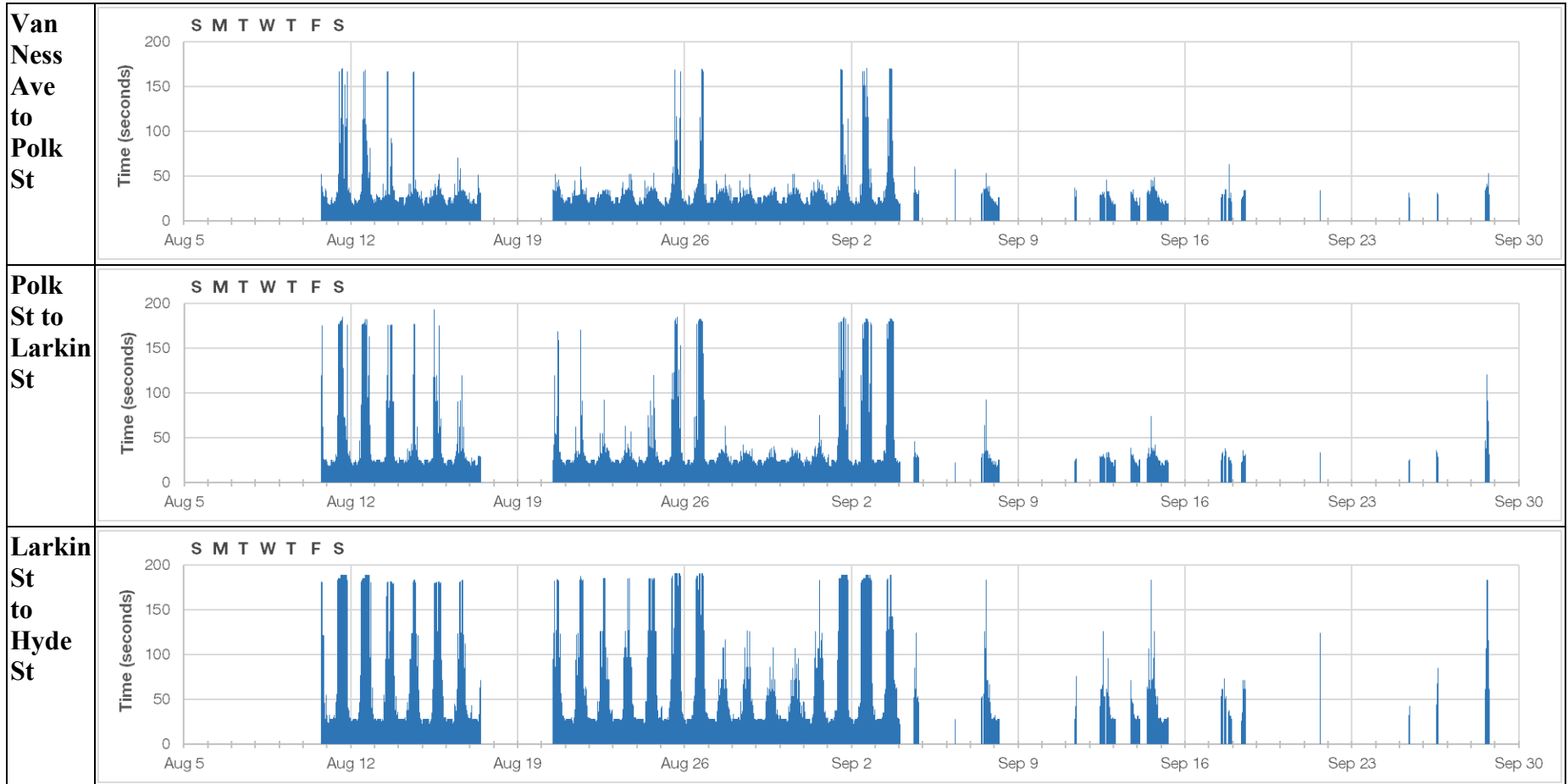# Memorandum

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5   Google Directions API

The project team harvested real-time travel time estimates via the Google Directions API for each relevant roadway link in the project study area between August 10th and September 28th.

5.1   Lombard Street (upstream of the Crooked Street)

As discussed in the memorandum "Lombard Data Collection traffic/queuing measurement approach and Google Directions API ground-truthing," portions of Lombard St upstream of the Crooked Street experience extremely low average travel speeds (less than ¼-mile per hour) and extremely low traffic volumes (less than 30 cars per hour) while queued.
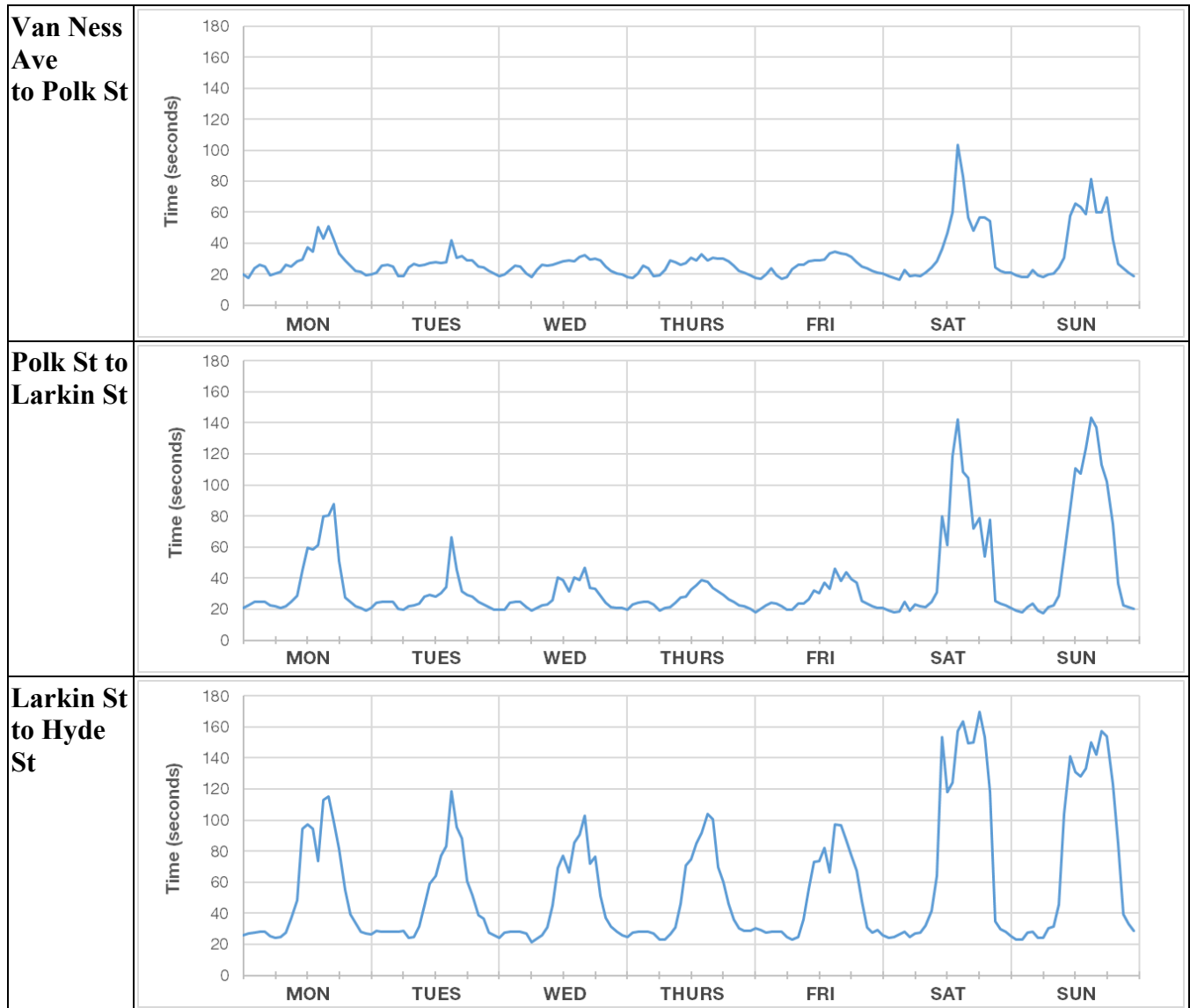
On links with extremely low average travel speeds and/or extremely low volumes, the Google Directions API has been observed to drastically underestimate travel times. However, the estimated travel times reported by the Google Directions API are useful for estimating the "relative congestion" (i.e., the congestion of a roadway link relative to other times of the week and within the bounds of traffic performance as directly observed in the field) of a given roadway link at particular times. Raw travel times reported for Lombard St are reported in Table 4.

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Table 4- Google-Directions-API-Reported Travel Times on Lombard St (Raw Data)

Van Ness Ave to Polk St	
Polk St to Larkin St	
Larkin St to Hyde St	

While the span of data gathered via the Google Directions API was more limited that intended (owing to technical difficulties originating from the API itself), sufficient data was collected to develop general weekly congestion profiles for the relevant roadway links. The most useful data was reported between August 10th and September 3rd. Table 5 reports an average weekly profile based on the above raw travel times reported above.

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**Table 5- Google-Directions-API-Reported Travel Times on Lombard St
(Average Weekly Profile)**

|	
Van Ness Ave to Polk St	
Polk St to Larkin St	
Larkin St to Hyde St	

The data in Table 5 is consistent with the anecdotal reports of car queuing on Lombard Street upstream of the Crooked Street. Every day, some queuing (and, resulting congestion) occurs on the first block immediately upstream of the Crooked Street (Larkin St to Hyde St). On some days (generally Saturday through Tuesday), the queuing extends an additional block further upstream (Polk St to Larking St) for portions of the day. Often on Saturdays and Sundays, the queuing was observed extending a third block (Van Ness Ave to Polk St) for most of the day.

Consistent with previous discussion above regarding the reliability of Google Directions API travel times, the project team performed a benchmarking exercise to relate the travel time data with known field conditions. Travel times reflecting free-flow speeds (in this case, approximately 20 seconds) can reasonably be assumed to correlate with little or no queuing on a block. However, understanding raw

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travel time outputs from the Google Directions API to be less reliable on highly-congested roadway links, the project team identified raw travel time outputs above 70 seconds on a given block to correlate with the block being completely full of queued cars. Interpreting the travel time data according to these constraints, a weekly profile of average queue length can be estimated, as shown in Table 6.

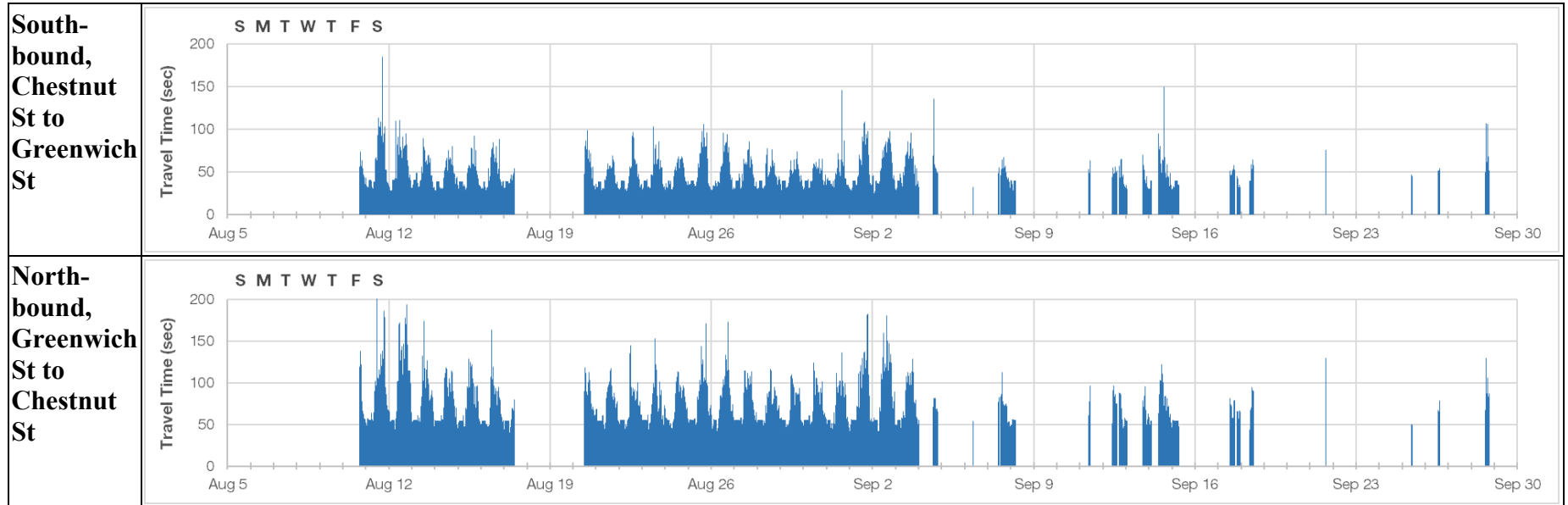**Table 6- Google-Directions-API-Inferred Overall Average Queue Length**
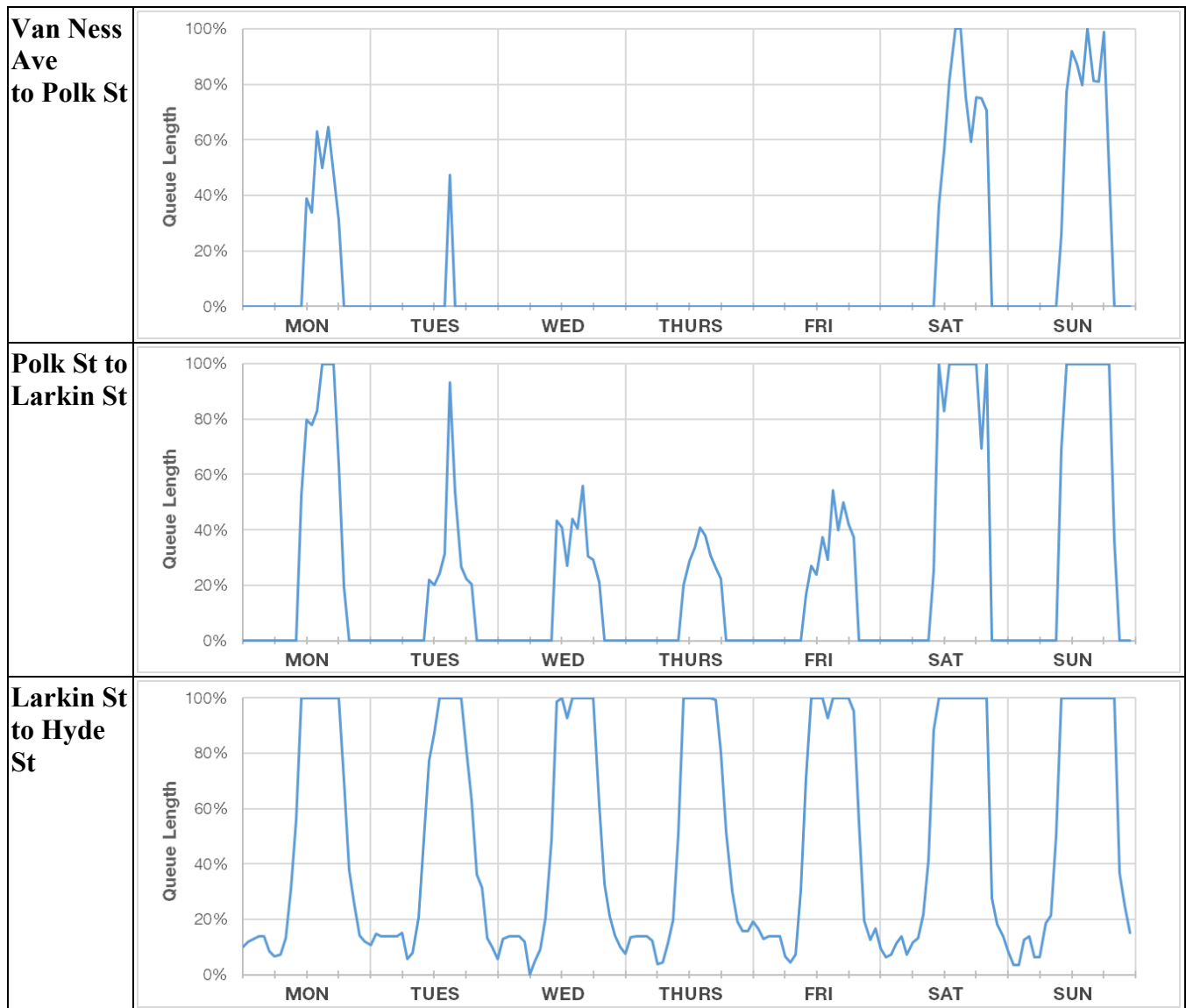
Note: Queue lengths report length of each block in queue; for reference, each block can queue approximately 16 cars along each 400-ft block.

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5.2 Hyde St (and Cable Car operations)

As a supplementary exercise, travel time estimates for Hyde St immediately north and south of the Crooked Street were also harvested via the Google Directions API with the goal of estimating congestion encountered by cable cars on the Powell/Hyde St Cable Car line. Raw travel times reported for Hyde St are reported in Table 7.

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Table 7- Google-Directions-API-Reported Travel Times on Hyde St (Raw Data)

South-bound, Chestnut St to Greenwich St	
North-bound, Greenwich St to Chestnut St	

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As with data collected along Lombard St, the span of data gathered via the Google Directions API was more limited that intended. However, sufficient data was collected to develop general weekly congestion profiles for the relevant roadway links. The most useful data was reported between August 10th and September 3rd. Table 8 reports an average weekly profile based on the above raw travel times reported above.

Table 8- Google-Directions-API-Reported Average Travel Times on Hyde St
(Average Weekly Profile)

Southbound, Chestnut St to Greenwich St	
Northbound, Greenwich St to Chestnut St	
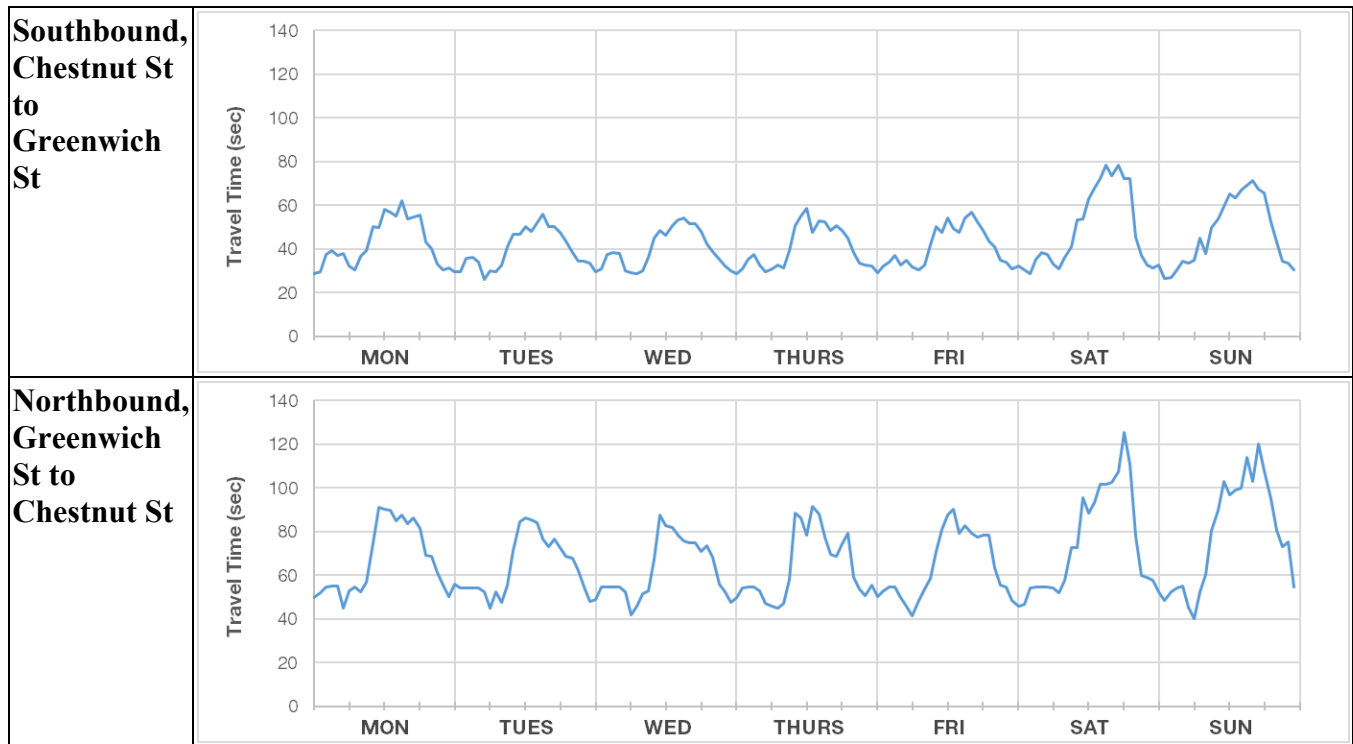
The same data above is also expressed as average speeds and shown in Table 9.

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Table 9- Google-Directions-API-Reported Average Speeds on Hyde St
(Average Weekly Profile)

Southbound, Chestnut St to Greenwich St	
Northbound, Greenwich St to Chestnut St	
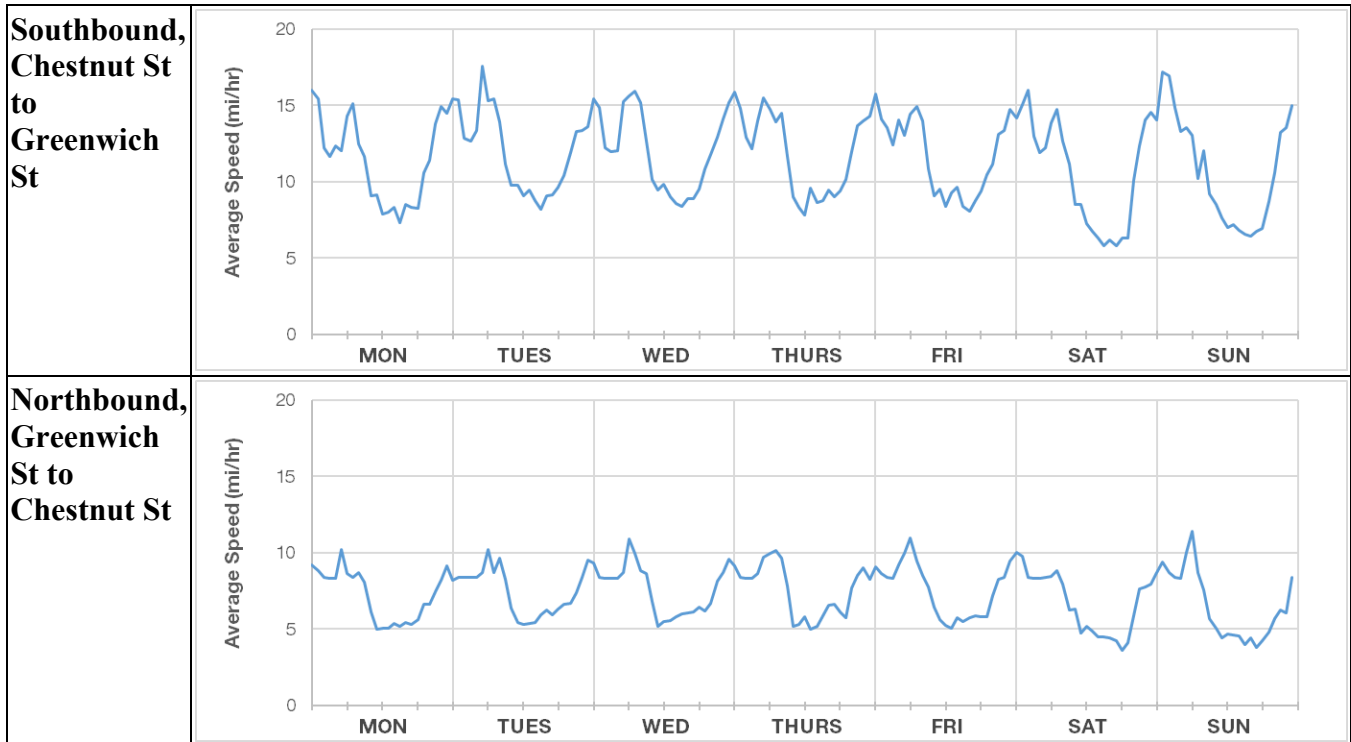
From the above tables, northbound Hyde St consistently experiences some congestion during mid-day every day of the week. Further, the greatest congestion consistently occurs on Saturdays and Sundays.

Notably, southbound Hyde St has consistently slower average speeds (and consequently, greater travel times) than does southbound Hyde St.

6   Weekly Profiles

Figures 12 through 14 below summarize the data collection effort in the form of average weekly profiles of visitor traffic (pedestrian and car) and car queuing upstream of the Crooked Street. In general, greater visitor activity and car queuing occurs during daylight hours throughout the week. However, visitor activity and car queuing are greatest during daylight hours on Saturday and Sunday. During these times, car queuing upstream of the Crooked Street extend to and beyond Van Ness Ave nearly continuously for over six hours.
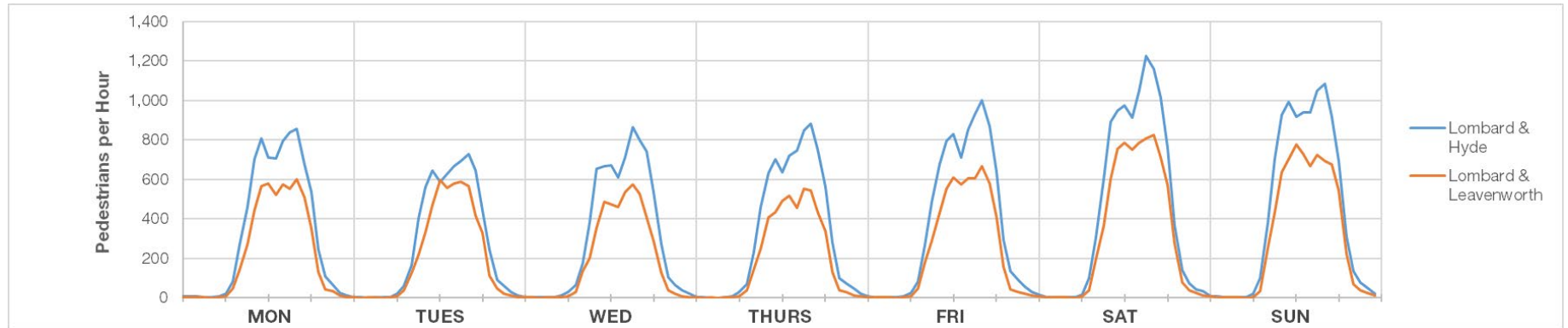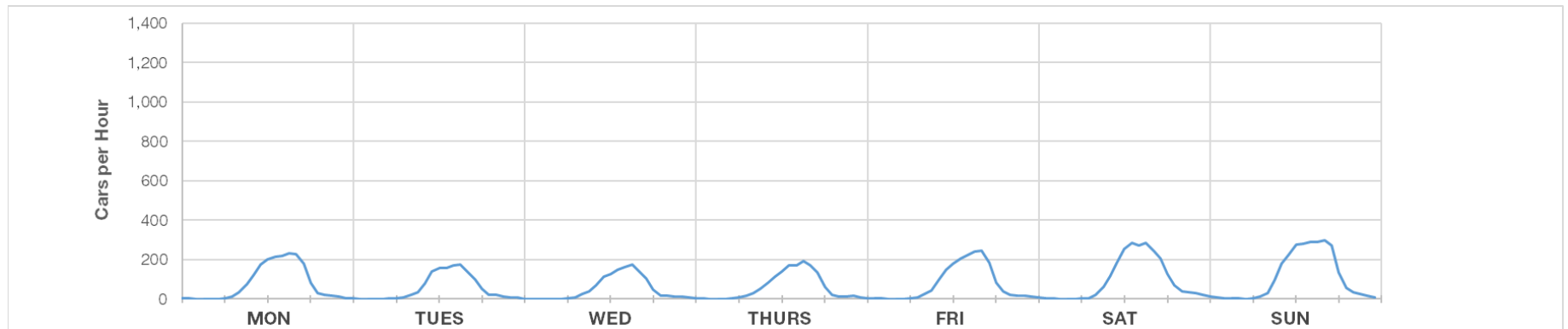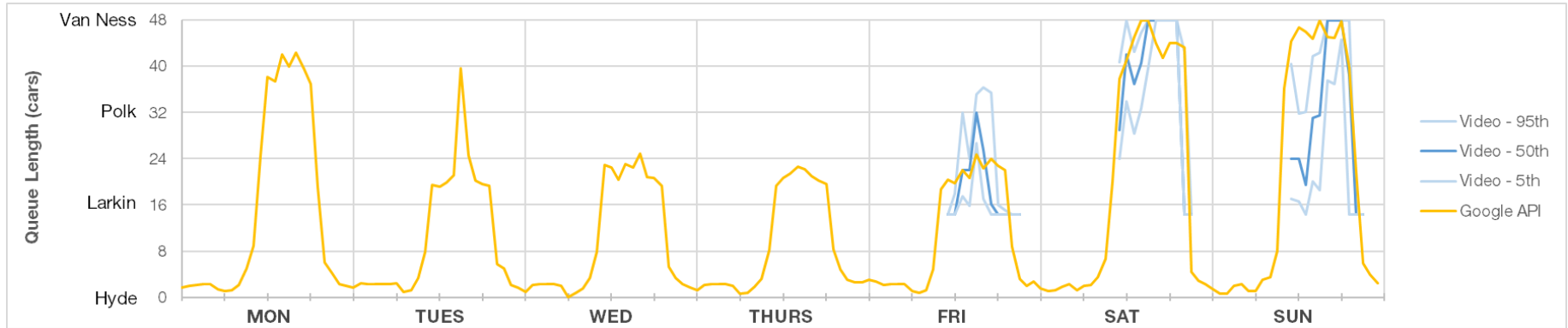
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Figure 12- Crooked Street Pedestrian Visitors

Figure 13- Crooked Street Car Traffic

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Figure 14- Car Queuing Upstream of the Crooked Street

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To	Andrew Heidel, Camille Guiriba (SFCTA)	Date October 11, 2018
Copies	Keith Tanner (SFMTA)	Reference number 262316
From	Chester Fung, Justin Walker (Arup)	File reference 4-05
Subject	Lombard Crooked Street Data Collection- Intercept Survey Findings Summary	

This memorandum summarizes findings from an intercept survey administered to visitors of the Lombard Street "Crooked Street." The team administered the survey over two days (Saturday, August 18th and Sunday, August 19th) to Crooked Street visitors in cars queuing to drive the Crooked Street. The survey was designed to estimate visitors' willing to pay for reservations to drive the Crooked Street should a mandatory reservation system be implemented. The team administered the survey to 399 respondents (some of whom did not provide responses to every question).

The sections of this memo summarize responses to each of the following survey questions:
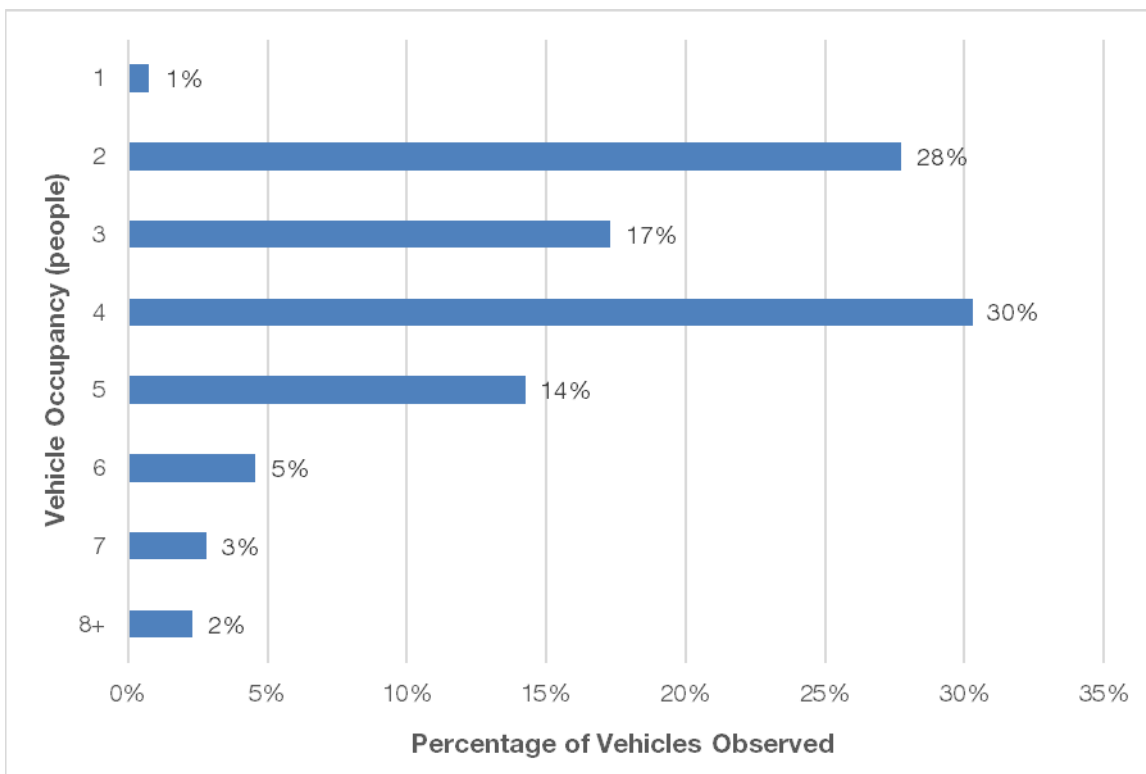
1. Visitor characteristics

2. Visit planning

3. Interest in reservation system

4. Willingness to pay

5. Preferred alternatives

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1   Visitor Characteristics

As part of the intercept survey, the occupancy of each vehicle interviewed was observed (see Figure 1 below). The average observed group size was 3.65 people.
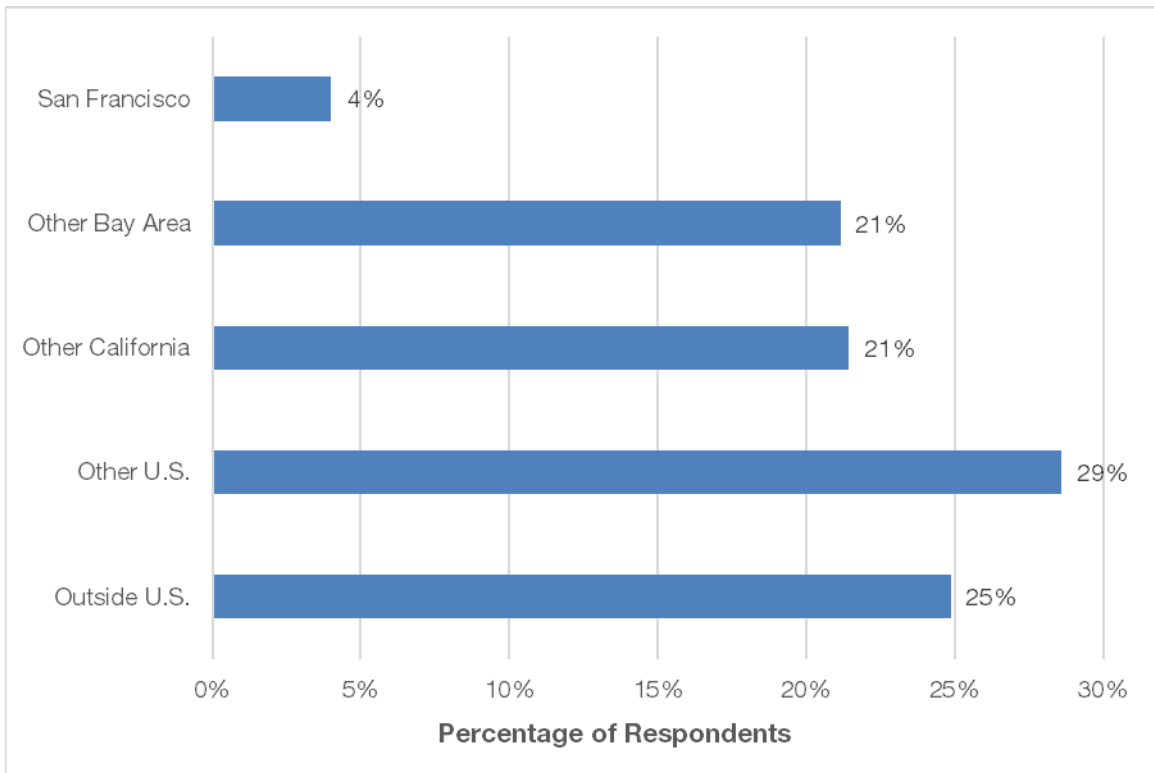
Figure 1- Observed Vehicle Occupancy (n = 393)

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Of those visiting to drive the Crooked Street, a wide range of home locations within, near to, and far from San Francisco were reported. For the purposes of the analysis in this section, in instances where car occupants reported multiple origin locations, each origin location was counted as a single response. As shown in Figure 2, only 4% of respondents indicated they were visiting from San Francisco. Beyond San Francisco, the distribution of home locations was relatively even, with approximately one quarter of respondents visiting from each the Bay Area, other California locations, other U.S. states, and other countries.
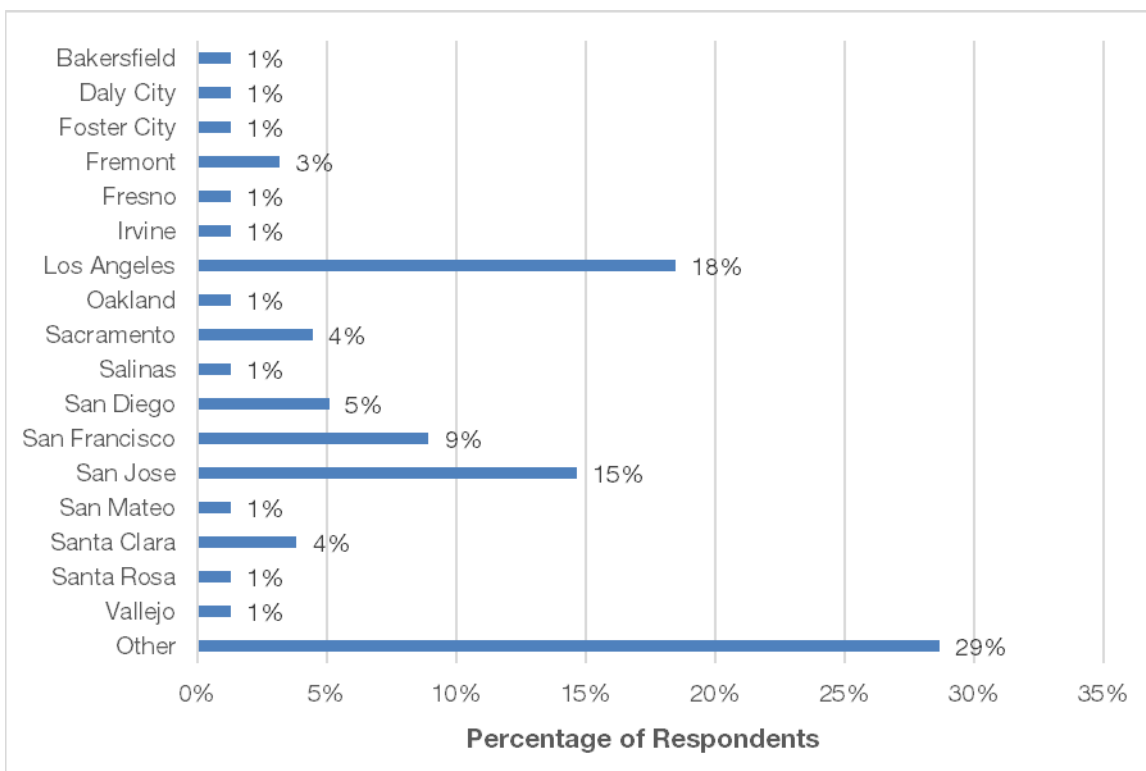
Figure 2- Visitor Home Locations (n = 350)

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Of the 47 percent of respondents visiting from within California, 61 different home cities were reported. Figure 3 shows the most common home states or territories reported.

Figure 3- Visitor Home Locations- California (n = 163)

Note: 44 cities with one respondent each are aggregated into the "Other" category.

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Of the 29 percent of respondents visiting from other U.S. states or territories, 34 different home states were reported. Figure 4 shows the most common home states or territories reported.

Figure 4- Visitor Home Locations- Other U.S. States (n = 100)
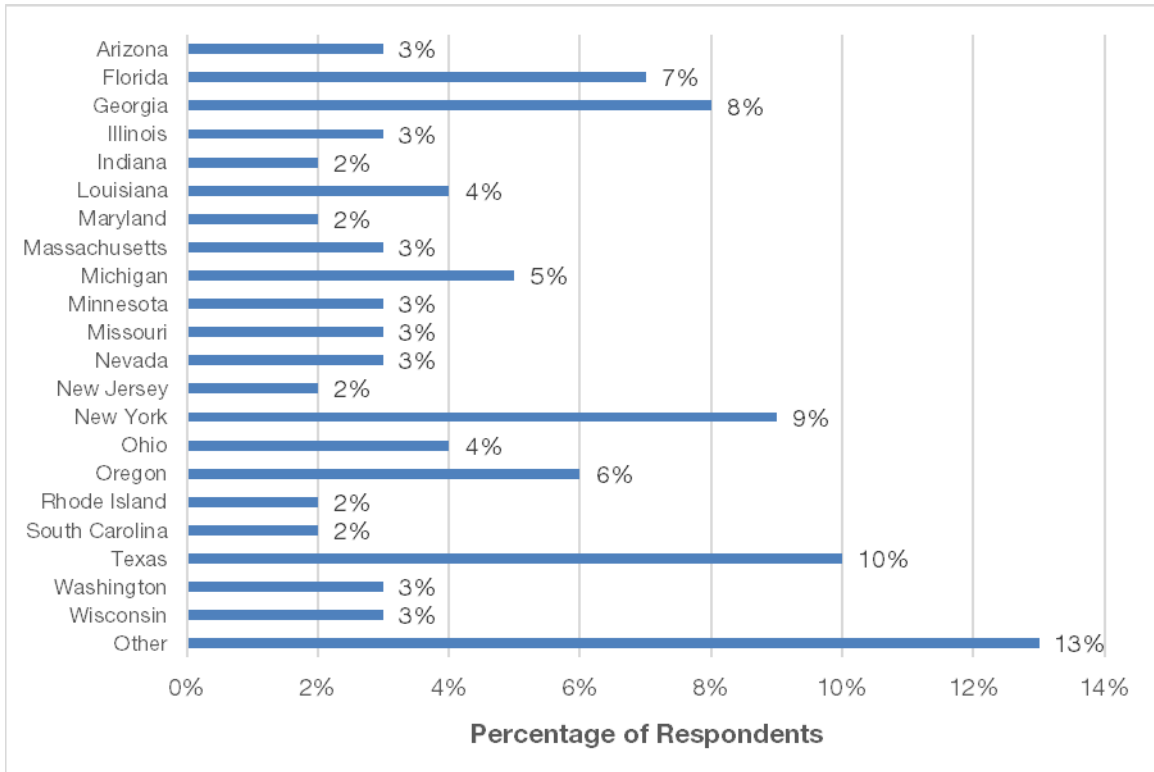

Note: 13 states or territories with one respondent each are aggregated into the "Other" category.

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Of the 25 percent of respondents visiting from other countries, 29 different home countries were reported.

Figure 5 shows the most common international home locations reported.

Figure 5- Visitor Home Locations- International (n = 87)
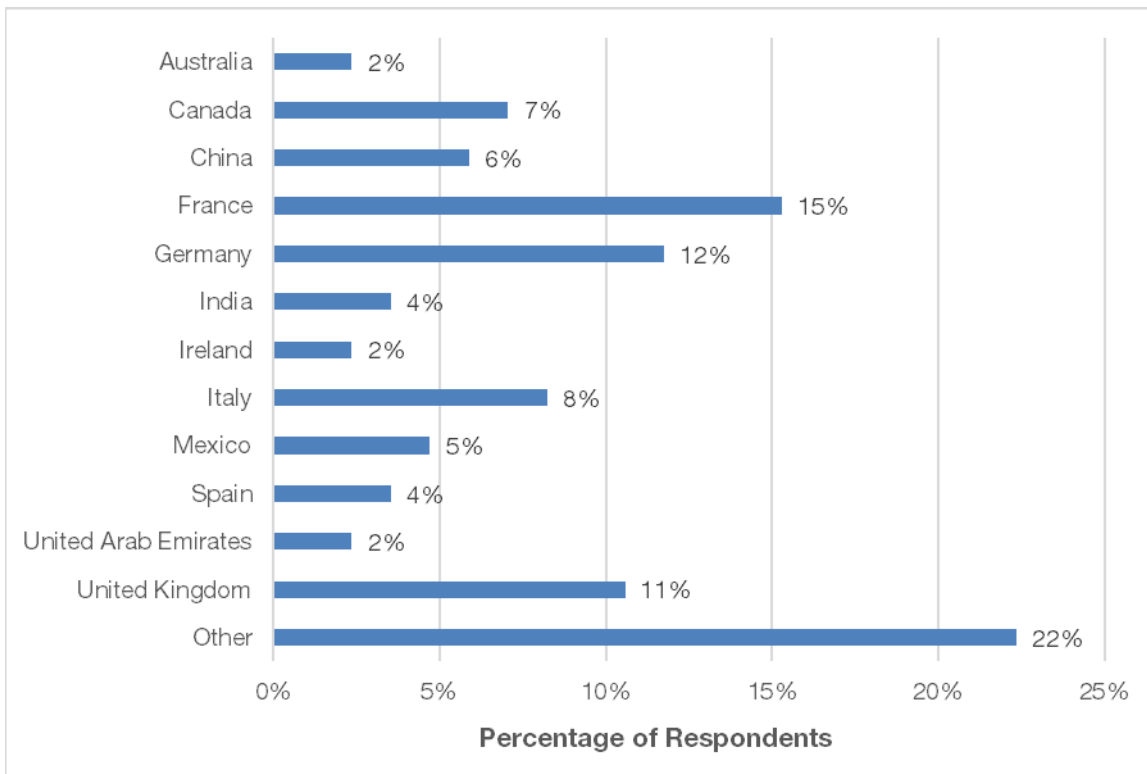
Note: 17 countries with one respondent each are aggregated into the "Other" category.

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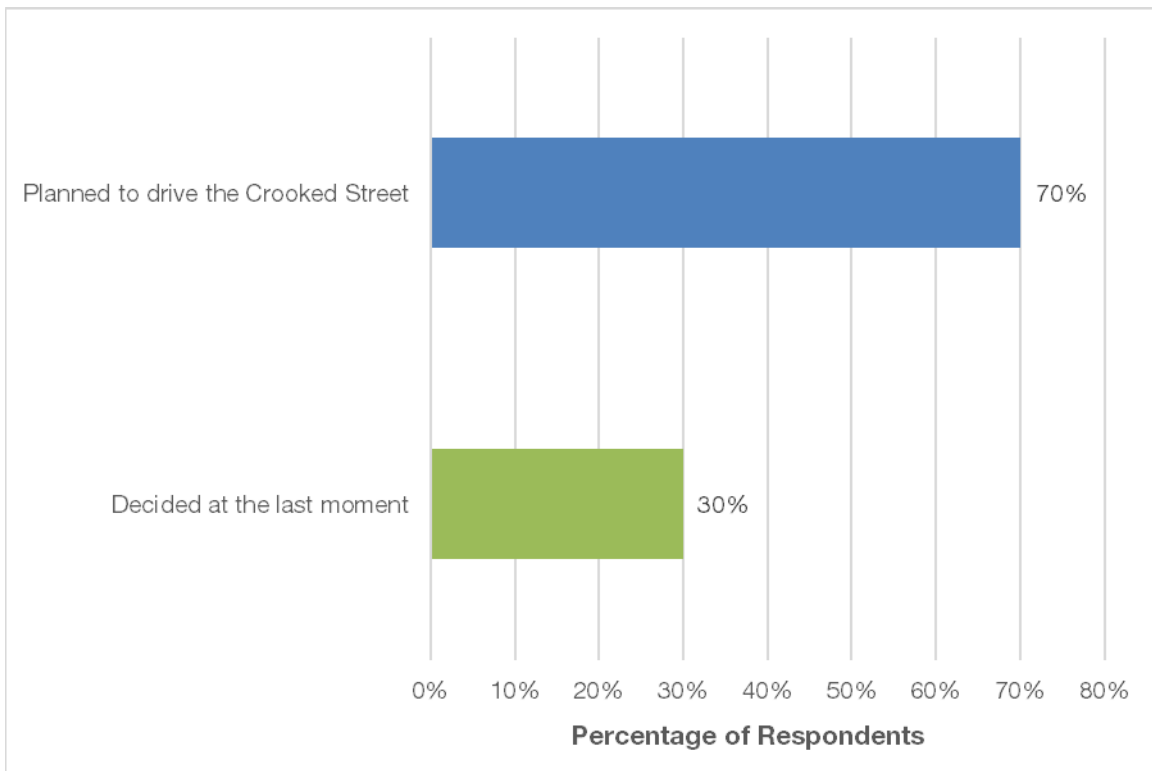Arup North America Ltd | F0.3

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2   Visit Planning

Of those visiting to drive the Crooked Street, most planned driving the Crooked Street as part of their overall visit to San Francisco (see

Figure **6** below). A smaller portion of visitors decided to drive the Crooked Street at the last minute.

Figure 6- Visit Planning (n = 367)

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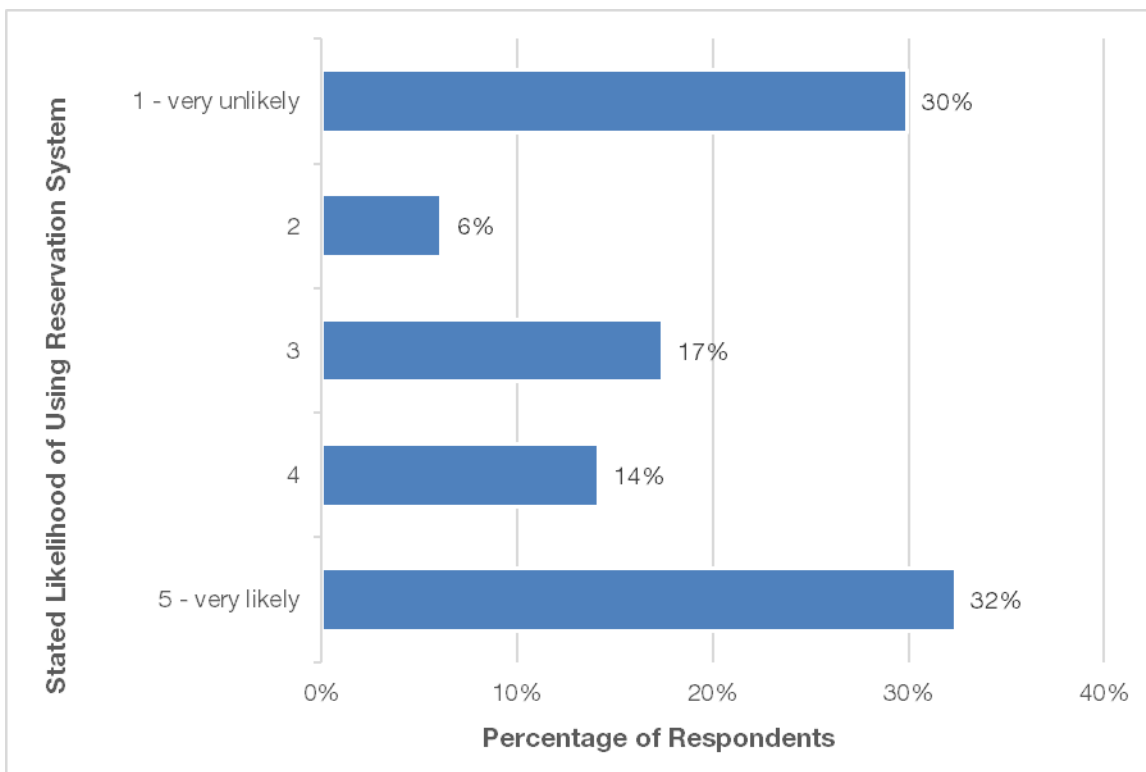
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3 Stated Interest in Reservation System

Respondents were asked to give a qualitative estimate of how likely they would be to drive Lombard Street if reservations were required. Responses were divided among five possible qualitative responses (see Figure 7 below).

Figure 7- Stated Likelihood of Using Reservation System (n = 361)

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4   Willingness to Pay

Respondents were each randomly presented one of four possible prices ($5, $10, $15, and $20) for a theoretical mandatory reservation to drive the Crooked Street. Lower reservation prices were favored over higher prices (see Figure 8 below). A linear trendline interpolating user willingness-to-pay for all values between $5 and $20 is also shown.

Figure 8- Willingness-to-Pay by Reservation Price (n = 292*)

Trendline
$y = -0.0329x + 0.7311$
$R^2 = 0.9524$
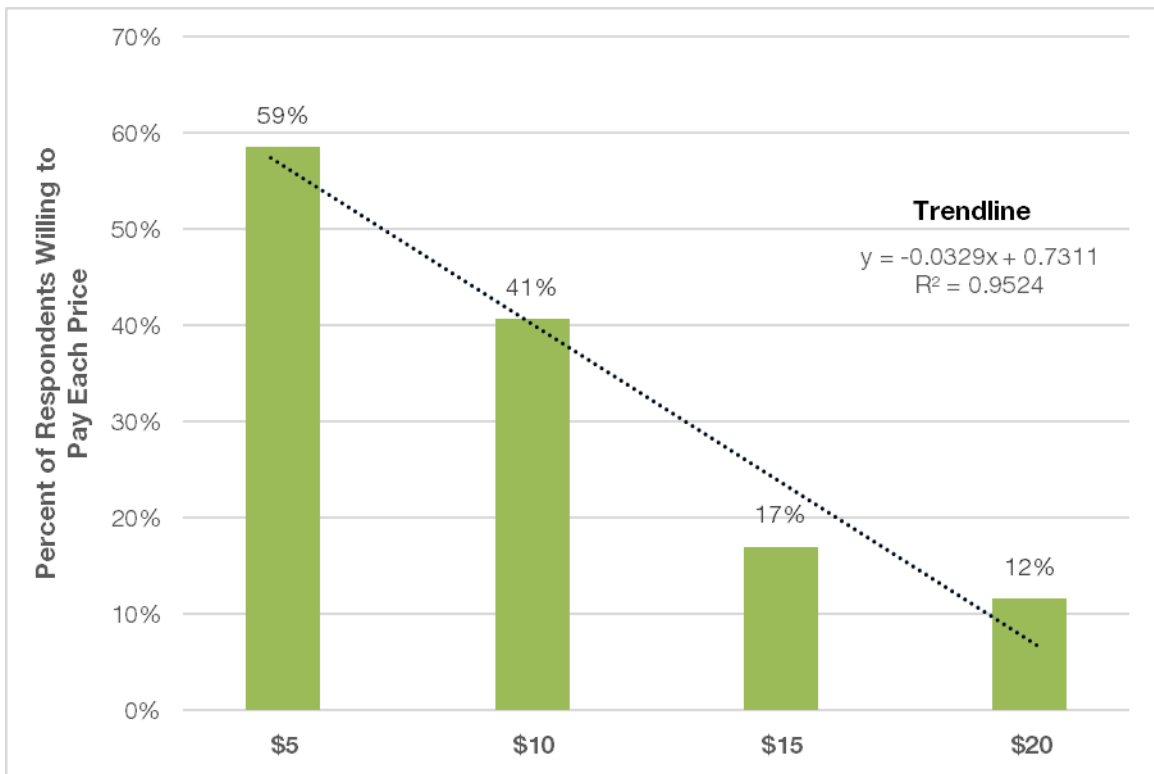
*292 total respondents; each price above was presented to approximately one quarter of the total respondents.

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5   Preferred Alternatives

Respondents were evenly divided among possible alternative visit plans should a theoretical reservation be unavailable at their preferred Crooked Street visit time (see Figure 9 below).

Figure 9- Preferred Alternative If Reservation Unavailable (n = 204)

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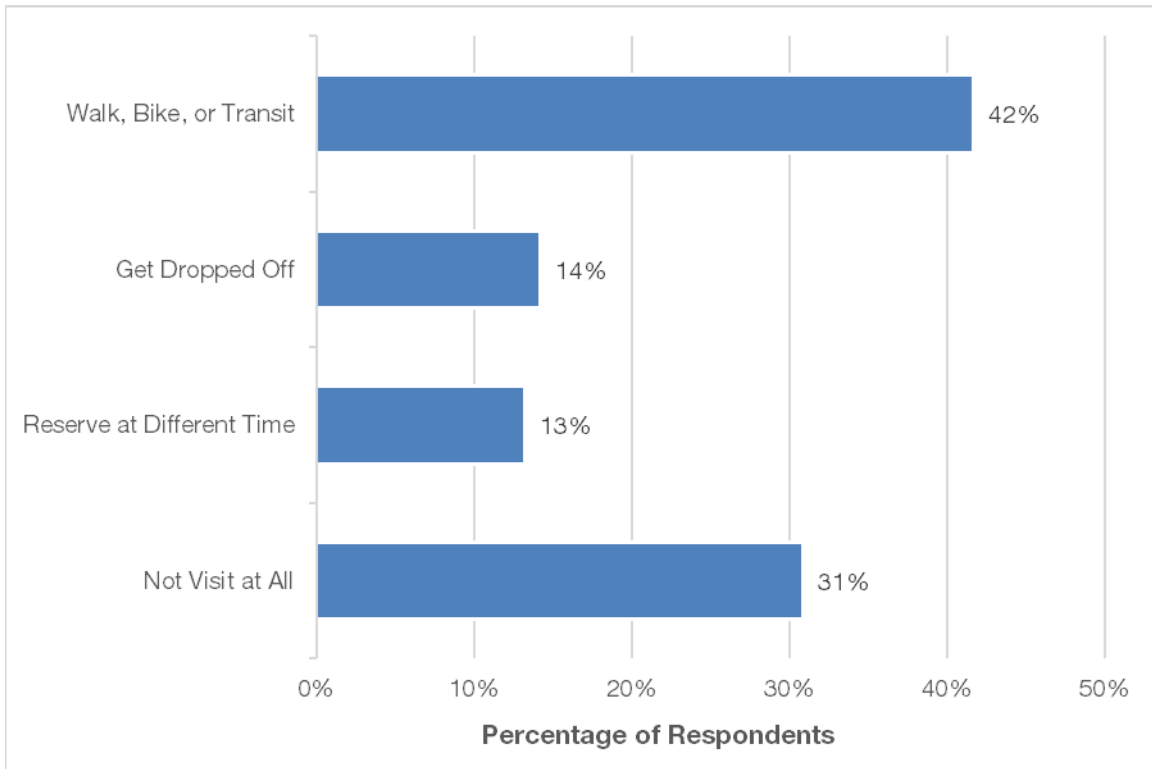
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6   Cross-Tab Results

The project team calculated cross-tabulations of selected survey question responses with other question responses to find other trends and relationships. This section describes the cross-tabulations conducted, including ones using the following questions:

- Number of people in surveyed cars

- Home locations

- Plan to visit in advance vs. last-minute decision

- Alternative if desired reservation were unavailable

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Table 1- Preferences Based on Number of People Observed in Surveyed Cars

		How many people are in the car?													
		1		2		3		4		5		6		7		8+	
		Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Home Location	San Francisco	1	33.3%	6	5.8%	1	1.5%	4	3.3%	1	1.8%	1	6.3%	0	0.0%	0	0.0%
	Other Bay Area	0	0.0%	14	13.5%	18	27.7%	30	24.8%	16	28.6%	3	18.8%	8	53.3%	2	22.2%
	Other California	0	0.0%	23	22.1%	14	21.5%	21	17.4%	10	17.9%	5	31.3%	3	20.0%	1	11.1%
	Other U.S.	1	33.3%	43	41.3%	16	24.6%	29	24.0%	12	21.4%	4	25.0%	3	20.0%	2	22.2%
	Outside U.S.	1	33.3%	18	17.3%	16	24.6%	37	30.6%	17	30.4%	3	18.8%	1	6.7%	4	44.4%
Did you plan to drive the Crooked Street as part of your visit to San Francisco or did you decide to at the last moment?	Planned to drive the Crooked Street	2	100.0%	62	60.2%	42	64.6%	90	75.0%	42	82.4%	13	68.4%	12	80.0%	7	77.8%
	Decided at the last moment	0	0.0%	41	39.8%	23	35.4%	30	25.0%	9	17.6%	6	31.6%	3	20.0%	2	22.2%
Willingness-to-pay at each price level	$5 Yes	0	n/a	14	58.3%	7	53.8%	13	59.1%	7	63.6%	1	33.3%	2	100.0%	0	n/a
	No	0	n/a	10	41.7%	6	46.2%	9	40.9%	4	36.4%	2	66.7%	0	0.0%	0	n/a
	$10 Yes	0	n/a	9	50.0%	5	35.7%	4	30.8%	2	50.0%	2	28.6%	1	100.0%	1	50.0%
	No	0	n/a	9	50.0%	9	64.3%	9	69.2%	2	50.0%	5	71.4%	0	0.0%	1	50.0%
	$15 Yes	1	50.0%	6	20.7%	1	6.3%	7	23.3%	0	0.0%	1	50.0%	0	n/a	0	0.0%
	No	1	50.0%	23	79.3%	15	93.8%	23	76.7%	15	100.0%	1	50.0%	0	n/a	2	100.0%
	$20 Yes	0	n/a	1	5.6%	2	16.7%	1	4.5%	1	12.5%	2	40.0%	0	0.0%	2	66.7%
	No	0	n/a	17	94.4%	10	83.3%	21	95.5%	7	87.5%	3	60.0%	1	100.0%	1	33.3%
Preferred alternative if reservation unavailable	Walk, Bike, or Transit	0	n/a	31	51.7%	15	34.9%	22	41.5%	10	37.0%	5	29.4%	0	0.0%	2	40.0%
	Get Dropped Off	0	n/a	8	13.3%	5	11.6%	8	15.1%	5	18.5%	3	17.6%	0	0.0%	1	20.0%
	Reserve at a Different Time	0	n/a	9	15.0%	2	4.7%	11	20.8%	4	14.8%	0	0.0%	3	75.0%	1	20.0%
	Not Visit At All	0	n/a	12	20.0%	21	48.8%	12	22.6%	8	29.6%	9	52.9%	1	25.0%	1	20.0%

Note: Use caution when interpreting cells in cross-tabulation table above with few responses reported.

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Table 2- Preferences Based on Home Locations

			San Francisco		Other Bay Area		Other California		Other U.S.		Outside U.S.	
			Count	%	Count	%	Count	%	Count	%	Count	%
How many people are in the car?		1	1	7.1%	0	0.0%	0	0.0%	1	0.9%	1	1.0%
		2	6	42.9%	14	15.4%	23	29.9%	43	39.1%	18	18.6%
		3	1	7.1%	18	19.8%	14	18.2%	16	14.5%	16	16.5%
		4	4	28.6%	30	33.0%	21	27.3%	29	26.4%	37	38.1%
		5	1	7.1%	16	17.6%	10	13.0%	12	10.9%	17	17.5%
		6	1	7.1%	3	3.3%	5	6.5%	4	3.6%	3	3.1%
		7	0	0.0%	8	8.8%	3	3.9%	3	2.7%	1	1.0%
		8+	0	0.0%	2	2.2%	1	1.3%	2	1.8%	4	4.1%
Did you plan to drive the Crooked Street as part of your visit to San Francisco or did you decide to at the last moment?		Planned to drive the Crooked Street	7	50.0%	52	61.2%	53	70.7%	72	72.0%	78	84.8%
		Decided at the last moment	7	50.0%	33	38.8%	22	29.3%	28	28.0%	14	15.2%
Willingness-to-pay at each price level	$5	Yes	2	40.0%	7	50.0%	5	55.6%	18	64.3%	8	53.3%
		No	3	60.0%	7	50.0%	4	44.4%	10	35.7%	7	46.7%
	$10	Yes	0	n/a	4	30.8%	6	50.0%	8	50.0%	6	42.9%
		No	0	n/a	9	69.2%	6	50.0%	8	50.0%	8	57.1%
	$15	Yes	0	0.0%	3	13.0%	4	21.1%	6	24.0%	3	11.5%
		No	2	100.0%	20	87.0%	15	78.9%	19	76.0%	23	88.5%
	$20	Yes	0	0.0%	2	15.4%	1	12.5%	4	20.0%	2	10.0%
		No	4	100.0%	11	84.6%	7	87.5%	16	80.0%	18	90.0%
Preferred alternative if reservation unavailable		Walk, Bike, or Transit	2	25.0%	13	35.1%	15	39.5%	28	41.2%	25	55.6%
		Get Dropped Off	1	12.5%	7	18.9%	5	13.2%	8	11.8%	7	15.6%
		Reserve at a Different Time	2	25.0%	3	8.1%	6	15.8%	13	19.1%	3	6.7%
		Not Visit At All	3	37.5%	14	37.8%	12	31.6%	19	27.9%	10	22.2%

Note: Use caution when interpreting cells in cross-tabulation table above with few responses reported.

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Table 3- Preferences Based on Plans to Visit the Crooked Street

| | | Did you plan to drive the Crooked Street as part of your visit to San Francisco or did you decide to at the last moment? | | | |
| | | Planned to drive the Crooked Street | | Decided at the last moment | |
		Count	%	Count	%
How many people are in the car?	1	2	0.7%	0	0.0%
	2	62	23.0%	41	36.0%
	3	42	15.6%	23	20.2%
	4	90	33.3%	30	26.3%
	5	42	15.6%	9	7.9%
	6	13	4.8%	6	5.3%
	7	12	4.4%	3	2.6%
	8+	7	2.6%	2	1.8%
Home Location	San Francisco	7	2.7%	7	6.7%
	Other Bay Area	52	19.8%	33	31.7%
	Other California	53	20.2%	22	21.2%
	Other U.S.	72	27.5%	28	26.9%
	Outside U.S.	78	29.8%	14	13.5%
Willingness-to-pay at each price level	$5 Yes	27	60.0%	14	51.9%
	$5 No	18	40.0%	13	48.1%
	$10 Yes	19	45.2%	4	26.7%
	$10 No	23	54.8%	11	73.3%
	$15 Yes	11	17.5%	2	6.7%
	$15 No	52	82.5%	28	93.3%
	$20 Yes	7	13.7%	2	12.5%
	$20 No	44	86.3%	14	87.5%
Preferred alternative if reservation unavailable	Walk, Bike, or Transit	62	44.6%	20	31.3%
	Get Dropped Off	18	12.9%	12	18.8%
	Reserve at a Different Time	22	15.8%	5	7.8%
	Not Visit At All	37	26.6%	27	42.2%

Note: Use caution when interpreting cells in cross-tabulation table above with few responses reported.

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Table 4- Preferences Based on Alternative Preferred if Desired Reservation Unavailable

| | | If you were unable to make a reservation at the exact time you want to visit Lombard St., would you...? | | | | | | | |
| | | Walk, Bike, or Transit | | Get Dropped Off | | Reserve at a Different Time | | Not Visit At All | |
		Count	%	Count	%	Count	%	Count	%
How many people are in the car?	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	2	31	36.5%	8	26.7%	9	30.0%	12	18.8%
	3	15	17.6%	5	16.7%	2	6.7%	21	32.8%
	4	22	25.9%	8	26.7%	11	36.7%	12	18.8%
	5	10	11.8%	5	16.7%	4	13.3%	8	12.5%
	6	5	5.9%	3	10.0%	0	0.0%	9	14.1%
	7	0	0.0%	0	0.0%	3	10.0%	1	1.6%
	8+	2	2.4%	1	3.3%	1	3.3%	1	1.6%
Home Location	San Francisco	2	2.4%	1	3.6%	2	7.4%	3	5.2%
	Other Bay Area	13	15.7%	7	25.0%	3	11.1%	14	24.1%
	Other California	15	18.1%	5	17.9%	6	22.2%	12	20.7%
	Other U.S.	28	33.7%	8	28.6%	13	48.1%	19	32.8%
	Outside U.S.	25	30.1%	7	25.0%	3	11.1%	10	17.2%
Did you plan to drive the Crooked Street as part of your visit to San Francisco or did you decide to at the last moment?	Planned to drive the Crooked Street	62	77.5%	18	64.3%	20	80.0%	35	60.3%
	Decided at the last moment	18	22.5%	10	35.7%	5	20.0%	23	39.7%
Willingness-to-pay at each price level	$5 Yes	10	55.6%	6	60.0%	12	92.3%	9	56.3%
	$5 No	8	44.4%	4	40.0%	1	7.7%	7	43.8%
	$10 Yes	7	50.0%	4	57.1%	3	60.0%	5	33.3%
	$10 No	7	50.0%	3	42.9%	2	40.0%	10	66.7%
	$15 Yes	4	16.0%	0	0.0%	3	60.0%	1	5.6%
	$15 No	21	84.0%	9	100.0%	2	40.0%	17	94.4%
	$20 Yes	2	7.4%	1	33.3%	2	33.3%	3	30.0%
	$20 No	25	92.6%	2	66.7%	4	66.7%	7	70.0%

Note: Use caution when interpreting cells in cross-tabulation table above with few responses reported.

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7   Key Findings

The project team identified several notable trends from the survey results:

1. As expected, the overwhelming majority (96%) of visitors to Lombard were visiting from outside San Francisco, and 75% of visitors were from beyond the Bay Area.

2. Virtually all vehicles visiting Lombard Street (99%) contained more than one person, and 61% contained more than two people.

3. Overall, nearly half (46%) of respondents stated that they would be somewhat or very likely to use a reservation system if visiting Lombard were to require it.

4. Overall, nearly 60% of respondents stated a willingness to pay at least $5 to visit Lombard.

5. If the desired reservation time were unavailable, more than half stated they would find a different way to get to Lombard, whereas more than 10% stated they would come at a different time, and more than 30% stated they would not visit at all.

Cross-tabulation trends observed:

1. The more someone was willing to pay, the more likely they would visit even if reservations were required.

2. Most people with high willingness-to-pay had planned ahead of time to visit the Crooked Street as part of their overall visit to San Francisco.

3. Willingness-to-pay did not appear to vary with home location, with the exception that Americans from beyond the Bay Area were willing to pay more in general. Accordingly, a reservation system might deter casual tourists (and some local San Franciscans, although it should be noted that the number of San Franciscans visiting Lombard is so low, at 4%, that the measure of their willingness-to-pay is not statistically meaningful). The exact number of visitors deterred is difficult to estimate but may be one-third or greater.

4. Visitors from farther away are more likely than visitors from closer locations to walk, bike, or take transit to visit the Crooked Street if a reservation to drive is not available at their preferred time. By the same token, visitors from closer locations are more likely to skip visiting the Crooked Street altogether under the same scenario.

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8   Appendix A: Survey Questions

1) How many people are in the car? (OBSERVED BY SURVEYOR)
2) Where are you visiting from?
   a) Bay Area [GO TO QUESTION 3]
   b) Other place in the United States [GO TO QUESTION 4]
   c) Outside of the United States [GO TO QUESTION 5]
3) What is the purpose of your trip today?
   a) Want to see the Crooked Street
   b) Live in the Bay Area but showing someone around
   c) Other
4) What is your home zip code? [GO TO QUESTION 5]
5) What is your home country? [GO TO QUESTION 5]
6) Did you plan to drive the Crooked Street as part of your visit to San Francisco or did you decide to at the last moment?
   a) Planned to drive
   b) Decided at the last moment
7) If a reservation were **required** to drive the Crooked Street at this time of day and there were almost no line, how likely would you be to use it, on a scale of 1 to 5, 1 being very unlikely and 5 being very likely?
8) Would you be willing to pay _____ in order to reserve this time of day to visit Lombard St? [Initial number randomly given at $5, $10, $15, $20]
   a) YES [GO TO QUESTION 9]
      NO [GO TO QUESTION 10]
9) [IF YES, add $5 to the initial price and follow-up:] Would you be willing to pay _____ to visit Lombard St at this time of day?
10) [IF NO, subtract $5 to the initial price, UNLESS INITIAL PRICE = $5, and follow-up:] Would you be willing to pay _____ to visit Lombard St at this time of day?
11) If you were unable to make a reservation at the exact time you want to visit Lombard St, would you…?
    a) Try to reserve another timeslot within an hour or two of your preferred time
    b) Reserve a time at a completely different time of day
    c) Visit by walking, biking, or transit
    d) Get dropped off at Lombard St by car (Rideshare, private car, taxi, etc)
    e) Not visit Lombard St at all

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