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Memorandum

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CC	Colin Burgett, Nelson\Nygaard Consulting		
Subject	Ocean Beach Master Plan – Transportation Operations and Alternatives Analysis		
From	Tim Erney, AICP / PTP Jeffrey Chan, PTP Amanda Leahy, AICP		
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Introduction

This memorandum summarizes the results of the transportation analysis in support of the development of transportation improvement alternatives for those initial concepts, which are developed as part of the Ocean Beach Master Plan (OBMP). This analysis produced forecasts for future conditions and evaluated proposed project elements both in isolation and in combination. The objective of this transportation analysis is to assess any potential impacts of the individual OBMP major project elements and/or combination of project elements on the transportation and circulation network.

For the purpose of this evaluation, the transportation study area is generally bounded by Lincoln Way to the north, Sunset Boulevard to the east, John Muir Drive to the south, and The Great Highway to the west. The data collection effort and observations of conditions of the existing transportation facilities within the study area, including current roadway/intersection configurations, transit service and ridership, pedestrian and bicycle facilities, on-street and public off-street parking spaces, and on-street loading spaces are described in detail in the Existing Conditions Analysis Memorandum, dated February 3, 2014.

This transportation analysis will serve as a preliminary evaluation to assist in the process of development of a list of improvement alternatives for the final project description. As a result, the technical approach (including methodologies, assumptions and analysis tools) are generally consistent with the San Francisco Planning Department's standards and requirements for documentation for environmental review. However, it is important to note that this study is not intended for use in a formal or complete environmental review process (which would typically require supporting documentation that are in compliance with the California Environmental Quality Act [CEQA] and/or the National Environmental Policy Act [NEPA]) . The evaluation process for this effort, in addition to those conducted and completed, and documented in the Existing Conditions Analysis Memorandum, consists of several steps, including:

1. Development of the Future (Year 2040) Baseline Conditions
2. Identification of major project elements and alternatives for evaluation (which includes a feasibility review to screen out infeasible, conflicting, or redundant alternatives)
3. Technical analysis of alternatives
4. Tabulation and documentation of analysis results
5. Conclusion

As currently proposed for consideration for implementation, the project elements and their variants, which may have the potential to substantially affect transportation conditions in the study area, have been organized by each of the five following sections of the Great Highway, denoted by the respective segment limits within the study area:

- Upper Great Highway–North, from Sloat Boulevard to Lincoln Way, considerations to reduce and/or reconfigure travel lanes
- The Great Highway–South, from Sloat Boulevard to Skyline Boulevard, consideration for full roadway closure
- Sloat Boulevard–West, from Upper Great Highway to 45th Avenue, considerations to reduce and/or reconfigure travel lanes
- Sloat Boulevard–East, from 45th Avenue to Skyline Boulevard, considerations to reduce and/or reconfigure travel lanes
- Skyline Boulevard, from Sloat Boulevard to The Great Highway, potential to reconfigure intersections

These major project elements will be evaluated in isolation and in combination with the other major project elements and their variants. Two additional major project elements that are proposed for consideration for implementation would result in modifications to access and circulation in the area, but these elements are not anticipated to result in major operational effects in terms of vehicular operations for intersections or roadways; as such, have not been selected for detailed evaluation at this time.

- L-Taraval Terminus and Transit Center; considerations to reconfigure L-Taraval terminus and create a transit hub
- Zoo (Armory) Road and Herbst Road; considerations to provide pedestrian and bicycle amenities and reconfigure parking

Additionally, and complementary to the project elements proposed for the Sloat Boulevard–West and The Great Highway–South section as described above, there is consideration for the realignment of the San Francisco Zoo entrance and parking lot access location to be via 47th Avenue, and/or to provide parking lot access away from Sloat Boulevard (i.e., via Zoo (Armory) Road and Herbst Road off of Skyline Boulevard). Since this concept has not been formally considered for implementation, it will not be fully assessed for transportation operations at this time, but it may eventually be taken into consideration as it relates to the operations of the alternatives carried forth for further analysis.

Future Conditions

An assessment was conducted to evaluate future transportation operating conditions in the study area. Future traffic volumes were developed using output from the travel demand model developed by the San Francisco County Transportation Authority (SFCTA). Model outputs for Year 2012 (model base year) was compared with output for Year 2040 (model forecast year) to derive growth factors, which were then applied to existing data counts to obtain the Future Baseline Conditions (Year 2040) roadway segment traffic volumes (herein referred to as “Future Conditions”). Intersection vehicle turning movements were forecast using the furnessing process to balance projected growth for each approach/departure of an intersection with the proportion of left, through, and right turning vehicles.

Traffic volumes throughout the study area, including the Great Highway and parallel facilities, were found to increase at a maximum rate of 0.25 percent (%) per year. To provide a conservative estimate of Future Conditions vehicular travel demand in the study area, a growth rate of 0.5% per year was applied to existing traffic volumes. To account for the potential increase in transit ridership and non-motorized travel a growth rate of 1% per year was applied to the documented existing conditions transit ridership, pedestrian, and bicycle volumes.

Intersection Analysis

Intersections representing the locations where the major project elements and/or improvement alternatives could potentially impact transportation operations were chosen for evaluation. Study intersections were

evaluated using the 2000 Highway Capacity Manual (HCM) operations methodology[1] and calculated using the Synchro 8, Build 773 software package, published by Trafficware. For signalized intersections, this methodology determines the capacity of each lane group approaching the intersection and calculates an average delay (in seconds per vehicle) for each of the various movements at the different approaches of the intersection. A combined weighted average delay and Level of Service (LOS) are then presented for the intersection. For unsignalized intersections, the average delay and LOS for the worst stop-controlled approach at the intersection is presented.

The LOS methodology is a qualitative description of the performance of an intersection based on the average delay per vehicle. Intersection LOS range from LOS A, which indicate free-flow or excellent conditions with short delays, to LOS F, which indicates congested or overloaded conditions with extremely long delays. LOS definitions for signalized and unsignalized intersections are described in Table 1. In San Francisco, LOS A through D is considered excellent to satisfactory levels, and LOS E and F represent unacceptable service levels.

Table 1
LOS Criteria for Intersections

LOS	Description	Average Delay (seconds per vehicle)	
		Signalized Intersections	Unsignalized Intersections(1)
A	Little or no delay	≤ 10.0	≤ 10.0
B	Short traffic delay	> 10.0 and ≤ 20.0	> 10.0 and ≤ 15.0
C	Average traffic delay	> 20.0 and ≤ 35.0	> 15.0 and ≤ 25.0
D	Long traffic delay	> 35.0 and ≤ 55.0	> 25.0 and ≤ 35.0
E	Very long traffic delay	> 55.0 and ≤ 80.0	> 35.0 and ≤ 50.0
F	Extreme traffic delay	> 80.0	> 50.0

Source: Highway Capacity Manual, Transportation Research Board 2000.
Notes: LOS criteria for roundabouts is the same as that shown for unsignalized intersections

It should be noted that delay for intersections operating at LOS F is typically reported as "greater than 80.0 seconds" for signalized intersections and "greater than 50.0 seconds" for unsignalized intersections, as 80.0 seconds and 50.0 seconds are generally considered the limits of the meaningful range for the analysis results using the respective analysis methodology for signalized and unsignalized intersections.

Roundabouts

Several methods of roundabout modeling have been developed, most of them in other countries where roundabouts are common intersection control devices or treatments. The Signalized and Unsignalized Intersection Design and Research Aid (SIDRA) program and Synchro 8 offer an option to implement HCM procedures. The Oregon Department of Transportation (ODOT) Roundabout Calculator employs the National Cooperative Highway Research Program (NCHRP) Report 572 method. The capacity of the entry approach is determined by the availability of gaps in the circulating roadway. The delay on the entry approach is determined from the relationship between the demand volume and the computed capacity of the approach. This is an example of "gap acceptance" methodology. The capacity estimation model involves an opposed movement that must yield right of way to an opposing movement. The entry capacity for the opposed movement depends primarily on the volume of the opposing movement. When there is no opposing traffic,

[1] Adjustments are typically made to the capacity of each intersection to account for various factors that reduce the ability of the streets to accommodate vehicles (such as the number of pedestrians, bus stops, vehicle types, lane widths, grades, on-street parking and queues).

the capacity of the opposed movement approaches a value in the range of 1,500 vehicles per hour per lane. As the opposing volume increases to the point where there are no gaps available, the capacity of the opposed movement drops to zero.

The concept of critical gap and follow-up time are important to understand roundabout capacity. The critical gap is defined as the gap, measured in seconds, between circulating vehicles that will be required before a vehicle on an approach will enter the roundabout. It is understood that more aggressive drivers are likely to accept a smaller gap than less aggressive drivers. Therefore, the gap that would be acceptable to approximately half of the motorists is considered to be the critical gap. The follow-up time is defined as the additional time (after the critical gap) required for subsequent vehicles to enter the roundabout. This concept recognizes that long gaps will accommodate multiple vehicles. The critical gap and follow-up time are referred to collectively as the entry lane gap acceptance parameters.

The average delay to each vehicle (measured in seconds) is estimated as the sum of the queuing delay and the geometric delay. The queuing delay accounts for the time spent by each vehicle waiting to enter the roundabout. It is a function of the demand/capacity ratio and the length of the analysis period. The geometric delay accounts for the time spent in the circulating lands of the roundabout. The level of service criteria are the same as those currently used for unsignalized intersections as shown in Table 1.

Intersection Level of Service

Intersection operating conditions were analyzed at a total of 12 study intersections, which represent locations where the proposed major elements and alternatives could potentially impact intersection operations. Weekday PM peak hour (5:00 PM to 6:00 PM) and the Saturday midday peak hour (1:00 PM to 2:00 PM) analysis were conducted at the following intersections:

1. Lincoln Way / Upper Great Highway
2. Lincoln Way / La Playa Street / Martin Luther King Jr. Drive
3. Lincoln Way / 37th Avenue
4. Lincoln Way / 36th Avenue
5. Taraval Street / Lower Great Highway
6. Sloat Boulevard / Upper Great Highway
7. Sloat Boulevard / 47th Avenue
8. Sloat Boulevard / 46th Avenue
9. Sloat Boulevard / 45th Avenue
10. Sloat Boulevard / Skyline Boulevard
11. Lake Merced Boulevard / Skyline Boulevard / Herbst Road
12. The Great Highway / Skyline Boulevard

Depending on the improvement alternative being considered, only a subset of these intersections that are deemed to affect transportation operations may be evaluated, and a qualitative evaluation may instead be provided for other intersections, in addition to those listed above (e.g., Sloat Boulevard / Sunset Boulevard, Skyline Boulevard / Harding Road, and Skyline Boulevard / Zoo (Armory) Road). It should be noted that this transportation assessment is focused on locations that have the potential to be affected by one or more of the major project elements and are not intended to be a complete evaluation of conditions for the entire study area.

Existing Conditions and Future (Year 2040) Baseline Conditions intersection Level of Service results are summarized in Table 2.

Table 2
Intersection Levels of Service

Intersection		Traffic Control[1]	Peak Hour[2]	Existing Conditions		Future Conditions	
				LOS	Delay[3]	LOS	Delay[3]
1.	Lincoln Way / Upper Great Highway	Signal	PM	B	11.4	B	13.0
			Midday	B	11.0	B	11.6
2.	Lincoln Way / La Playa Street / Martin Luther King Jr. Drive	AWSC	PM	B	13.3	C	17.8
			Midday	B	10.7	B	11.8
3.	Lincoln Way / 37th Avenue	Signal	PM	B	13.9	C	34.8
			Midday	B	12.4	B	13.0
4.	Lincoln Way / 36th Avenue	Signal	PM	A	7.6	B	10.0
			Midday	A	6.9	A	7.4
5.	Taraval Street / Lower Great Highway	AWSC	PM	A	8.9	A	9.2
			Midday	A	8.5	A	8.9
6.	Sloat Boulevard / Upper Great Highway	Signal	PM	C	34.7	D	43.8
			Midday	C	34.7	D	35.5
7.	Sloat Boulevard / 47th Avenue	OWSC	PM	C	15.3	C	16.4
			Midday	B	11.9	B	11.7
8.	Sloat Boulevard / 46th Avenue	OWSC	PM	A	9.4	A	9.5
			Midday	A	9.9	A	10.0
9.	Sloat Boulevard / 45th Avenue	Signal	PM	A	9.3	A	9.5
			Midday	B	10.7	B	10.0
10.	Sloat Boulevard / Skyline Boulevard	AWSC	PM	C	16.9	C	24.1
			Midday	B	11.7	B	13.3
11.	Skyline Boulevard / Lake Merced Boulevard / Herbst Road	Signal	PM	A	7.8	A	9.4
			Midday	A	8.8	B	11.0
12.	Skyline Boulevard / The Great Highway	AWSC	PM	B	14.6	C	20.2
			Midday	B	13.7	C	17.3

Source: AECOM, 2014.
Notes: OWSC = One-Way Stop-Control, AWSC = All-Way Stop-Control. LOS = Level of Service.
[1] For all-way stop-controlled intersections, delay is presented for the worst stop-controlled approach.
[2] Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM)
[3] Delay is presented in seconds per vehicle.

As shown in Table 2, all study intersections currently operate at LOS C or better during the weekday PM and Saturday midday peak hours and would continue to operate at LOS C or better under Future (Year 2040) Baseline Conditions, with the exception of Sloat Boulevard / Upper Great Highway and Sloat Boulevard / Skyline Boulevard which would operate at acceptable LOS D during the weekday PM peak hour and the weekday PM and Saturday midday peak hours, respectively.

Roadway Segment Analysis

Twenty-four hour pneumatic hose counts were collected on Sunday, July 14, 2013, over a three-day period in December 2013 (Thursday, December 5, 2013 through Saturday, December 7, 2013), and during two

consecutive Sundays in July 2013 (July 7 and July 14)[2]. The Great Highway (Upper) was closed between Fulton Street and Sloat Boulevard on Sunday July 7, 2013 for a Sunday Streets festival.

Additionally, historic average daily traffic volume data was obtained from the SFMTA traffic volumes database (SFMTA Traffic Count Data 1995-2013), and the California Department of Transportation (Caltrans) District 4 2012 Ramp Volumes to supplement the 24-hour pneumatic hose count data. Results of this data collection effort were utilized to estimate the available capacity on parallel roadway facilities, such as 19th Avenue and Sunset Boulevard, to evaluate whether these roadways would serve as a feasible alternative route for through vehicles or cut-through traffic in the future. Roadway segment volumes are provided in their entirety in the Appendix.

The capacity of roadway facilities are based on the capacity formulas provided in the 2000 Highway Capacity Manual.[3] The capacities shown are based on level of service E/F capacities representing the maximum flow which can pass through a given segment. Hourly and daily capacities for urban roadways on level terrain are shown in Table 3.

Table 3
Roadway Capacity

Facility Type	Typical Operating Speed Range	Capacity	
		Hourly (vehicles per hour per lane)	Daily (vehicles per day)
Highway	40 – 45	1,600	38,000
Arterial	25 – 45	800	19,000
Collector	35 – 40	700	17,000
Local	25 – 40	600	14,000
Slip Ramp	50	1,500	36,000
Loop Ramp	45	1,250	30,000

Source: Highway Capacity Manual, Transportation Research Board 2000.
Notes: Typical operating speed range shown in miles per hour (mph).
Hourly capacity shown as vehicles per hour per lane (vphpl). Daily capacity shown as vehicles per day (vpd).
Daily capacity estimated as 24 times the hourly capacity and rounded to the nearest 1,000 vehicles.

It should be noted that roadway capacity may vary based on a number of factors, including, but not limited to, lane width, shoulder width, presence of heavy vehicles (including buses) in the traffic stream, number of parking maneuvers, and operations of adjacent intersections. Additionally, it would be possible for demand to exceed the capacities shown on a given segment.

Average daily traffic volumes in the study area, for those roadways where the major elements and alternatives could potentially impact operations, are summarized in Table 4. Based on existing hourly traffic volume data, the weekday PM peak hour and Saturday midday peak hour traffic volumes are between 8% and 11% of daily traffic volumes, respectively.

[2] Note that additional Sunday counts were conducted in July (July 7, 2013) when The Great Highway (Upper) was closed between Lincoln Way and Sloat Boulevard for Sunday Streets festival. Results of this information will be submitted as part of a subsequent evaluation.
[3] Adjustments are typically made to the capacity of each roadway facility to account for various factors that reduce the ability of the streets to accommodate vehicles (such as the terrain, area type, and speed limit).

Table 4
Average Daily Traffic

Road	Segment	Dir.	Existing Conditions[1]		Future Conditions[2]	
			Weekday	Saturday	Weekday	Saturday
Skyline Blvd.	South of The Great Hwy.	NB	17,500	15,100	20,000	17,200
		SB	14,200	12,500	16,200	14,200
Skyline Blvd.	Between Sloat Blvd. and The Great Hwy.	NB	9,400	8,200	10,700	9,400
		SB	6,400	5,800	7,300	6,600
Sloat Blvd.	Between Upper Great Hwy. and 43rd Ave.	EB	2,700	2,600	3,100	3,000
		WB	4,400	4,500	5,100	5,200
Sloat Blvd.	Between 43rd Ave. and Skyline Blvd.	EB	4,600	4,400	5,200	5,000
		WB	8,100	6,500	9,300	7,400
Sloat Blvd.	Between Skyline Blvd. and Sunset Blvd.	EB	8,900	7,400	10,200	8,500
		WB	8,800	7,800	10,000	8,900
The Great Hwy.	Between Sloat Blvd. and Skyline Blvd.	NB	9,500	7,700	10,900	8,800
		SB	8,900	7,700	10,200	8,800
Upper Great Hwy.	Between Ulloa St. and Sloat Blvd.	NB	9,200	7,800	10,500	8,900
		SB	8,300	7,700	9,400	8,800
Lower Great Hwy.	Between Ulloa St. and Sloat Blvd.	NB	2,500	2,200	2,900	2,500
		SB	1,600	1,700	1,800	1,900
The Great Hwy.	Between Lincoln Wy. And Fulton St.	NB	8,200	8,400	9,400	9,600
		SB	11,900	8,200	13,600	9,400
The Great Hwy.	North of Fulton St.	NB	6,200	5,500	7,100	6,300
		SB	6,600	5,800	7,500	6,700
Sunset Blvd.	Between Judah St. and Taraval St.	NB	11,200	9,900	12,800	11,300
		SB	9,800	8,700	11,200	9,900
Sunset Blvd.	Between Wawona St. and Sloat Blvd.	NB	21,700	19,300	24,800	22,000
		SB	21,500	19,100	24,500	21,800
Crossover Dr.	North of Martin Luther King Jr. Dr.	NB	40,800	36,200	46,500	41,200
		SB	40,300	35,700	45,900	40,800
Martin Luther King Jr. Dr.	East of 25th Ave.	EB	6,200	5,500	7,000	6,200
		WB	4,500	4,000	5,100	4,600

Source: AECOM 2014.

Notes: Dir. = direction, NB = northbound, SB = southbound, EB = eastbound, WB = westbound. Blvd. = Boulevard, Hwy. = Highway, Dr. = Drive, Jr. = Junior, Ave. = Avenue, St. = Street.
Traffic volumes are rounded up to the nearest 100 vehicles.
[1] Weekday counts were collected on Thursday, December 5, 2013. Saturday counts were collected on Saturday, December 7, 2013.
[2] A growth rate of 0.5% per year was applied to existing traffic volumes to estimate future traffic volumes.

Transit Analysis

Transit ridership and capacity conditions were assessed for the Muni bus and light rail lines that serve the study area. To account for the potential increase in transit ridership, a growth rate of 1% per year was applied to existing transit ridership obtained from SFMTA's Transit Effectiveness Plan (TEP) and automatic passenger count data. Existing and future weekday PM peak hour transit ridership on Muni bus and light rail lines that serve the study area is shown in Table 5.

Table 5

Transit Ridership – Weekday PM Peak Hour

Line	Stop Location	Dir.	Existing Conditions[1]		Future Conditions[2]	
			Boarding	Alighting	Boarding	Alighting
L-Taraval	Wawona St. / 46th Ave.	IB	16	0	20	0
		OB	0	131	0	170
N-Judah	Judah St. / La Playa St.	IB	56	0	75	0
		OB	0	69	0	90
18-Legion of Honor / Stonestown	Vicente St. / 46th Ave.	IB	2	2	5	5
		OB	1	9	5	15
	Lincoln Wy. / The Great Hwy.[3]	IB	1	1	5	5
		OB	3	4	5	5
23-Bayview / SF Zoo	The Great Hwy. / Sloat Blvd.	IB	18	0	25	0
		OB	0	9	0	15
	Sloat Blvd. / 45th Ave.	IB	4	0	5	0
		OB	1	8	5	10
29-Sunset / Presidio	Lincoln Wy. / 36th Ave.[4]	IB	6	4	10	5
		OB	0	4	0	5
	Sunset Blvd. / Taraval St.	IB	10	16	15	20
		OB	12	12	15	15
	Sunset Blvd. / Sloat Blvd.	IB	0	1	0	5
		OB	0	0	0	0

Source: SFMTA, 2011. AECOM, 2014.

Notes: Dir. = Direction, IB = Inbound to downtown San Francisco, OB = Outbound from downtown San Francisco, St. = Street, Ave. = Avenue, Hwy. = Highway, Blvd. = Boulevard.

[1] Existing weekday PM peak hour transit ridership was obtained from SFMTA TEP and automated passenger count data.

[2] A growth rate of 1% per year was applied to existing transit ridership to estimate future transit ridership. Future ridership volumes are rounded up to the nearest 5.

[3] In the outbound (18-Stonestown) direction the stop is located at Lincoln Way / La Playa Street.

[4] In the outbound (29-Sunset) direction the stop is located at Lincoln Way / 37th Avenue.

Currently, headways for light rail vehicles on the L-Taraval and N-Judah are between 6.7 and 7.5 minutes during the weekday PM peak period. The scheduled peak period time between buses on Muni Route 18 and Route 23 is 20 minutes. The peak period headway for Muni Route 29 is 10 minutes.

During the weekday PM peak hour (5:00 PM to 6:00 PM), approximately 75 passengers are estimated to board and 90 passengers are estimated to alight from the N-Judah at the Judah Street / La Playa Street stop. With a peak hour headway of between 7 and 8 minutes and an even distribution of ridership over the peak

hour, approximately 10 passengers would board each N-Judah (inbound) and 12 passengers would alight from each N-Judah (outbound) under Future Conditions.

During the weekday PM peak hour, the highest transit ridership in the study area would be expected to occur on the L-Taraval line at the Wawona Street / 46th Avenue platform. Twenty passengers are estimated to board and 170 passengers are estimated to alight from the L-Taraval at this location under Future Conditions. With a peak hour headway of between 7 and 8 minutes and an even distribution of ridership over the peak hour approximately 5 passengers would board each L-Taraval (inbound) and 25 passengers would alight from each L-Taraval (outbound) during the weekday PM peak hour under Future Conditions. Similar to existing conditions, the majority of transit riders (approximately 85%) that would board/alight at Wawona Street / 46th Avenue would be destined for locations across Sloat Boulevard (including the Zoo). The other riders would proceed east (approximately 5%) or west (approximately 10%) along Wawona Street and a minimal number would be expected to travel north of the terminal. Light rail platform and bus shelter capacity and access would be acceptable. In general, platform and sidewalk widths would be adequate to handle forecast passenger flows during the peak hour.

The Transit Effectiveness Project (SFMTA 2011) proposes to streamline the 18-46th Avenue to follow a more direct route to Stonestown Galleria and 19th Avenue. The proposed alignment would operate between the zoo and Stonestown Galleria shopping center via Sloat Boulevard, Sunset Boulevard, Lake Merced Boulevard, and Winston Drive. Service along Skyline Boulevard, John Muir Drive, and a portion of Lake Merced Boulevard would be replaced by the revised 17-Parkmerced bus line. Improvements proposed for the N-Judah light rail line include the relocation of existing bus stops, provision of new bus bulbs, bus zones, and boarding islands on Judah Street as part of the expanded travel time reduction proposal. No improvements are proposed for the 23-Monterey bus route or the L-Taraval as part of the TEP. However, it should be noted, that the reconfiguration of the L-Taraval terminus at 46th Avenue / Wawona Street and the creation of a transit hub with the 18-46th Avenue and 23-Monterey bus lines is being considered.

Pedestrian and Bicycle Analysis

Throughout the study area, bicycle and pedestrian conditions were qualitatively evaluated. Pedestrian crosswalk and sidewalk counts were conducted at the following crosswalks and sidewalk locations in the study area during the weekday and Saturday midday peak period (12:00 PM to 2:00 PM) in December 2013:

Crosswalks

1. Lincoln Way / Upper Great Highway
2. Lincoln Way / La Playa Street / Martin Luther King Jr. Drive
3. Upper Great Highway at Judah Street
4. Sloat Boulevard / Upper Great Highway
5. Sloat Boulevard / 47th Avenue
6. Sloat Boulevard / 46th Avenue
7. Sloat Boulevard / 45th Avenue
8. Sloat Boulevard / 43rd Avenue
9. Sloat Boulevard / Skyline Boulevard
10. Lake Merced Boulevard / Skyline Boulevard / Herbst Road
11. The Great Highway / Skyline Boulevard

Sidewalks

1. Upper Great Highway, between Lincoln Way and Judah Street
2. Upper Great Highway, between Vicente Street and Sloat Boulevard
3. 47th Avenue, between Wawona Street and Sloat Boulevard
4. 46th Avenue, between Wawona Street and Sloat Boulevard

Currently sidewalks are 8 to 10 feet in width along most streets and crosswalks are striped and are 10 to 15 feet in width at most intersections in the study area. No pedestrian or bicycle improvements are proposed in the study area. As indicated in the pedestrian crosswalk and sidewalk counts and confirmed through field observations, higher levels of pedestrian and bicycle activity occur during the Saturday midday peak hour than during the weekday PM peak hour. Therefore, the higher Saturday midday peak hour sidewalk activity and Saturday midday peak hour and peak 15-minute pedestrian crosswalk volumes are summarized in Table 6 and Table 7, respectively.

Table 6

Sidewalk Activity – Saturday Midday Peak Hour

Segment	Side	Dir. of Travel	Existing Conditions[1]		Future Conditions[2]	
			Ped.	Bicycle[3]	Ped.	Bicycle[3]
Upper Great Highway, between Lincoln Way and Judah Street	East Trail	NB	25	7	35	10
		SB	35	7	45	10
	West Trail	NB	3	0	5	0
		SB	1	1	5	5
Upper Great Highway, between Vicente Street and Sloat Boulevard	East Trail	NB	23	6	30	10
		SB	16	6	25	10
	West Trail	NB	1	0	5	0
		SB	2	0	5	0
47th Avenue, between Wawona Street and Sloat Boulevard	East	NB	12	0	20	0
		SB	11	0	15	0
	West	NB	0	0	0	0
		SB	5	0	10	0
46th Avenue, between Wawona Street and Sloat Boulevard	East	NB	1	0	5	0
		SB	2	0	5	0
	West	NB	0	0	0	0
		SB	11	0	15	0

Source: AECOM, 2014.

Notes: Dir. = Direction, NB = northbound, SB = southbound, Ped. = Pedestrian.
The Saturday midday peak hour volume is the peak hour (consecutive 15-minute period) sidewalk volume (total pedestrians on both sides) during the midday period between 12:00 PM and 2:00 PM.
[1] Saturday midday peak period pedestrian counts were collected on Saturday, December 7, 2013.
[2] A growth rate of 1% per year was applied to existing crosswalk volumes to estimate future volumes. Future volumes are rounded up to the nearest 5.
[3] Bicycle count includes those bicycles traveling on the trail or sidewalk and does not include bicycles traveling on adjacent, parallel facilities or roadways.

Table 7
Crosswalk Activity – Saturday Midday Peak Hour

Intersection	Crosswalk	Existing Conditions[1]		Future Conditions[2]	
		Peak Hour[3]	Peak 15-Minute[4]	Peak Hour[3]	Peak 15-Minute[4]
Lincoln Way / Upper Great Highway	North	41	14	55	20
	East	60	23	80	30
	South	29	12	40	20
	West	27	12	35	20
Lincoln Way / La Playa Street / Martin Luther King Jr. Drive	North	7	4	10	10
	East	7	5	10	10
	South	23	9	30	15
	West	19	7	25	10
The Great Highway at Judah Street[5]	Crossing	101	28	130	40
	N. of XW	3	2	5	5
	S. of XW	0	0	0	0
	Total	104	30	135	45
Sloat Boulevard / Upper Great Highway	North	30	10	40	15
	East	9	6	15	10
	South	14	8	20	15
	West	10	4	15	10
Sloat Boulevard / 47th Avenue	North	50	15	65	20
	East	64	28	85	40
	West	31	16	40	25
Sloat Boulevard / 46th Avenue	North	48	18	65	25
	East	8	6	15	10
Sloat Boulevard / 45th Avenue	North	64	22	85	30
	East	23	10	30	15
	South	64	24	85	35
	West	20	7	30	10
Sloat Boulevard / 43rd Avenue	North	24	8	35	15
	East	4	2	10	5
	West	1	2	5	5
Sloat Boulevard / Skyline Boulevard	North	14	6	20	10
	East	1	2	5	5
	South	11	5	15	10
	West	0	3	0	5
Lake Merced Boulevard / Skyline Boulevard / Herbst Road	South	9	3	15	5
	West	9	3	15	5
The Great Highway / Skyline Boulevard[5]	North	1	1	5	5

Source: AECOM 2014.

Notes: "-" indicates no crossing facility exists at that location.

[1] Saturday midday peak period pedestrian counts were collected on Saturday, December 7, 2013.

[2] A growth rate of 1% per year was applied to existing crosswalk volumes to estimate future volumes. Future volumes are rounded up to the nearest 5.

[3] The Peak Hour volume is the peak hour (consecutive 15-minute period) intersection volume (total pedestrians at the crosswalk) during the midday period between 12:00 PM and 2:00 PM.

[4] The Peak 15-Minute volume is the peak 15-minute intersection volume (total pedestrians at the crosswalk) that occurs during the midday period between 12:00 PM and 2:00 PM. The Peak 15-Minute volume may occur outside of the peak hour of the same intersection.

[5] Pedestrian crossing volumes include illegal crossings (jaywalkers).

Approximately 210 pedestrians are estimated to utilize crosswalks at the Lincoln Way / Upper Great Highway signalized intersection during the Saturday midday peak hour under Future Conditions. The highest crossing demand, 80 pedestrians (35 northbound, 45 southbound), occurs on the east crosswalk across Lincoln Way. Vehicular traffic on conflicting movements would continue to be relatively low with approximately 30 vehicles making a northbound right turn from Upper Great Highway and 290 vehicles making a westbound right turn from Lincoln Way under Future Conditions.

Approximately 75 pedestrians are estimated to cross at the Lincoln Way / La Playa Street / Martin Luther King Jr. Drive all-way stop-controlled intersection during the Saturday midday peak hour under Future Conditions. The highest crossing demand, 30 pedestrians during the Saturday midday peak hour, occurs on the south crosswalk, across La Playa Street. Vehicle traffic on conflicting movements would continue to be relatively low (120 NB La Playa Street approach, 20 WBL and 30 EBR) under Future Conditions.

Currently, there are seven signalized midblock crossing locations on Upper Great Highway, between Lincoln Way and Sloat Boulevard. The longest distance between signalized crossing locations is approximately 0.25 miles. Signals along this segment are pre-timed and the pedestrian phase is automatically initiated each 90-second cycle. Approximately 130 pedestrians are estimated to cross Upper Great Highway at the signalized crossing at Judah Street during the Saturday midday peak hour under Future Conditions. Without enforcement, jaywalking and/or crossing against a red light would likely continue.

The majority of pedestrian activity crossing Sloat Boulevard would be expected to continue to occur at the unsignalized Sloat Boulevard / 47th Avenue intersection. Approximately 125 pedestrians (85 east crosswalk, 65 west crosswalks) are estimated to cross Sloat Boulevard at 47th Avenue during the Saturday midday peak hour under Future Conditions, compared to 15 pedestrians crossing Sloat Boulevard at 46th Avenue.

The Sloat Boulevard / Skyline Boulevard intersection is a large intersection with atypical configuration. The free right-turn channels and long crossing distances are particularly problematic for pedestrians and bicyclists. Approximately 20 pedestrians are estimated to cross 39th Avenue via the north crosswalk and 15 pedestrians are estimated to cross Skyline Boulevard via the south crosswalk during the Saturday midday peak hour under Future Conditions. Approximately 5 pedestrians would cross Sloat Boulevard via the east crosswalk. The north crosswalk measures approximately 44 feet long and10 feet wide and vehicle traffic on conflicting movements would continue to be very low (10 SBR, 90 WBR) under Future Conditions. The south crosswalk is actually a series of crosswalks connected by a median and two separate, channelizing islands that separate the free eastbound and northbound right turn movements and the stop-controlled eastbound through, and northbound and westbound left turn movements at the intersection. The total “south crosswalk” crossing distance is 232 feet, measured from the southwest corner to the southeast corner of the intersection. Total pedestrian crossing time would be approximately 66 seconds, assuming unimpeded movement at a speed of 3.5 feet per second. Conflicting vehicle traffic would continue to be fairly high (total of approximately 1,140 vehicles) during the Saturday midday peak hour – conflicting movements include the free channelized eastbound right turn (160 vehicles), the stop-controlled northbound left turn (300 vehicles) and dual stop-controlled westbound left turn (350 vehicles) and the free channelized northbound right turn (490 vehicles) under Future Conditions.

Major Project Elements and Alternatives

The purpose of this section is to present and describe each major project element and design variation, related assumptions, and to outline the screening analysis used to determine the final recommended set of alternatives to be further evaluated in this transportation study. The project elements and their variants have been organized by section of the study area as described in the Draft Charrette Summary:

- Upper Great Highway–North, from Sloat Boulevard to Lincoln Way
- The Great Highway–South, from Sloat Boulevard to Skyline Boulevard
- Sloat Boulevard–West, from Upper Great Highway to 45th Avenue

- Sloat Boulevard–East, from 45th Avenue to Skyline Boulevard
- Skyline Boulevard, from Sloat Boulevard to The Great Highway
- L-Taraval Terminus and Transit Center
- Zoo (Armory) Road and Herbst Road

Major project elements and variants are summarized in Table 8.

Table 8
Major Project Elements and Variants

ID	Project Element / Variants	Notes
A	Upper Great Highway–North	
A1	Maintain current configuration	Carry forward
A2	Reduce to two lanes	
	a) Maintain signalized crossings and < 35mph signal progression	Carry forward
	b) Implement traffic calming devices (i.e., chicanes)	Carry forward
B	The Great Highway–South	
B1	Maintain current configuration	Do not pursue
B2	Reduce to two lanes, utilize east (currently northbound) travel lanes	
	a) Bi-directional (one lane in each direction)	Carry forward
	b) One-way southbound (two lanes southbound)	Carry forward
	c) One-way northbound (two lanes northbound)	Carry forward
B3	Full closure, provide service road one-way northbound	Carry forward
C	Sloat Boulevard–West	
C1	Maintain current configuration	
	a) Realign zoo access to 47th Avenue	Carry forward
	b) Provide beach turnaround	Do not pursue
	c) Provide zoo drop-off bay	Do not pursue
C2	Reduce to three lanes	
	a) Realign zoo access to 47th Avenue	Carry forward
	b) Provide beach turnaround	Do not pursue
	c) Provide zoo drop-off bay	Do not pursue
D	Sloat Boulevard–East	
D1	Maintain current configuration	Carry forward, requires implementation of C1
D2	Transition from three lanes to five lanes	Carry forward, requires implementation of C3
E	Skyline Boulevard	
E1	Maintain current configuration	Carry forward
E2	Reconfigure intersections as signalized intersections or roundabouts	
	a) Sloat Boulevard / Skyline Boulevard	Carry forward
	b) Lake Merced Boulevard / Skyline Boulevard	Carry forward

	c) Herbst Road / Skyline Boulevard	Carry forward
	d) Zoo Road / Skyline Boulevard	Carry forward
	e) The Great Highway / Skyline Boulevard	Carry forward
F	Zoo (Armory) Road and Herbst Road	
F1	Maintain current configuration	Carry forward
F2	Provide sidewalks and bicycle lanes, formalize intersections	Carry forward
F3	Convert to two-way operations	Carry forward
G	L-Taraval Terminus and Transit Center	
G1	Maintain current configuration	Carry forward
G2	Relocate L-Taraval Terminus south of Sloat Boulevard	Do not pursue
G3	Acquire Roberts Motel and create an arrival plaza	Carry forward
G4	Acquire block south of existing L-Taraval Terminus	
	a) Create an arrival plaza and transit hub	Carry forward
	b) Integrate L-Taraval terminus into mixed-use building	Carry forward

Source: Nelson\Nygaard, 2014. AECOM, 2014.

A screening process was developed and applied to the alternatives. The screening analysis provides a rationale for retaining the most promising alternatives, while discarding those with fatal flaws or which offer significantly lower benefits or benefit to cost compared to the retained alternatives. The screening process suggests refinements to alternatives as they are developed for further study. Viable project elements and/or design alternatives may ultimately be combined to develop a series of tiered alternatives ranging from low-cost, near-term measures to high-cost, longer-term measures. Therefore, in some cases, the evaluation of major facilities may be conducted with the assumption that certain design alternatives have already been implemented. In addition to the major project elements and design alternatives carried forward for analysis, a number of minor initiatives (e.g., spot operational improvements, management strategies, or land use controls) will be carried forward for on-going evaluation and consideration. At the conclusion of the screening process, the final alternatives will be defined in sufficient detail to allow preliminary technical assessment of environmental impacts, conceptual engineering, transportation impacts and roadway operational characteristics and geometrics. The final recommended set of alternatives will be packaged for on-going refinement and further evaluation.

As shown in Table 8, the following project elements and variants were discarded from further analysis:

- B1, maintain current configuration along The Great Highway–South
- C1b and C2b, Provide beach turnaround on Sloat Boulevard–West
- C1c and C2c, Provide Zoo drop-off bay on Sloat Boulevard–West
- G2, relocate L-Taraval Terminus south of Sloat Boulevard

Maintaining four lanes along the southern portion The Great Highway, which is vulnerable to coastal erosion, would diminish the potential for bicycle and pedestrian connections between Ocean Beach, Fort Funston, and Lake Merced. Additionally, the ongoing loss of coastal access parking and more frequent roadway closures due to sand intrusion would be expected.

Provision of a beach turnaround at the west end of Sloat Boulevard would enable convenient access to the beach. However, the turnaround would be located in a coastal erosion zone and would be susceptible to sea level rise and sand intrusion and should not be considered for the long-term.

Provision of a drop-off bay for zoo visitors would enable convenient access to the zoo. However, this feature requires a substantial amount of roadway space. Curbside drop-off should be provided to accommodate zoo visitors with less traffic complexity and reduced potential for vehicle-vehicle, vehicle-bicycle, and vehicle-pedestrian conflicts.

Relocation of the L-Taraval terminus south of Sloat Boulevard would result in complex track geometry, slow train speeds, and delayed pedestrian crossings and negative impacts to vehicular traffic flow along Sloat Boulevard.

Traffic Calming Elements

The concept of traffic calming is fundamentally concerned with reducing the potential adverse impact of motor vehicles on built up areas. Traffic calming techniques are typically intended to reduce speed, control traffic volumes, improve transit access, and to encourage pedestrian and bicycle use. By affecting vehicle speeds, volumes, and trajectories, as well as streetscape composition, traffic calming measures may result in substantial effects on both the safety and quality of the pedestrian realm, facilitating non-motorized travel. The National Highway Traffic Safety Administration (NHTSA) estimates the probability of death, disfigurement, or debilitating injury doubles for every 10 miles per hour (mph) of vehicle travel speed over 50 mph.[4] Additionally, the Oregon Department of Transportation (ODOT) reported speed statistics indicating that there is an 85% likelihood of death for a pedestrian struck by an automobile at 40 mph, while a pedestrian struck at 30 mph has a 45% chance of being killed, and the risk drops to 15% at 20 mph.[5] The Federal Highway Administration (FHWA) estimates that each one mile per hour reduction in vehicle travel speed may reduce injury crashes by five percent.[6] One of the major challenges of traffic calming is to balance vehicular mobility needs against improvements for non-motorized street users.

This section focuses on traffic calming devices and techniques that have been proposed for implementation as part of the OBMP, and is not intended to include a comprehensive list or description of all traffic calming devices that could be implemented.

Chicane. Chicanes are raised curbs that create serpentine, horizontal shifting of the travel lanes along a roadway. The shifting of lanes reduces speeds by eliminating long stretches of straight roadway and forcing motor vehicles to shift laterally. Chicanes should be placed 400 to 600 feet apart and alignment of the chicane should be shifted at least one lane-width with a minimum deflection angle of 45 degrees. Center islands, or other barriers such as a raised median, are recommended to prevent motorists from driving down the roadway centerline in order to avoid the lateral shift. On roadways, such as Upper Great Highway, where bicycle traffic is accommodated, a bicycle bypass should be provided.

- Advantages: horizontal deflection forces vehicles to slow down
- Disadvantages: difficult for large or oversized vehicles to maneuver, can negatively impact emergency response times, potential for head-on and fixed-object collisions, complicates drainage features which may lead to high implementation costs
- Effectiveness: reduce 85th percentile vehicle speeds by up to six percent[7,8]

[4] National Highway Traffic Safety Association. 2005. Speed Shatters Life. http://www.nhtsa.dot.gov/people/outreach/safesobr/pub/think.pdf. Accessed April 2014.
[5] Oregon Department of Transportation, 1999. Main Street...when a highway runs through it: A Handbook for Oregon Communities.
[6] Transportation Research Board. 2002. The Relative Risks of School Travel. Special Report 269
[7] The 85th percentile speed is the point at which 85% of the vehicles are traveling at or below that speed.
[8] Corkle, et. al. 2001. Investigating the Effectiveness of Traffic Calming Strategies on Driver Behavior, Traffic Flow, and Speed. Minnesota Local Road Research Board, Minnesota Department of Transportation.

- Cost: range from $10,000 to more than $35,000, depending on the length of roadway and the number of devices installed

Roundabout. Roundabouts are used at intersections in place of traffic signals and can handle heavy traffic volumes. Roundabouts are circular intersections, typically characterized by yield controlled (with or without signage) entry points and channelized approaches, with their primary purpose of maintaining continuous traffic flow. The capacity of roundabouts is typically higher than that of signalized intersections because there is no lost time during red phases for approaches that are stopped, and roundabouts allow vehicles to enter from each leg simultaneously. Traffic signals are often timed to favor the major movement or approach to the detriment of the minor approach(es), while roundabouts provide each vehicle with an equal opportunity to enter, irrespective of entry location. Roundabouts function best when all approach roadways carry similar volumes. If the major approach roadway has substantially higher volumes than the minor approach roadway, vehicles may have difficulty entering from the lower volume approach roadway due to insufficient gaps in traffic.

Experience has demonstrated that vehicular crashes are significantly reduced when low-speed single lane roundabouts replace four-way intersections.[9]

- Advantages: reduced number of conflict points, central and splitter islands allow pedestrians to cross one direction of traffic at a time, one-way operation virtually eliminates possibility of right-angle or head-on collision, lower absolute speeds (less than 30 mph) reduces potential severity of collision, potential for landscaping acts as streetscape improvement.
- Disadvantages: difficult for large or oversized vehicles to maneuver, can negatively impact emergency response times, multi-lane roundabouts may be confusing to drivers and could create weaving conflicts, lack of audible warning signs may be difficult for visually impaired pedestrians to identify gaps in traffic and could make it difficult and/or unsafe to cross.
- Cost: varies depending on a number of factors, including, but not limited to, terrain, right-of-way constraints, and landscaping.

Other Considerations: A series of roundabouts will provide effective speed control along roadways as vehicles progress in a more uniform fashion, while maintaining adequate throughput. Traffic signals located closer than approximately 0.5 mile may result in platoons of vehicles with varying speeds that progress each time the signal turns green.

Transit stops located on the near side of the roundabout should be located far enough away from the splitter island so that a vehicle overtaking a bus is in no danger of being forced into the island. For a single lane entry where capacity is not an issue the transit stop can be located at the crosswalk. Transit stops on the far-side of the roundabout should be located beyond the pedestrian crossing and have pull-outs constructed to minimize queuing in the roundabout.

Bicyclists may be disadvantaged by roundabout design, and marked bicycle lanes through roundabouts have not been shown to improve safety. Bike lanes should be terminated in advance of crosswalks at roundabouts. For one-lane roundabouts with slow speeds and light traffic, bicyclists may merge into the vehicular travel lane comfortably. At multilane roundabouts, which are far more challenging for cyclists to navigate, additional safety and design features should be provided.

Curb extensions. Curb extensions, such as bulbouts, neckdowns, chokers, or mid-block crossings are physical devices placed in the roadway to create horizontal deflections by narrowing points along the roadway. Curb extensions extend the sidewalk to narrow the roadway and provide additional pedestrian

[9] Institute of Transportation Engineers. 2009. Context Sensitive Solutions in Designing of Major Urban Thoroughfare for Walkable Communities.

space. Curb extensions can be used at corners and at mid-block locations. Vehicles are forced to slow down to safely negotiate the narrowed points on the roadway. Narrowing of the main road section is referred to as a choker or mid-block crossing (when refuge and pavement markings are added); narrowing at an intersection is referred to as a neckdown or bulbout.

- Advantages: increase pedestrian visibility and waiting space at intersections, shorten pedestrian crossing distance and reduces pedestrian exposure to vehicles, tighter curb radii slows turning vehicles
- Disadvantages: difficult for large or oversized vehicles to negotiate, complicates drainage features which may lead to high implementation costs, reduce flexibility of the roadway, if constructed so that left-turning cars can block through traffic it may result in queues
- Effectiveness: reduces vehicle speeds by approximately three mph[10]

Guidelines and best practices for implementation of these, and other, traffic control devices can be found in the San Francisco Better Streets Plan. The City of San Francisco has also adopted the Traffic Calming Guidelines, which govern appropriate traffic calming procedures and measures. The Traffic Calming Guidelines provide a table of traffic calming measures that indicates which measures are acceptable on which types of streets within San Francisco. These guidelines do not provide standard plans or detailed design guidance for individual measures. The City of San Francisco has standard plans for traffic circles and speed humps, but not for other traffic calming features.

Evaluation of Alternatives

This section provides a preliminary evaluation of the proposed Ocean Beach Master Plan project elements to determine the potential for future transportation-related concerns, primarily with respect to intersection and roadway operations, transit conditions, pedestrian and bicycle circulation, and on-street parking and loading availability.

Transportation-related assumptions, including, but not limited to: travel demand and trip assignment, roadway configuration, intersection geometry, transit, pedestrian, and bicycle treatments, and provision of parking, are described in detail for the alternative being analyzed.

Upper Great Highway – North

Design alternatives and variants developed for Upper Great Highway–North, from Sloat Boulevard to Lincoln Way, include:

1. Maintain current configuration
2. Reduce Upper Great Highway–North to two lanes (one lane in each direction) and maintain signalized crossings on every other city block (Sunset District sized blocks)
3. Reduce Upper Great Highway–North to two lanes (one lane in each direction) and replace signals with traffic calming devices (i.e., chicanes) on every city block (Sunset District sized blocks)

The design alternatives for Upper Great Highway–North focus on improving pedestrian connections between Golden Gate Park and the Sunset District and existing promenades at O'Shaughnessy Seawall, Noriega Seawall, and a future promenade connecting to the zoo, Fort Funston and Lake Merced. Another key issue is the need to address and/or accommodate sand migration and to provide staging areas for sand storage. Provision of adequate parking is also a consideration, with parking spaces offering a view of the ocean deemed to be valuable by the public and stakeholders.

[10] Ewing, Reid. 1999. Traffic Calming: State of the Practice. Washington, DC: Institute of Transportation Engineers, U.S. Department of Transportation.

Parking options for these design alternatives include:

- No parking
- Parallel and/or perpendicular parking in separated bays
- Perpendicular parking along the Noriega Seawall

The potential effects of these parking options will be discussed and evaluated in conjunction with the preferred design alternative.

Traffic Analysis

Future (Year 2040) Baseline Conditions weekday and Saturday hourly traffic volumes on Upper Great Highway–North are shown in Figure 1.

As shown in Figure 1, with two lanes in each direction and a directional capacity of 1,600 vehicles per hour on Upper Great Highway–North, capacity would exceed demand during all hours. With one lane in each direction and a directional capacity of 800 vehicles per hour, future traffic volumes would be accommodated with the exception of approximately five hours each day during the peak period(s) when hourly demand would exceed capacity in at least one direction.

- Weekday
    - Northbound, 6:30 AM to 8:30 AM and 3:30 PM to 5:30 PM
    - Southbound, 3:00 PM to 6:00 PM
- Weekend
    - Northbound, 3:30 PM to 4:00 PM
    - Southbound, 2:30 PM to 5:00 PM

Reducing travel lanes on Upper Great Highway–North from the current four lane configuration to a two lane configuration may cause some motorists to shift to an alternate mode of travel (e.g., transit or carpool), change their time of travel (peak-spreading), or choose to travel to a similar or related destination or use an alternate parallel route (e.g., Sunset Boulevard or 19th Avenue) that would not require traversing Upper Great Highway. Based on data collected during a recent Sunday Streets event closure of The Great Highway (on July 7, 2013), it is projected that with a 50% reduction in capacity along Upper Great Highway, approximately 10% of vehicles would reroute to Sunset Boulevard or 19th Avenue, as observed from the corresponding increase in traffic volumes on these roadways .

As currently proposed Upper Great Highway–North would be narrowed to provide two travel lanes. The current two southbound travel lanes would be used for parking pockets, restrooms, signage, and other amenities. Designated storage areas would be maintained and dunes would be allowed to migrate inland. Sand ladders and modular boardwalks would be installed to provide and maintain access. A multi-use promenade would be introduced west of the roadway. Travel lanes would measure approximately 11 feet in width with a 5 foot bicycle lane provided in both directions. Chicanes would be installed on every other city block (Sunset District sized block) (i.e., Irving Street, Kirkham Street, Moraga Street, Ortega Street, Quintara Street, Santiago Street, and Ulloa Street), approximately 500 feet from the adjacent crossing locations (i.e., Judah Street, Lawton Street, Noriega Street, Pacheco Street, Rivera Street, Taraval Street, and Vicente Street). Vehicles traveling southbound on Upper Great Highway would be forced to shift laterally and negotiate around a median divider. Chicanes would not be installed in the northbound travel lane, with the exception of at the Vicente Street crossing location located approximately 850 feet north of Sloat Boulevard / The Great Highway, shown in Figure 2.

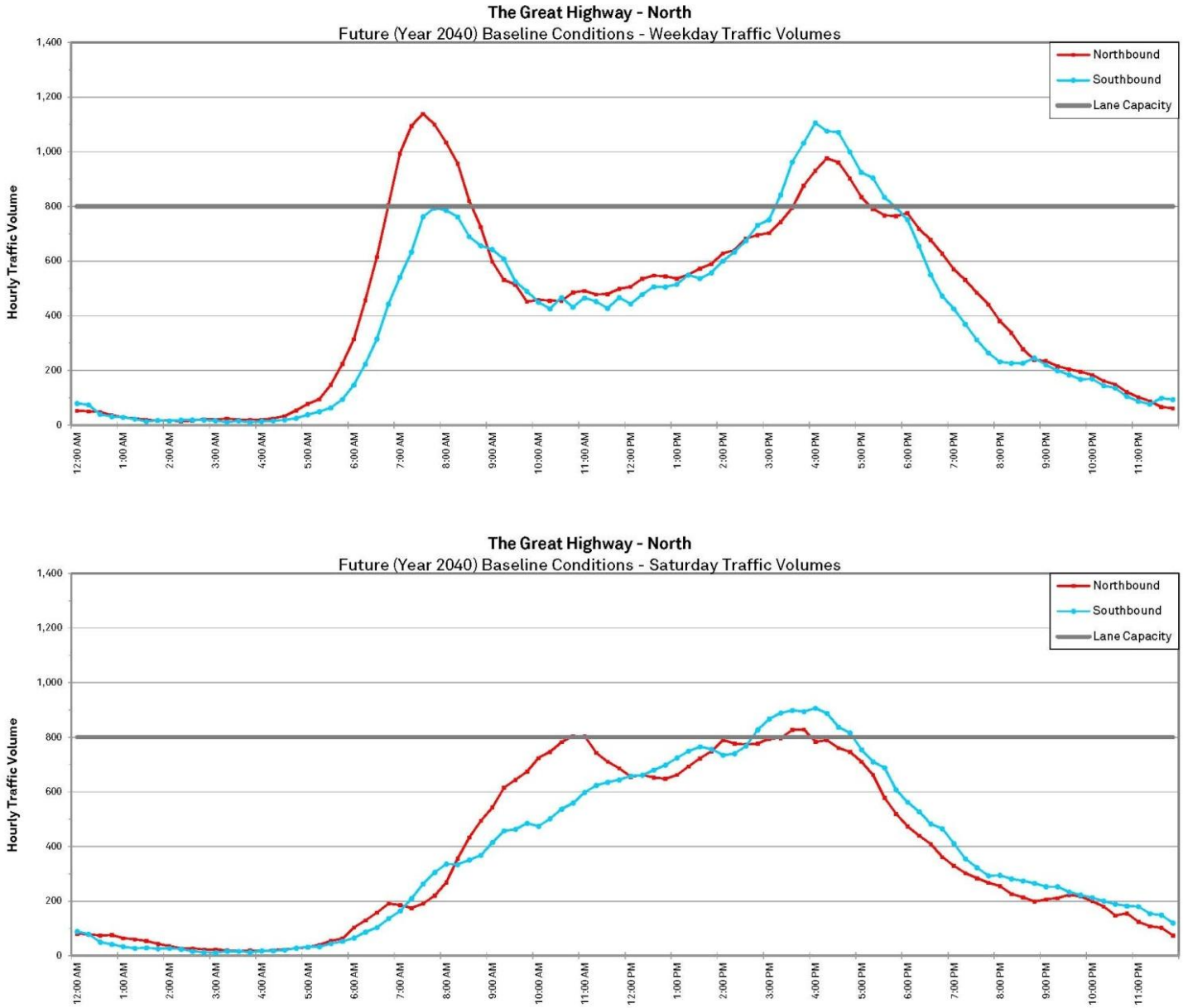

Figure 1: Future (Year 2040) Baseline Conditions Hourly Traffic Volumes, Upper Great Highway–North

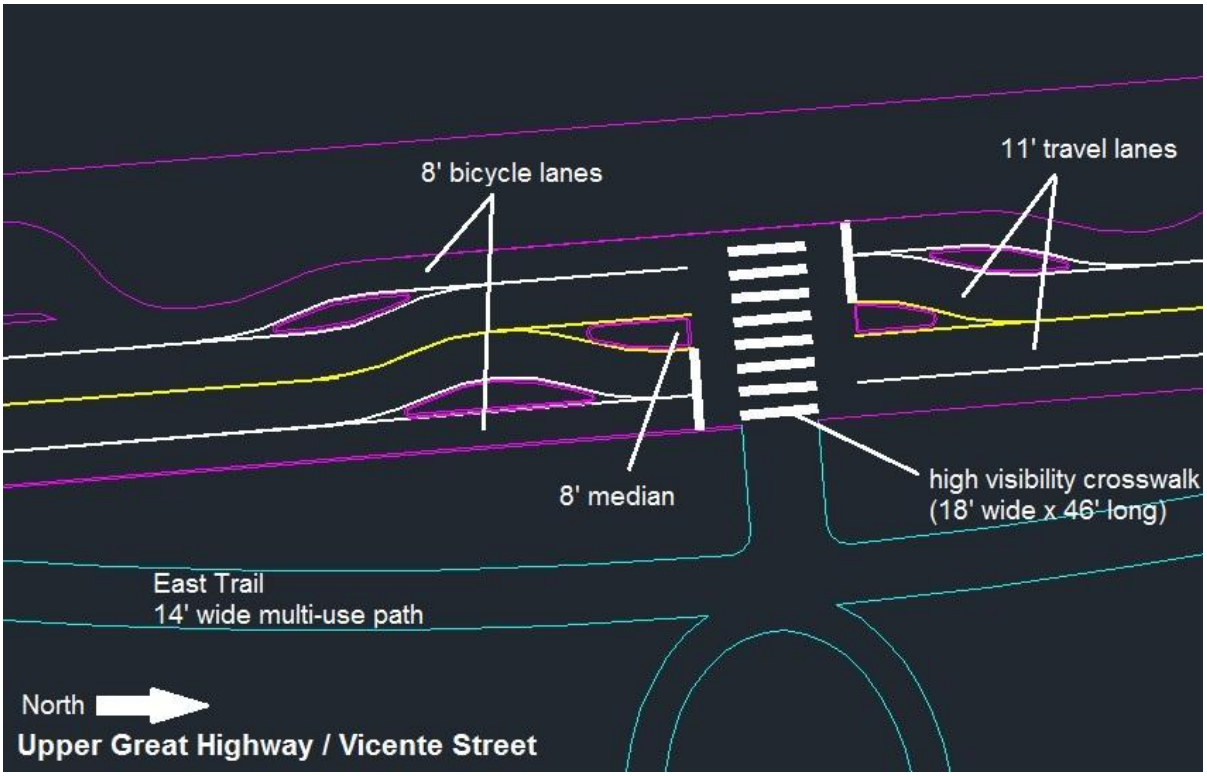

Figure 2: Upper Great Highway / Vicente Street

Installation of chicanes has been proven to reduce 85th percentile vehicle speeds by up to six percent (MDOT 2001). Reduction in vehicle speeds correlates with a reduction in vehicle throughput and capacity of a roadway. The estimated capacity on Upper Great Highway–North would be expected to decrease from approximately 800 vehicles per hour per lane in the current four lane configuration to between 600 and 700 vehicles per hour in a two lane configuration with high visibility crosswalks on every other city block (Sunset District sized blocks), and chicanes in the southbound lane on alternative city blocks (spaced approximately every 1,000 feet).

Intersection Operations. Intersections along Upper Great Highway–North would be reconfigured to provide one northbound through lane and one southbound through lane. The Lincoln Way / Upper Great Highway intersection would be reconfigured to provide one northbound through lane and right-turn pocket, one southbound through lane and left-turn pocket, and one westbound right-turn lane and one left-turn lane. The existing beach turnaround at the west end of Sloat Boulevard would be closed and the Sloat Boulevard / Upper Great Highway intersection would be reconfigured to provide one northbound through lane and one northbound right-turn pocket, one southbound through lane and one southbound left-turn pocket, and one westbound right-turn lane and one westbound left-turn lane.

Future (Year 2040) Conditions intersection Level of Service results for Lincoln Way / Upper Great Highway and Sloat Boulevard / The Great Highway under with a two lane configuration on Upper Great Highway–North are summarized in Table 9.

Table 9
Intersection Levels of Service – Upper Great Highway–North

Intersection	Peak Hour[1]	Future Baseline		Upper Great Highway–North, Two Lanes		
		LOS	Delay[2]	LOS	Delay[2]	Signal[3]
Lincoln Way / Upper Great Highway[4]	PM	B	13.0	C	26.1	C
	Midday	B	11.6	C	21.0	B
Sloat Boulevard / Upper Great Highway[4]	PM	D	40.1	D	46.9	C
	Midday	D	35.8	C	24.0	C

Source: AECOM, 2014.
Notes: "-" indicates not applicable for this scenario
[1] Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM)
[2] Delay is presented in seconds per vehicle. For all-way stop-controlled intersections, delay is presented for the worst stop-controlled approach.
[3] LOS with signalization or optimization of existing signal.
[4] Intersection would be reconfigured with reduction of Upper Great Highway–North to two lanes.

As shown in Table 9, all study intersections currently operate at LOS D or better during the weekday PM and Saturday midday peak hours under Future (Year 2040) Baseline Conditions and would continue to operate at LOS D or better with a two lane configuration on Upper Great Highway–North. The reduction in capacity at the Lincoln Way / Upper Great Highway intersection would increase vehicle delay by approximately 10 to 13 seconds and degrade operations from LOS B to LOS C with the existing signal timing. With signal optimization, e.g., phasing and timing improvements, operations of this intersection could be improved to LOS C and LOS B during the weekday PM and weekend midday peak hour, respectively. The removal of the beach turnaround at the west end of Sloat Boulevard would create a three-leg intersection with fewer conflict points (9 versus 32) and more green time allocated to the remaining approaches. With signal optimization, e.g., phasing and timing improvements, operations of this intersection could be improved to LOS C during the weekday PM and weekend midday peak hours.

Pedestrians and Bicycles. A two lane configuration on Upper Great Highway–North with narrowed travel lanes and lower traffic speeds would improve conditions for pedestrians and bicyclists. Pedestrian crossing distance would decrease from approximately 85 feet to approximately 35 feet across Upper Great Highway and from 85 feet to approximately 60 feet across Lincoln Way. Total pedestrian crossing time would decrease from approximately 25 seconds to 10 seconds to cross Upper Great Highway and from 25 seconds to 17 seconds to across Lincoln Way, assuming unimpeded movement at a speed of 3.5 feet per second. The crossing at Great Highway / Vicente Street would be the widest, measuring approximately 46 feet in length, including an eight foot median. Total crossing time would be approximately 13 seconds. Eight foot wide bicycle lanes, delineated with painted lane markings would be provided in both directions. Bicycle lanes would be wider than the minimum width (five feet) and would enable a bicyclist to pass a slower bicyclist, or ride side-by-side, without entering the adjacent travel lane.

The Great Highway – South

Design alternatives and variants that have been developed for The Great Highway–South, from Sloat Boulevard to Skyline Boulevard, include:

1. Maintain current configuration
2. Reduce The Great Highway, between Sloat Boulevard and Skyline Boulevard, to two lanes (utilize east (currently northbound) travel lanes

a. Bi-directional (one lane in each direction)
b. One-way southbound (two lanes southbound)
c. One-way northbound (two lanes northbound)

3. Full closure of The Great Highway, between Sloat Boulevard and Skyline Boulevard

The design alternatives for The Great Highway–South focus on improving pedestrian and bicycle connections, maintaining access to the zoo and parking lot, and accommodating truck access to the Westside Pump Station and the Oceanside Wastewater Treatment Plant. Another key issue is the need to accommodate a phased removal of The Great Highway–South, including maintaining a single lane in each direction.

Parking options for these design alternatives include:

- No parking
- Perpendicular and/or angled parking along Zoo (Armory) Road and Herbst Road
- Coastal access surface parking lot at south end of The Great Highway

The potential effects of these parking options will be discussed and evaluated in conjunction with the preferred design alternative.

Traffic Analysis

Future (Year 2040) Baseline Conditions hourly traffic volumes on The Great Highway–South (The Great Highway, between Sloat Boulevard and Skyline Boulevard) are shown in Figure 3.

As shown in Figure 3, with two lanes in each direction and a directional capacity of 1,600 vehicles per hour on The Great Highway – South, capacity would exceed demand during all hours. With one lane in each direction and a directional capacity of 800 vehicles per hour, future traffic volumes would be accommodated with the exception of approximately five hours each day during the peak period(s) when hourly demand would exceed capacity in at least one direction.

- Weekday
    - Northbound, 6:30 AM to 9:00 AM and 3:00 PM to 6:00 PM
    - Southbound, 7:00 AM to 8:30 AM and 3:30 to 6:00 PM
- Weekend
    - Northbound, 12:30 PM to 1:30 PM and 3:00 PM to 5:00 PM
    - Southbound, 2:30 PM to 5:00 PM

Reducing travel lanes on The Great Highway–South from the current four lane configuration to a two lane configuration may cause some motorists to shift to an alternate mode of travel (e.g., transit or carpool), change their time of travel (peak-spreading), or choose to travel to a similar or related destination or use an alternate route (e.g., Skyline Boulevard) that would not require traversing The Great Highway–South. For users on this section of The Great Highway with a local destination (primarily the zoo), vehicles were reassigned to the preferred zoo parking access routes. Based on these volumes, operating conditions with the project elements were calculated. With full closure of The Great Highway between Sloat Boulevard and Skyline Boulevard, zoo access would be provided via the existing (or relocated) entrance on Sloat Boulevard and via Zoo (Armory) Road on Skyline Boulevard. Access to the Westside Pump Station could be provided via a service road that would utilize The Great Highway northbound travel lane.

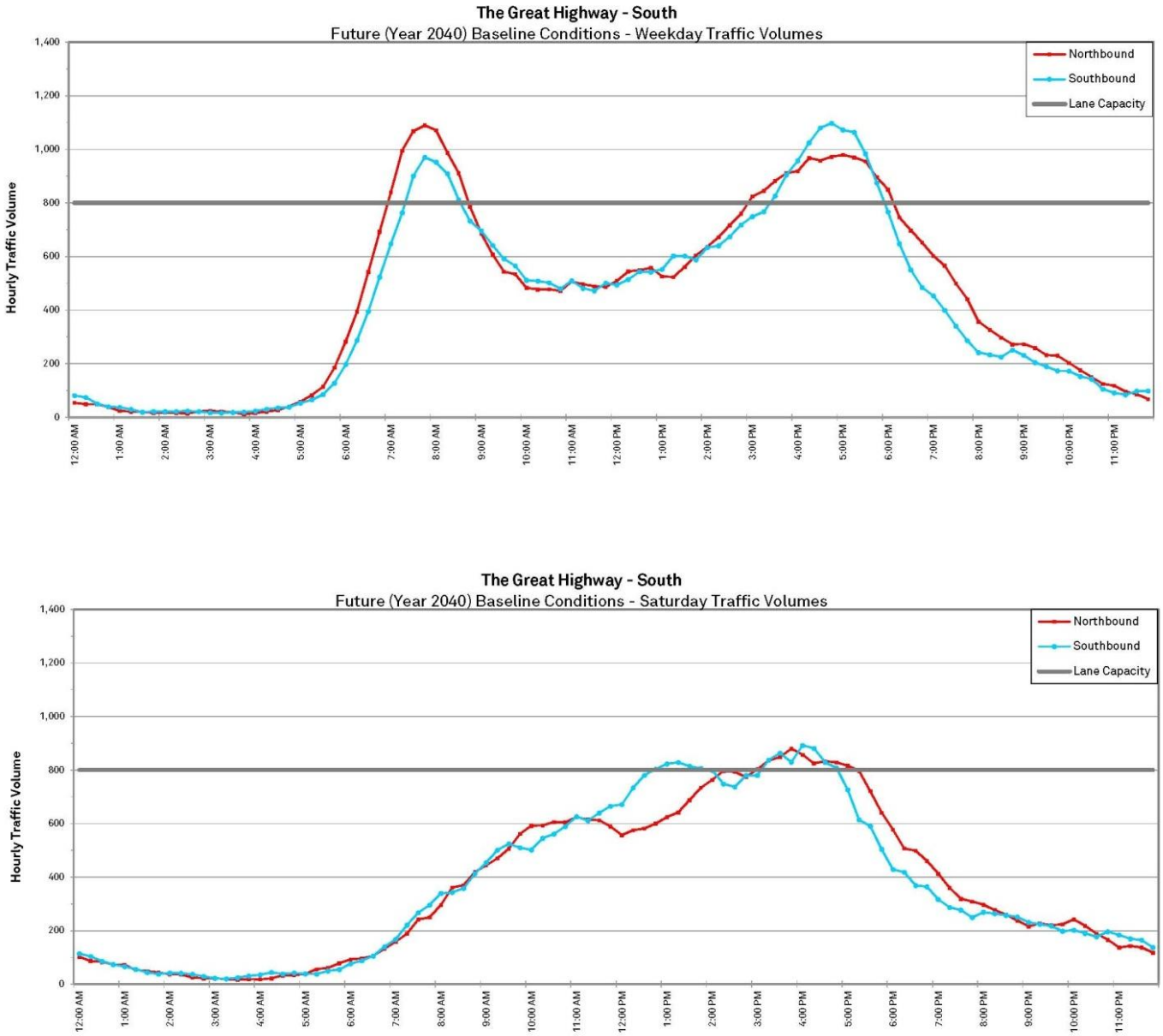

Figure 3: Future (Year 2040) Baseline Conditions Hourly Traffic Volumes, The Great Highway–South

Two Lanes, Bi-Directional. It is anticipated that through traffic using The Great Highway between Sloat Boulevard and Skyline Boulevard would use the northbound travel lanes along The Great Highway–South. The traffic assignment and diversion route is illustrated in Figure 4.

Figure 4: The Great Highway–South, Bi-Directional

With The Great Highway–South reduced to two lanes with bi-directional traffic, the Sloat Boulevard / Upper Great Highway intersection would be reconfigured to provide one northbound through lane and one right-turn pocket, one southbound through lane and one left-turn pocket, and one westbound right-turn lane and one westbound left-turn lane. The Skyline Boulevard / The Great Highway intersection would be reconfigured to provide one northbound through lane and one through-left lane, one southbound through lane and one right-turn pocket, and one eastbound left-right turn lane. Intersection Level of Service results for Future (Year 2040) Baseline Conditions and Future Conditions with The Great Highway–South reduced to two lanes, with bi-directional traffic is summarized in Table 10.

As shown in Table 10, all study intersections currently operate at LOS D or better during the weekday PM and Saturday midday peak hours under Future (Year 2040) Baseline Conditions. The reduction in capacity at the Skyline Boulevard / The Great Highway intersection would degrade operations of this stop-controlled intersection from LOS C to LOS F. With signalization, operations of this intersection could be improved to LOS E and LOS C during the weekday PM and weekend midday peak hour, respectively. The removal of the beach turnaround at the west end of Sloat Boulevard would create a three-leg intersection with fewer conflict points (9 versus 32) and more green time allocated to the remaining approaches. With signal optimization, e.g., phasing and timing improvements, operations of this intersection could be improved to LOS C during the weekday PM and weekend midday peak hours.

Table 10
Intersection Levels of Service – The Great Highway–South, Two Lanes Bi-Directional

Intersection	Peak Hour[1]	Future Baseline		The Great Highway–South, Two Lanes, Bi-Directional		
		LOS	Delay[2]	LOS	Delay[2]	Signal[3]
Sloat Boulevard / Upper Great Highway[4]	PM	D	43.8	D	45.7	C
	Midday	D	35.5	C	24.2	C
Skyline Boulevard / The Great Highway[4]	PM	C	18.7	F	> 180.0	E
	Midday	C	17.3	F	> 180.0	C

Source: AECOM, 2014.
Notes: "-" indicates not applicable for this scenario
[1] Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM)
[2] Delay is presented in seconds per vehicle. For all-way stop-controlled intersections, delay is presented for the worst stop-controlled approach.
[3] LOS with signalization or optimization of existing signal.
[4] Intersection would be reconfigured with reduction of The Great Highway–South to two lanes, bi-directional.

One-Way Southbound. It is anticipated that northbound through traffic using The Great Highway between Sloat Boulevard and Skyline Boulevard would reroute to Skyline Boulevard and Sloat Boulevard. The traffic assignment and diversion route is illustrated in Figure 5.

Figure 5: The Great Highway–South, One-Way Southbound

With The Great Highway–South reduced to two lanes with one-way southbound traffic, Sloat Boulevard / Upper Great Highway would be reconfigured to provide one southbound through lane with a left-turn pocket, and one westbound right-turn lane and one westbound left-turn lane. Skyline Boulevard / The Great Highway would be reconfigured to provide two northbound through lanes (to northbound Skyline Boulevard), two southbound through turn lanes (to southbound Great Highway), one eastbound left-turn lane (to northbound Skyline Boulevard) and one eastbound right-turn lane (to southbound Great Highway). Intersection Level of Service results for Future (Year 2040) Baseline Conditions and Future Conditions with The Great Highway–South reduced to two lanes, one-way southbound traffic is summarized in Table 11.

Table 11
Intersection Levels of Service – The Great Highway–South, One-Way Southbound

Intersection	Peak Hour[1]	Future Baseline		The Great Highway–South, One-Way Southbound		
		LOS	Delay[2]	LOS	Delay[2]	Signal[3]
Sloat Boulevard / Upper Great Highway[4]	PM	D	43.8	D	39.6	-
	Midday	D	35.5	D	45.7	-
Sloat Boulevard / 47th Avenue	PM	C	16.4	C	17.3	-
	Midday	B	11.7	B	13.9	-
Sloat Boulevard / 47th Avenue / Zoo Driveway[5]	PM	C	23.3	C	23.3	B
	Midday	A	9.2	B	14.7	B
Sloat Boulevard / 46th Avenue	PM	A	9.5	A	9.9	-
	Midday	A	10.0	B	10.6	-
Sloat Boulevard / 45th Avenue	PM	A	9.7	B	11.2	-
	Midday	B	11.1	B	13.3	-
Sloat Boulevard / Skyline Boulevard[6]	PM	D	30.0	F	> 180.0	C
	Midday	B	13.3	F	> 180.0	B
Skyline Boulevard / Herbst Road	PM	A	9.4	B	10.5	-
	Midday	B	12.1	A	8.2	-
Skyline Boulevard / Zoo (Armory) Road	PM	B	10.6	E	39.4	D
	Midday	B	10.3	E	43.4	B
Skyline Boulevard / The Great Highway[4]	PM	C	20.2	F	144.4	A
	Midday	C	17.3	F	101.9	B

Source: AECOM, 2014.
Notes: "-" indicates not applicable for this scenario
[1] Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM)
[2] Delay is presented in seconds per vehicle. For all-way stop-controlled intersections, delay is presented for the worst stop-controlled approach.
[3] LOS with signalization or optimization of existing signal.
[4] Intersection would be reconfigured with reduction of The Great Highway–South to two lanes, one-way southbound.
[5] Sloat Boulevard / 47th Avenue / Zoo Driveway would exist with the realignment of the existing Zoo Driveway to 47th Avenue. This intersection would provide entry to and exit from the zoo parking lot.
[6] The northbound left-turn volume increases substantially at Sloat Boulevard / Skyline Boulevard with reduction of The Great Highway–South to two lanes, one-way southbound.

As shown in Table 11, all study intersections currently operate at LOS D or better during the weekday PM and Saturday midday peak hours under Future (Year 2040) Baseline Conditions and would continue to operate at

LOS D or better with The Great Highway–South reduced to two lanes with one-way southbound traffic, with the exception of Sloat Boulevard / Skyline Boulevard (LOS F), Skyline Boulevard / Zoo (Armory Road) (LOS E), and Skyline Boulevard / The Great Highway (LOS F).

The removal of the beach turnaround at the west end of Sloat Boulevard would create a three-leg intersection with fewer conflict points (9 versus 32) and more green time allocated to the remaining approaches at Sloat Boulevard / Upper Great Highway. With signal optimization, e.g., phasing and timing improvements, operations of this intersection could be improved to LOS C during the weekday PM and weekend midday peak hours. The reduction in capacity at the Skyline Boulevard / The Great Highway intersection would degrade operations of this stop-controlled intersection from LOS C to LOS F. With signalization, operations of this intersection could be improved from LOS F to LOS E and LOS C during the weekday PM and weekend midday peak hour, respectively.

One-Way Northbound. It is anticipated that southbound through traffic using The Great Highway between Sloat Boulevard and Skyline Boulevard would reroute to Sloat Boulevard and Skyline Boulevard. The traffic assignment and diversion route is illustrated in Figure 6.

Figure 6: The Great Highway–South, One-Way Northbound

With The Great Highway–South reduced to two lanes with one-way northbound traffic, the Sloat Boulevard / Upper Great Highway intersection would be reconfigured to provide one northbound through lane and one right-turn lane, one southbound left-turn lane, and one westbound right-turn lane. Skyline Boulevard / The Great Highway would be reconfigured to provide two northbound left-turn lanes (to northbound Great Highway), two northbound through lanes (to northbound Skyline Boulevard), two southbound through lanes (to southbound Great Highway) and a southbound right-turn pocket (to northbound Great Highway). Intersection Level of Service results for Future (Year 2040) Baseline Conditions and Future Conditions with The Great Highway–South reduced to two lanes, one-way northbound traffic is summarized in Table 12.

Table 12
Intersection Levels of Service – The Great Highway–South, One-Way Northbound

Intersection	Peak Hour[1]	Future Baseline		The Great Highway–South, Two Lanes One-Way Northbound		
		LOS	Delay[2]	LOS	Delay[2]	Signal[3]
Sloat Boulevard / Upper Great Highway[4]	PM	D	43.8	F	119.1	-
	Midday	D	35.5	C	29.1	-
Sloat Boulevard / 47th Avenue	PM	C	16.4	C	17.1	A
	Midday	B	11.7	C	20.1	A
Sloat Boulevard / 47th Avenue / Zoo Driveway[5]	PM	C	23.3	D	38.2	C
	Midday	A	9.2	B	10.6	A
Sloat Boulevard / 46th Avenue[6]	PM	A	9.5	A	9.1	-
	Midday	A	10.0	A	9.8	-
Sloat Boulevard / 45th Avenue[6]	PM	A	9.7	B	11.1	-
	Midday	B	11.1	B	10.9	-
Sloat Boulevard / Skyline Boulevard[7]	PM	D	30.0	C	24.1	B
	Midday	B	13.3	B	13.3	B
Skyline Boulevard / Herbst Road	PM	A	9.4	E	69.7	B
	Midday	B	12.1	B	10.5	A
Skyline Boulevard / Zoo (Armory) Road	PM	B	10.6	B	11.2	-
	Midday	B	10.3	B	11.7	-
Skyline Boulevard / The Great Highway	PM	C	20.2	F	> 180.0	C
	Midday	C	17.3	C	23.9	B

Source: AECOM, 2014.
Notes: "-" indicates not applicable for this scenario
[1] Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM)
[2] Delay is presented in seconds per vehicle. For all-way stop-controlled intersections, delay is presented for the worst stop-controlled approach.
[3] LOS with signalization or optimization of existing signal.
[4] Intersection would be reconfigured with reduction of The Great Highway–South to two lanes, one-way northbound.
[5] Sloat Boulevard / 47th Avenue / Zoo Driveway would exist with the realignment of the existing Zoo Driveway to 47th Avenue. This intersection would provide entry to and exit from the zoo parking lot.
[6] Delay decreased slightly at this location despite an increase in eastbound traffic volumes. The reduction in delay can be attributed to an increase in intersection capacity utilization.
[7] The eastbound right-turn volume increases substantially at Sloat Boulevard / Skyline Boulevard with reduction of The Great Highway–South to two lanes, one-way northbound.

As shown in Table 12, all study intersections currently operate at LOS D or better during the weekday PM and Saturday midday peak hours under Future (Year 2040) Baseline Conditions and would continue to operate at LOS D or better with The Great Highway–South reduced to two lanes with one-way northbound traffic, with the exception of during the weekday PM peak hour at Sloat Boulevard / Upper Great Highway (LOS F), Skyline Boulevard / Herbst Road (LOS E), and Skyline Boulevard / The Great Highway (LOS F).

At Sloat Boulevard / Upper Great Highway, the high demand on the conflicting southbound left-turn (1,070 vehicles) and northbound through (800 vehicles) movements would cause the intersection to operate over capacity at LOS F during the weekday PM peak hour. At Skyline Boulevard / Herbst Road the northbound left-turn movement (20 vehicles) conflicts with the high demand on the critical southbound through movement (1,470 vehicles). Delay for northbound left-turning vehicles would exceed 200 seconds, and despite the low volume on this movement, contributes to the intersection average control delay of 69.7 seconds. With signal optimization, e.g., phasing and timing improvements, delay for the northbound left-turn movement could be reduced to approximately 80 seconds, and the overall operations of this intersection could be improved to LOS B during the weekday PM peak hour. At the unsignalized Skyline Boulevard / The Great Highway intersection, the high demand on the conflicting northbound left-turn (870 vehicles) and southbound through (1,610 vehicles) movements would cause the intersection to operate over capacity at LOS F during the weekday PM peak hour. With signalization, operations of this intersection could be improved to LOS C with average control delay of 26.9 seconds during the weekday PM peak hour.

Full Closure. It is anticipated that through traffic using The Great Highway between Sloat Boulevard and Skyline Boulevard would reroute to Sloat Boulevard and Skyline Boulevard. The Sloat Boulevard / Upper Great Highway intersection would not exist with full closure of The Great Highway–South. Optional designs for this location include DPW truck access on the south leg and a pedestrian-actuated or automated mid-block crossing facility to provide access to the multi-use path to the west. A potential future configuration of the Sloat Boulevard / Upper Great Highway intersection is shown in Figure 7. Intersection Level of Service results for Future (Year 2040) Baseline Conditions and Future Conditions with The Great Highway–South reduced to two lanes, full closure traffic is summarized in Table 13.

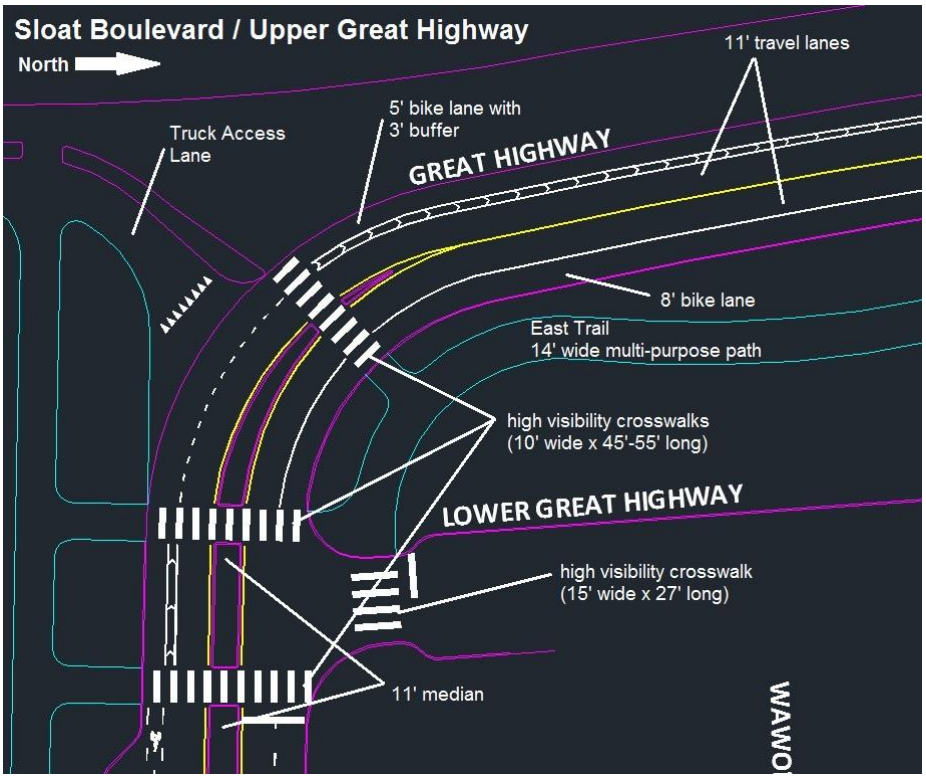

Figure 7: Sloat Boulevard / Upper Great Highway, Great Highway South–Full Closure

Table 13

Intersection Levels of Service – The Great Highway–South, Full Closure

Intersection	Peak Hour[1]	Future Baseline		The Great Highway–South, Full Closure		
		LOS	Delay[2]	LOS	Delay[2]	Signal[3]
Sloat Boulevard / Upper Great Highway[4]	PM	D	43.8	-	-	-
	Midday	D	35.5	-	-	-
Sloat Boulevard / 47th Avenue[5]	PM	C	16.4	D	29.4	A
	Midday	B	11.7	B	14.8	A
Sloat Boulevard / 47th Avenue / Zoo Driveway[5]	PM	C	23.3	D	35.8	-
	Midday	A	9.2	B	10.3	-
Sloat Boulevard / 46th Avenue[6]	PM	A	9.6	A	9.4	-
	Midday	A	10.0	B	10.6	-
Sloat Boulevard / 45th Avenue[6]	PM	A	9.7	B	10.1	-
	Midday	B	11.1	B	12.5	-
Sloat Boulevard / Skyline Boulevard[7]	PM	D	30.0	F	< 145.0	B
	Midday	B	13.3	F	< 180.0	B
Skyline Boulevard / Herbst Road	PM	A	9.4	B	14.6	-
	Midday	B	12.1	A	9.1	-
Skyline Boulevard / Zoo (Armory) Road	PM	B	10.6	F	> 180.0	E
	Midday	B	10.3	F	> 180.0	C
Skyline Boulevard / The Great Highway	PM	C	20.2	-	-	-
	Midday	C	17.3	-	-	-

Source: AECOM, 2014.

Notes: "-" indicates not applicable for this scenario

[1] Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM)

[2] Delay is presented in seconds per vehicle. For all-way stop-controlled intersections, delay is presented for the worst stop-controlled approach.

[3] LOS with signalization or optimization of existing signal.

[4] The Sloat Boulevard / Upper Great Highway intersection would not exist with full closure of The Great Highway–South. Optional designs for this location include DPW truck access on the south leg, addition of a beach turnaround on the west leg, and pedestrian-actuated or automated mid-block crossing facility to provide access to the multi-use path.

[5] Optional intersection designs for Sloat Boulevard / 47th Avenue include realigning the Zoo Driveway to the south leg and allowing entry and exit from the zoo parking lot.

[6] Delay decreased slightly at this location despite an increase in eastbound and westbound traffic volumes. The improvement is due to the increase in intersection capacity utilization.

[7] The northbound left-turn and eastbound right-turn volumes increase substantially at Sloat Boulevard / Skyline Boulevard with full closure of The Great Highway–South.

[8] The Skyline Boulevard / The Great Highway intersection would not exist with full closure of The Great Highway–South. Optional intersection designs include DPW truck access and coastal parking access road and/or bicycle lane.

Sloat Boulevard – West

Design alternatives and variants that have been developed for Sloat Boulevard–West, between Upper Great Highway and 45th Avenue, include:

1. Maintain current configuration
2. Reduce Sloat Boulevard, between The Great Highway and 45th Avenue, to three lanes (one lane in each direction with a center turn lane)
    a. Realign zoo access to Sloat Boulevard / 47th Avenue
    b. Designate on-street (curbside) drop-off area

The design alternatives for Sloat Boulevard–West focus on improving pedestrian and bicycle connections while maintaining access to Ocean Beach and the San Francisco Zoo. Reconfiguration of Sloat Boulevard creates the potential to connect the Great Highway multi-use path with the Lake Merced path. Cyclists could be accommodated via a bicycle-only path or shared multi-use path adjacent the zoo fence, on-street bicycle lanes, on-street buffered bicycle lanes (cycle track), or some combination of these. Realignment of the zoo access to 47th Avenue would enable motorists to enter and exit from all directions and would also require the relocation of a small service building.

Parking options for Sloat Boulevard–West includes:

- No parking
- Parallel and/or back-in angled parking

The potential effects of these parking options will be discussed and evaluated in conjunction with the design alternative.

Traffic Analysis

Maintaining a five lane configuration on Sloat Boulevard would accommodate current and future forecast traffic volumes with little or no delay. However, the higher travel speeds and longer pedestrian crossings create safety concerns that would be reduced by narrowing Sloat Boulevard to three lanes between Upper Great Highway and 45th Avenue, as shown in Figure 8.

Reducing travel lanes on Sloat Boulevard is not expected to result in an appreciable reduction in traffic volumes given the lack of alternate parallel facilities. However, due to the narrowing of the traveled way U-turns should be prohibited along this segment. Additionally, the potential implementation of other major project elements or design alternatives (i.e., closure of the Great Highway between Sloat Boulevard and Skyline Boulevard and the realignment of the Zoo Driveway with 47th Avenue) would affect traffic volumes along this section of Sloat Boulevard. The proposed configuration of the Sloat Boulevard / 47th Avenue / Zoo Driveway intersection is shown in Figure 9.

To account for the changes in traffic patterns resulting from implementation of one or more project elements, vehicles were manually reassigned to the transportation network to determine operating conditions. Intersection Level of Service results for Future (Year 2040) Baseline Conditions and Future Conditions with Sloat Boulevard–West reduced to three lanes (one lane in each direction with a center turn lane) with the various configurations of the Great Highway–South (two lanes bi-directional, one-way southbound, one-way northbound, and full closure) are summarized in Table 14.

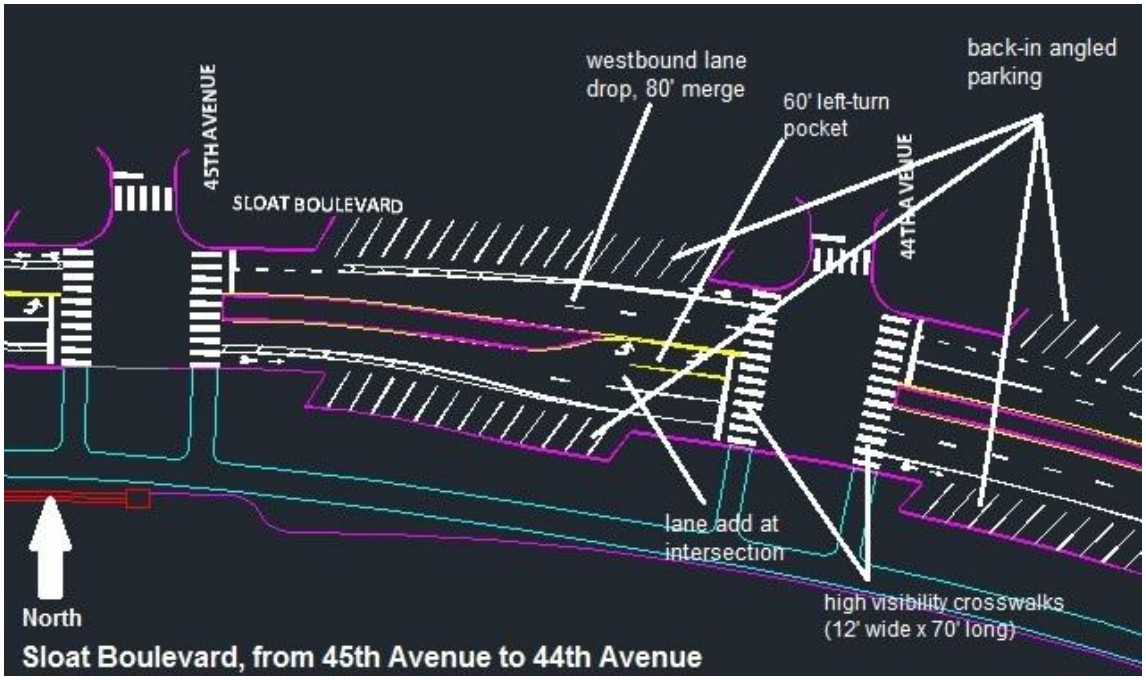

Figure 8: Sloat Boulevard, from 45th Avenue to 44th Avenue

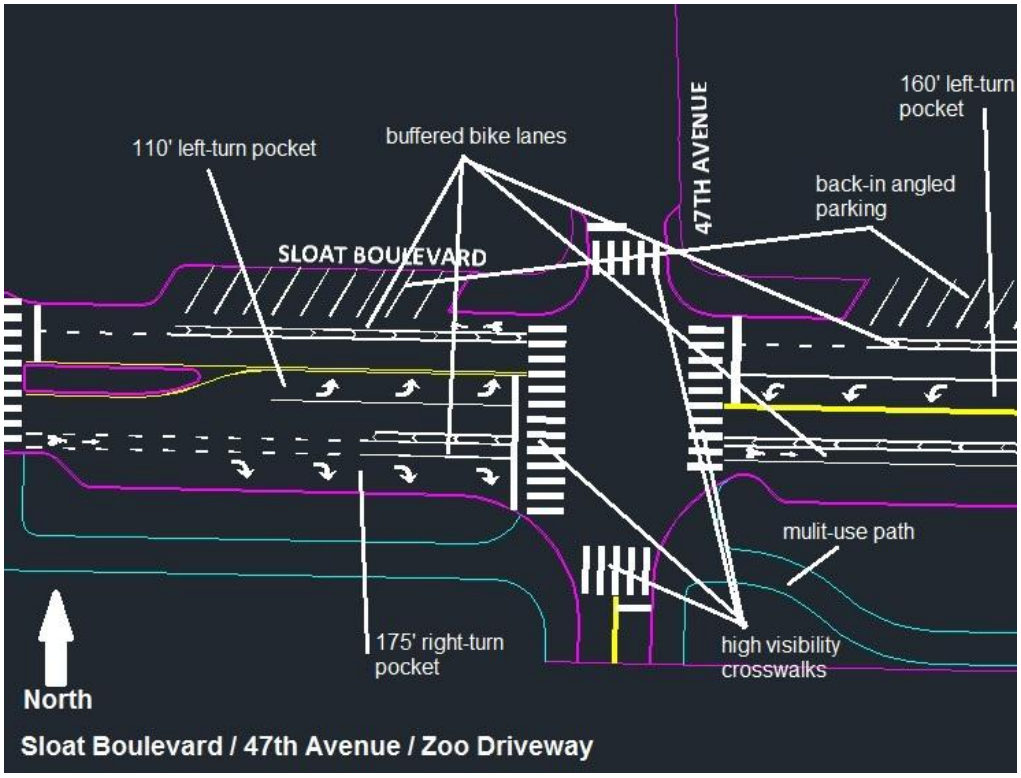

Figure 9: Sloat Boulevard / 47th Avenue / Zoo Driveway

Table 14
Intersection Levels of Service – Sloat Boulevard–West, Three Lanes (one lane in each direction with a center turn lane)

Intersection	Peak Hour[1]	Future Baseline		The Great Highway–South[3]							
				Bi-Directional		One-Way Southbound		One-Way Northbound		Full Closure	
		LOS	Delay[2]	LOS	Delay[2]	LOS	Delay[2]	LOS	Delay[2]	LOS	Delay[2]
Sloat Boulevard / Upper Great Highway[4]	PM	D	43.8	B	13.3	C	23.1	F	> 180.0	-	-
	Midday	D	35.5	B	11.3	B	14.7	F	81.5	-	-
Sloat Boulevard / 47th Avenue / Zoo Driveway[5]	PM	C	23.3	A	5.8	D	48.7	C	34.8	B	12.8
	Midday	A	9.2	A	6.6	F	98.8	A	7.5	E	66.1
Sloat Boulevard / 46th Avenue	PM	A	9.5	B	10.7	D	45.5	C	27.4	B	10.7
	Midday	A	10.0	B	12.1	E	64.7	A	6.9	D	50.2
Sloat Boulevard / 45th Avenue	PM	A	9.8	B	10.7	F	114.6	F	98.2	E	71.1
	Midday	B	11.2	B	12.1	F	107.2	B	15.1	F	107.2
Sloat Boulevard / Skyline Boulevard[6]	PM	C	24.1	C	23.2	F	> 180.0	C	24.1	F	145.0
	Midday	B	13.3	B	13.3	F	> 180.0	B	14.0	F	> 180.0
Sloat Boulevard / Skyline Boulevard (signal)	PM	-	-	C	20.6	C	20.3	C	21.9	C	20.3
	Midday	-	-	A	9.6	B	12.3	B	10.5	B	12.3

Source: AECOM, 2014.

Notes: "-" indicates not applicable for this scenario.

[1] Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM).

[2] Delay is presented in seconds per vehicle. For all-way stop-controlled intersections, delay is presented for the worst stop-controlled approach.

[3] Delay and LOS are presented assuming the intersection configurations obtained from the Ocean Beach Master.dwg file and assumes signalization of Sloat Boulevard / 46th Avenue, Sloat Boulevard / 45th Avenue. Delay and LOS are presented for Sloat Boulevard / Skyline Boulevard with all-way stop and signal control.

[4] The Sloat Boulevard / Upper Great Highway intersection would not exist with full closure of The Great Highway–South. Optional designs for this location include truck access on the south leg, addition of a beach turnaround on the west leg, and pedestrian-actuated or automated mid-block crossing facility to provide access to the multi-use path.

[5] Intersection level of service results are provided for the realigned Sloat Boulevard / 47th Avenue / Zoo Driveway intersection and assume optimization of the signal. Under Future Baseline conditions eastbound and westbound U-turns are accommodated. With Sloat Boulevard reduced to three lanes, U-turns would not be possible due to the narrower configuration.

[6] Intersection level of service results are provided for the stop-controlled intersection. HCM analysis does not allow more than two legs per controlled approach. The eastbound right-turn, northbound right-turn, and westbound through movements are modeled as free movements. Therefore, under the "one-way northbound" and "full closure" scenarios, the increase in the number of vehicles making an eastbound right-turn is not reflected in the delay calculation.

As shown in Table 14, all study intersections currently operate at LOS D or better during the weekday PM and Saturday midday peak hours under Future (Year 2040) Baseline Conditions and would continue to operate at LOS D or better with Sloat Boulevard reduced to three lanes and The Great Highway–South reduced to two lanes with bi-directional traffic. Sloat Boulevard / 45th Avenue and Sloat Boulevard / Skyline Boulevard would degrade to operate at LOS F during one or both peak hours with The Great Highway–South reduced to two lanes with one-way southbound traffic and with full closure of The Great Highway–South. Sloat Boulevard / Upper Great Highway and Sloat Boulevard / 45th Avenue would degrade to operate at LOS F during one or both beak hours with The Great Highway–South reduced to two lanes with one-way northbound traffic.

Transit. Increased traffic congestion along transit routes (18-46th Avenue and 23-Monterey) would slow down transit vehicles and result in increased transit travel time. As traffic volumes on the adjacent street increase re-entering the flow of traffic becomes more difficult for transit vehicles. Transit re-entry delay would increase at each bus stop along Sloat Boulevard. Additionally, although increases in transit ridership are generally viewed positively, the amount of time required for passenger boarding and alighting (i.e., dwell time) is directly correlated to the number of passengers boarding the transit vehicle. As transit ridership increases, transit vehicles would have to spend more time at stops, which may increase overall transit travel times.

Pedestrian and Bicycles. A three lane configuration on Sloat Boulevard–West with narrowed travel lanes and lower traffic speeds would improve conditions for pedestrians and bicyclists. Specifically, access to the San Francisco Zoo, Ocean Beach, and other local destinations would be facilitated by reduced crossing distances and slower traffic speeds, and the reconfiguration would allow for the creation of a new pedestrian greenway. The greenway would function as the new bike and pedestrian arrival to Ocean Beach's south end.

Pedestrian crossing distance would decrease from approximately 110 feet to approximately 70 feet across Sloat Boulevard at this location. Total pedestrian crossing time would decrease from approximately 31 seconds to 22 seconds, assuming unimpeded movement at a speed of 3.5 feet per second. Reducing crossing distances and providing designated pedestrian phases would improve conditions for the approximately 125 pedestrians (85 east crosswalk, 65 west crosswalk) that are estimated to cross Sloat Boulevard at 47th Avenue during the Saturday midday peak hour. Bulbouts would increase the street corner circulation/waiting area and improve pedestrian visibility and safety.

Bicycle lanes measuring five feet in width with a three foot striped buffer would be provided on both sides of Sloat Boulevard, from The Great Highway to 45th Avenue. To enable bicyclists to correctly position themselves to the left of the eastbound right turn lane at the realigned Sloat Boulevard / 47th Avenue / Zoo Driveway intersection, a through bike lane would be provided. This would lead to more predictable bicyclist and motorist travel movements and alert motorists to expect and yield to merging bicycle traffic.

Sloat Boulevard – East

Design alternatives and variants that have been developed for Sloat Boulevard–East, between 45th Avenue and Skyline Boulevard, include:

1. Maintain current configuration
2. Transition Sloat Boulevard from three lanes to five lanes between 45th Avenue and Skyline Boulevard
    a. Transition at 42nd Avenue
    b. Transition at 41st Avenue

The design alternatives for Sloat Boulevard–East focus on accommodating the higher traffic volumes on Sloat Boulevard east of 45th Avenue. The higher traffic volumes would require a transition from the three

lane configuration on Sloat Boulevard near Upper Great Highway, to a five lane configuration on Sloat Boulevard near Skyline Boulevard. Potential means of transitioning Sloat Boulevard from three lanes to five lanes include dropping a through lane as turning lane or adding dedicated a receiving lane at an intersection. As currently proposed, the transition would occur at Sloat Boulevard / 44th Avenue (see Figure 7).

Parking options for Sloat Boulevard–East includes:

- No parking
- Parallel parking and/or back-in angled parking
- Reconfigure and restripe existing surface parking lot

The potential effects of these parking options will be discussed and evaluated in conjunction with the design alternative.

Pedestrian and Bicycles. The proposed design features (e.g., multi-use path along the zoo fence, buffered bike lane, landscaped median/pedestrian refuge, wider landscaped sidewalks and corner bulbouts) proposed along Sloat Boulevard–East would improve conditions for pedestrians and bicyclists. Reconfiguration and signalization of the Sloat Boulevard / Skyline Boulevard intersection is essential to facilitating an improved bicycle and pedestrian connection to the proposed greenway.

Skyline Boulevard

Design alternatives and variants that have been developed for Skyline Boulevard, between Sloat Boulevard and The Great Highway, include:

1. Maintain current configuration
2. Reconfigure intersections along Skyline Boulevard
    a. Sloat Boulevard, Signalized T-intersection or roundabout
    b. Lake Merced Boulevard, Signalized four-way intersection or roundabout
    c. Herbst Road, T-intersection in conjunction with roundabout at Lake Merced Boulevard
    d. Zoo (Armory) Road, Signalized T-intersection or roundabout
    e. The Great Highway, Signalized three-way intersection or roundabout

The design alternatives for Skyline Boulevard focus on improving conditions for bicycles and pedestrians while improving vehicle progression along this stretch of roadway. Skyline Boulevard would be configured as a four lane roadway (two lanes in each direction) with a median that varies in width and six foot bicycle lanes on both sides.

Traffic Analysis

Roundabout Level of Service results for Future (Year 2040) Baseline Conditions and Future Conditions with the various configurations of the Great Highway–South (one-way southbound, one-way northbound, and full closure) that would affect traffic volumes along Skyline Boulevard are summarized in Table 15. The estimated 95th percentile and mean queue lengths are summarized in Table 16. The 95th percentile queue is defined to be the queue length (measured in vehicles) that has only a five percent probability of being exceeded during the analysis time period. The mean queue length is computed as the product of the average delay per vehicle and the entry flow rate for the evaluated movement.

Table 15
Roundabout Levels of Service

Intersection	Peak Hour[1]	Future Baseline		The Great Highway–South					
				One-Way Southbound		One-Way Northbound		Full Closure	
		LOS	Delay[2]	LOS	Delay[2]	LOS	Delay[2]	LOS	Delay[2]
Sloat Blvd / Skyline Blvd	PM	D	26.8	F	148.0	F	> 180.0	F	> 180.0
	Midday	B	12.3	F	62.3	C	15.8	F	73.2
Skyline Blvd / The Great Highway	PM	D	28.3	F	62.7	F	176.3	-	-
	Midday	C	18.4	C	22.5	D	26.8	-	-
Skyline Blvd / Lake Merced Blvd	PM	B	11.1	E	42.9	D	31.5	E	38.7
	Midday	A	8.6	C	24.7	A	9.8	C	21.7
Skyline Blvd / Zoo (Armory) Road	PM	A	7.1	D	30.7	B	14.3	D	26.4
	Midday	A	6.6	C	16.5	A	7.3	C	15.2

Source: AECOM, 2014.
Notes: "-" indicates not applicable for this scenario.
[1] Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM).
[2] Delay is reported as the average intersection delay.

Table 16
Roundabout 95th Percentile and Mean Queue Length (vehicles)

Intersection	Leg	Future Baseline		The Great Highway–South					
				One-Way Southbound		One-Way Northbound		Full Closure	
		PM	Mid.	PM	Mid.	PM	Mid.	PM	Mid.
Sloat Blvd / Skyline Blvd	South	19 (6)	7 (2)	51 (47)	29 (16)	19 (12)	7 (4)	51 (47)	29 (19)
	East	5 (4)	3 (2)	25 (22)	13 (8)	6 (6)	3 (2)	23 (22)	13 (10)
	West	3 (3)	2 (1)	2 (2)	2 (7)	106 (85)	9 (3)	61 (61)	26 (19)
Skyline Blvd / The Great Highway	North	7 (3)	5 (2)	2 (2)	2 (2)	59 (49)	12 (4)	-	-
	South	17 (8)	11 (5)	16 (14)	9 (5)	15 (11)	9 (8)	-	-
	West	7 (4)	3 (2)	37 (15)	14 (4)	-	-	-	-
Skyline Blvd / Lake Merced Blvd	North	2 (1)	2 (2)	2 (12)	2 (2)	21 (9)	4 (2)	11 (9)	6 (4)
	South	4 (3)	2 (2)	23 (13)	14 (6)	4 (5)	2 (1)	22 (11)	12 (5)
	East	3 (1)	2 (2)	10 (3)	7 (2)	3 (3)	2 (1)	10 (3)	6 (2)
Skyline Blvd / Zoo (Armory) Road	North	1 (1)	1 (1)	1 (3)	1 (2)	10 (4)	2 (1)	6 (6)	3 (2)
	South	2 (1)	2 (1)	21 (9)	12 (4)	3 (2)	2 (1)	20 (8)	10 (4)
	West	0 (1)	0 (1)	1 (1)	2 (3)	0 (0)	0 (0)	1 (1)	3 (1)

Source: AECOM, 2014.
Notes: "-" indicates not applicable for this scenario. Mid. = Midday.
Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM).
The 95th percentile and mean queue lengths are provided in vehicles. 1 vehicle = approximately 20 feet.

As shown in Table 15, all locations where roundabouts were considered would operate at LOS D or better with an average delay of less than 30.0 seconds during the weekday PM and Saturday midday peak hours under Future (Year 2040) Baseline Conditions. Roundabouts at Sloat Boulevard / Skyline Boulevard and Skyline Boulevard / The Great Highway would degrade to operate at unacceptable LOS F during one or both peak hours under all Future with Project Conditions scenarios (i.e., The Great Highway–South reduced to two lanes operating as one-way southbound, one-way northbound, and with full closure of The Great Highway–South).

Right-turn bypass lanes were considered to improve operations at these two intersection locations under Future with Project Conditions scenarios. The provision of a right-turn bypass lane allows right-turning traffic to bypass the roundabout, providing additional capacity for the through and left-turn movements at the approach. They are most beneficial when the demand of an approach exceeds its capacity and a significant proportion of the traffic at the approach is turning right.

There are two design options for right-turn bypass lanes:

- Acceleration lane at exit leg – Construct a bypass lane parallel to the adjacent roadway with sufficient length to allow vehicles in the bypass lane and vehicles exiting the roundabout to accelerate to comparable speeds. Merge the bypass lane with the exit lane at a taper rate according to AASHTO guidelines for the appropriate design speed.
- Yield control at exit leg – Construct a bypass lane with a yield-controlled entrance onto the adjacent exit roadway.

The option of providing an acceleration lane at the exit leg provides better operational performance. However, the option of providing a yield control at the exit leg generally requires less construction and right-of-way and is better for pedestrians and bicyclists.

Roundabout with right-turn bypass configurations are summarized as follows for the Future with Project Conditions scenarios:

- One-Way Southbound – Right-turn bypass lane added to the northbound approach at Sloat Boulevard / Skyline Boulevard and the eastbound approach at Skyline Boulevard / The Great Highway.
- One-Way Northbound – Right-turn bypass lane added to the eastbound approach at Sloat Boulevard / Skyline Boulevard and the southbound approach at Skyline Boulevard / The Great Highway.
- Full Closure – Right-turn bypass lane added to the northbound and eastbound approaches at Sloat Boulevard / Skyline Boulevard.

Roundabout Level of Service results for the right-turn bypass configurations are summarized in Table 17. The 95th percentile and mean queue length results are summarized in Table 18.

As shown in Table 17, the roundabout at Sloat Boulevard / Skyline Boulevard would continue to operate at unacceptable LOS F (55.4 seconds of delay) during the weekday PM peak hour under Future Conditions with The Great Highway–South reduced to two lanes, operating as one-way southbound, and the addition of a right-turn bypass lane on the northbound approach. Under Future Conditions with The Great Highway–South reduced to two lanes, operating as one-way northbound, the addition of a right-turn bypass lane on the southbound approach to Skyline Boulevard / The Great Highway would improve LOS from LOS D (26.8 seconds of delay) to LOS C (23.0 seconds of delay). This intersection would continue to operate at LOS F (176.3 seconds of delay) during the weekday PM peak hour. The addition of a right-turn bypass lane on the northbound and eastbound approaches to Sloat Boulevard / Skyline Boulevard would improve Level of Service from LOS F (greater than 180.0 seconds of delay) to LOS E (41.5 seconds of delay) and LOS C (20.1 seconds of delay) during the weekday PM and Saturday midday peak hours, respectively.

Table 17
Roundabout Levels of Service – Mitigated Conditions

Intersection	Peak Hour[1]	The Great Highway–South					
		One-Way Southbound[3]		One-Way Northbound[4]		Full Closure[5]	
		LOS	Delay[2]	LOS	Delay[2]	LOS	Delay[2]
Sloat Blvd / Skyline Blvd	PM	F	55.4	C	17.9	E	41.5
	Midday	D	25.1	A	9.4	C	20.1
Skyline Blvd / The Great Highway	PM	C	16.7	F	176.3	-	-
	Midday	B	11.0	C	23.0	-	-

Source: AECOM, 2014.
Notes: "-" indicates not applicable for this scenario.
[1] Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM).
[2] Delay is reported as the average intersection delay.
[3] The mitigated configuration includes adding a right-turn bypass lane on the northbound approach at Sloat Boulevard / Skyline Boulevard and the eastbound approach at Skyline Boulevard / The Great Highway.
[4] The mitigated configuration includes adding a right-turn bypass lane on the eastbound approach at Sloat Boulevard / Skyline Boulevard and the southbound approach at Skyline Boulevard / The Great Highway.
[5] The mitigated configuration includes adding a right-turn bypass lane on the northbound and eastbound approaches at Sloat Boulevard / Skyline Boulevard.

Table 18
Roundabout 95th Percentile and Mean Queue Length (vehicles) – Mitigated Conditions

Intersection	Leg	The Great Highway–South					
		One-Way Southbound[3]		One-Way Northbound[4]		Full Closure[5]	
		PM	Mid.	PM	Mid.	PM	Mid.
Sloat Blvd / Skyline Blvd	South	11 (11)	7 (4)	19 (4)	7 (2)	11 (8)	7 (3)
	East	25 (8)	13 (3)	6 (3)	3 (1)	23 (6)	13 (3)
	West	2 (4)	2 (3)	11 (8)	1 (2)	5 (3)	3 (1)
Skyline Blvd / The Great Highway	North	2 (2)	2 (1)	59 (49)	10 (3)	-	-
	South	16 (5)	9 (3)	15 (8)	9 (6)	-	-
	West	2 (0)	1 (2)	-	-	-	-

Source: AECOM, 2014.
Notes: "-" indicates not applicable for this scenario. Mid. = Midday.
Peak Hour analysis includes weekday PM peak hour (5:00 PM to 6:00 PM) and Saturday midday peak hour (1:00 PM to 2:00 PM).
The 95th percentile and mean queue lengths are provided in vehicles. 1 vehicle = approximately 20 feet.
[3] The mitigated configuration includes adding a northbound right bypass lane at Sloat Boulevard / Skyline Boulevard and an eastbound right bypass lane at Skyline Boulevard / The Great Highway.
[4] The mitigated configuration includes adding an eastbound right bypass lane at Sloat Boulevard / Skyline Boulevard and a southbound right bypass lane at Skyline Boulevard / The Great Highway.
[5] The mitigated configuration includes adding a northbound right and eastbound right bypass lane at Sloat Boulevard / Skyline Boulevard.

Transit. For safety and operational reasons, bus stops should be located as far away from entries and exits as possible, and never in the circulatory roadway.

- Near-side stops – If a bus stop is to be provided on the near side of a roundabout, it should be located far enough away from the splitter island so that a vehicle overtaking a stationary bus is in no danger of being forced into the splitter island if the bus begins to pull away from the stop.
- Far-side stops – Bus stops on the far side of a roundabout should be constructed with pull-outs to minimize queuing into the roundabout. These stops should be located beyond the pedestrian crossing to improve visibility of pedestrians to exiting vehicles.

Pedestrians and Bicycles. Pedestrian crossing locations at roundabouts are a balance among pedestrian convenience, pedestrian safety, and roundabout operations. Both crossing location and crossing distance are important for pedestrian convenience and safety. In general, right-turn bypass lanes should be avoided, especially in urban areas with bicycle and pedestrian activity. The entries and exits of bypass lanes can increase conflicts with bicyclists. The typically higher speeds of bypass lanes and the lower expectation of drivers to stop, increases the risk of collisions with pedestrians.

The installation of well designed splitter islands of sufficient size to store pedestrians, thus allowing them to cross only one direction of traffic at a time, will result in pedestrians being able to move safely and freely around the intersection. Crosswalks should be located to take advantage of the splitter island. Crossings should be located at a distance away from the yield line to reduce the chance that vehicles will be queued across the crosswalk and a distance away from the exit to reduce the chance that vehicles will be queued in the circulation lane.

To accommodate bicycles, bicycle lanes should be terminated in advance of the roundabout to encourage cyclists to mix with vehicle traffic. It is recommended that on approaches with bicycle lanes, the bicycle lane should terminate approximately 100 feet upstream of the yield line to allow for merging with vehicles. This method is most successful at smaller roundabouts with speeds below 20 miles per hour where bicycle speeds can more closely match vehicle speeds. To accommodate bicyclists who prefer not to use the circulatory roadway, a widened sidewalk or a shared bicycle/pedestrian path may be provided physically separated from the circulatory roadway.

Zoo (Armory) Road and Herbst Road

Design alternatives and variants that have been developed for Zoo (Armory) Road and Herbst Road, include:

1. Maintain current configuration
2. Convert Zoo (Armory) Road and/or Herbst Road to two-way operations
3. Provide sidewalks and bicycle lanes along Zoo (Armory) Road and Herbst Road

The design alternatives for Zoo (Armory) Road and Herbst Road focus on reorganizing parking and formalizing these roadways for more frequent public use as low-speed, low-volume streets serving parking spaces for the zoo and the beach.

Parking options for these design alternatives include:

- No parking
- Coastal access surface parking lot
- Separate and reconfigured zoo employee and visitor parking lots
- Perpendicular and angled parking along Zoo (Armory) Road and Herbst Road

L-Taraval Terminus and Transit Center

Design alternatives and variants that have been developed for the L-Taraval Terminus on Wawona Street, between 46th Avenue and 47th Avenue, include:

1. Maintain current configuration
2. Move L-Taraval terminus south of Sloat Boulevard
3. Acquire Roberts Motel and create an arrival plaza
4. Acquire entire block
    a. Create an arrival plaza
    b. Integrate L-Taraval terminus and transit center into a mixed use building

The design alternatives for the L-Taraval Terminus and Transit Center focus on improving transit connections, and creating a transit hub with the existing Muni bus routes (18-46th Avenue and 23-Monterey). Bicycle and pedestrian linkages play an integral role in establishing an effective and safe transit system. An improved bicycle and pedestrian realm makes transit a more viable mode, while an improved transit system will help make a community less automobile-dependent and more bicycle- and pedestrian-friendly. This symbiotic relationship highlights the importance of improving access to transit.

Parking Conditions

The existing and proposed parking supply is organized by section of the study area as described in the Draft Charrette Summary and is summarized in Table 19. As shown in Table 19, the project would make substantial changes to the parking supply within the study area. The project would yield more coastal access parking. In place of the existing parking lot at Sloat Boulevard / Upper Great Highway, new lots would be constructed at Zoo (Armory) Road, south of the existing zoo parking lot, at a new Skyline trailhead and along Upper Great Highway, north of Sloat Boulevard. Additional overflow parking lot may be constructed near the Janet Pomeroy Center and on San Francisco Public Utilities Commission property, south of the zoo. In place of the existing parallel and median parking, back-in angled parking would be provided on Sloat Boulevard in a three-lane configuration.

An assessment of on-street and off-street parking conditions within the study area was conducted. The proposed parking supply scenarios were compared to the estimated parking demand during the weekday and weekend midday peak periods. Generally, on-street parking demand in the area was observed to be relatively low with occupancy levels between 40% and 50% during the weekday and weekend midday peak periods, respectively. Demand was highest (100% occupied) for the angled parking spaces in the median of Sloat Boulevard, between 43rd Avenue and 47th Avenue (approximately 90 spaces). Occupancy rates of the angled parking spaces between 43rd Avenue and Skyline Boulevard were observed to be very low (approximately 10%) during the weekday and weekend midday peak periods. The expected parking demand along Sloat Boulevard would be exceeded under both Option 1 (85 on-street and 76 off-street spaces) and Option 2 (136 on-street and 157 off-street spaces).

It should be noted that vehicular movements in and out of diagonal parking presents hazards to bicyclists. For this reason, it is recommended to avoid diagonal parking configurations adjacent to bike routes (e.g., Sloat Boulevard). At locations where diagonal parking is absolutely necessary, back-in angled parking should be considered. This parking layout requires drivers to pull in front of a vacant space and reverse into the parking space and naturally forces the drivers to look behind them before crossing the path of oncoming bicyclists. Back-in angled parking improves motorists' sightlines of oncoming bicycle and motor traffic while exiting compared to traditional (head-in) diagonal parking. Other benefits include convenient curbside loading to the trunk (depending on presence of landscaping elements), vehicle doors open towards curb and provides an extra barrier/protection for people exiting the vehicle, and it may provide up to twice the number of parking spaces compared to parallel parking.

Table 19
Parking Supply

Location	Existing Supply[1]	Proposed Supply	
		Option 1[2]	Option 2[3]
North Reach			
Point Lobos Parking Lot	56	-	-
Land's End Parking Lot	134	-	-
Cliff House (street)	125	-	-
Key Move 5.1a, 5.1b	-	375	375
North Reach Total	315	375	375
The Great Highway–North			
O'Shaughanessy Promenade Lot	166	-	-
Golden Gate Parking Lot	125	-	-
Key Move 3.3a, 3.3b, 3.3c	-	75	-
Parking Bays (two-lane configuration)	-	-	246
The Great Highway–North Total	291	75	246
The Great Highway–South			
Great Highway Parking Lot 1	55	-	-
Great Highway Parking Lot 2	55	-	-
OWPCP Parking Lot	135	135	135
Key Move 1.6	-	14	-
Coastal Access Parking Lot	-	-	100
The Great Highway–South Total	245	149	235
Sloat Boulevard (East and West)			
On-Street (median and parallel)	369	-	-
Key Move 1.1, 1.3a, 1.3b, 1.3c, 1.3d	-	85	-
Key Move 1.3d (overflow lot)	-	76	157
Back-in angled parking (three-lanes)	-	-	136
Sloat Boulevard Total	369	161	293
Zoo (Armory) Road and Herbst Road / San Francisco Zoo			
Visitor Parking Lot	459	459	459
Key Move 1.7a	-	59	-
Zoo (Armory) Road (Key Move 1.7b)	-	75	62
Herbst Road (Key Move 1.76)	-	118	190
Zoo (Armory) Road and Herbst Road Total	459	711	711
Overall Total	1,679	1,219	1,608

Source: Nelson\Nygaard, 2014. AECOM, 2014.

Notes: "-" indicates not applicable. No parking is provided along Skyline Boulevard.

[1] Existing Supply presented as summarized in the Ocean Beach Master Plan, May 2012.

[2] Proposed Supply, Option 1 presented as summarized in Ocean Beach Master Plan Parking Counts includes Key Moves 1.1, 1.3, 1.6, 1.7, 3.3, and 5.1.

[3] Proposed Supply, Option 2 presented as shown in Ocean Beach _Master.dwg file and assumes Great Highway–North reduced to two lanes, Great Highway–South reduced to two lanes (or fully closed), and Sloat Boulevard reduced to three lanes.

Conclusion

The purpose of this transportation operations and alternatives analysis was not to recommend a preferred alternative; however, this memorandum and the results of the analysis are intended to provide a comparison of several potential improvements based on performance of the overall transportation network. Based on the analyses, several of the alternatives are expected to operate acceptably and may be considered for further study. Qualitative assessments of the proposed benefits (or detriments) associated with each improvement option have been provided for evaluation purposes. Qualitative assessments for each transportation attribute (traffic, transit, pedestrians, bicycles, and parking) were considered in the process of summarizing their relative degrees of the resulting benefits or detriments of each project element. Assessment descriptions and markings are included in Table 20.

Table 20
Assessment Marking and Description

Assessment	Marking	Description
"High Positive"	+++	Substantial improvement in intersection LOS (e.g., improving the operations from unacceptable LOS to acceptable LOS), transit travel time, pedestrian and bicycle connections, or parking supply.
"Medium Positive"	++	Noticeable improvement in LOS, transit travel time, pedestrian and bicycle connections, or parking supply.
"Low Positive"	+	Minimal operational improvement (e.g., some improvement to operations, but little to no tangible change in LOS).
"Negligible Effect"	·	Negligible change in operations.
"Low Negative"	-	Minor degradation or inconvenience for traffic, transit, pedestrians, bicycles, or parking (e.g., some degradation to operations, but little to no tangible change in LOS).
"Medium Negative"	--	Substantial detriment to traffic, transit, pedestrians, bicycles, or parking (e.g., reallocation of parking space to create an additional travel lane would result in a medium negative consequence for parking).

Table 21 summarizes and prioritizes the proposed major project elements and alternatives in a multi-objective ranking matrix based on overall effectiveness using the assessment descriptions and markings shown in Table 20. These improvement options may be considered for implementation individually or collectively. All of the major project elements and design alternatives for Sloat Boulevard, Skyline Boulevard, and Upper Great Highway could accommodate a phased removal of The Great Highway, between Sloat Boulevard and Skyline Boulevard, including maintaining a single lane in each direction on this segment of roadway. Other factors such as environmental viability and project implementation costs must be considered in addition to transportation operations in determining the feasibility of the alternatives. Further analysis, data collection, and forecasts might determine transportation issues that may not have been accounted for in this initial operations analysis; thus, may result in some alternatives being discarded or not fully evaluated.

The transportation operations and alternatives analysis process resulted in a preliminary set of transportation improvements that haves been evaluated for fatal flaws and operational feasibility, which

also most adequately meet the multi-objective transportation needs of the stakeholders of the charette and public outreach processes throughout the analysis duration. These transportation improvements may be assembled for further consideration for implementation and may be readily grouped by similarities in phasing, funding, or purpose, to further into the funding and environmental clearance stages.

Table 21
Multi-Objective Ranking Matrix

Project Element	Benefits					Notes
	Traffic	Transit	Peds.	Bikes	Parking	
Upper Great Highway–North Two lanes	-	·	++	++	+	• Reduces pedestrian crossing distances • Reduces vehicle speeds • Provides 8' bicycle lanes • Increases beachfront parking supply
The Great Highway–South Two lanes, bi-directional	-	·	++	++	+	• Facilitates pedestrian and bicycle connection • Provides coastal access parking lot
The Great Highway–South One-way southbound	--	-	-	-	·	• Increases traffic on Sloat Boulevard (EB) and Skyline Boulevard (SB)
The Great Highway–South One-way northbound	--	-	-	-	·	• Increases traffic on Sloat Boulevard (WB) and Skyline Boulevard (NB)
The Great Highway–South Full Closure	--	-	-	-	·	• Increases traffic on Sloat Boulevard and Skyline Boulevard, both directions
Sloat Boulevard Three lanes	-	-	+++	+++	·	• Reduces pedestrian crossing distance • Provides 5' buffered bike lane • Reduces vehicular capacity and increases delay
Skyline Boulevard Roundabouts	+	-	-	-	·	• Reduces vehicular delay at certain locations under some scenarios • Forces bicyclists to merge with traffic in the roundabout
Zoo (Armory) Road and Herbst Road	·	·	++	++	++	• Increases parking supply • Improves pedestrian and bicycle facilities
L-Taraval Transit Center	·	+++	++	++	·	• Improves transit connections
Zoo Access Realign to 47th Avenue	+	·	+	+	·	• Enables entry and exit onto Sloat Boulevard • Provides signalized crossing at 47th Avenue