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Technical Memorandum

March 30, 2022

Project# 26750

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Portland, OR 97205

From: Zifeng (Lilian) Wu, T.E. & Alec Donowitz

RE: South San Francisco: 100 East Grand – Traffic Study Memorandum

The proposed research & development (R&D) facility is to be located at 100 E Grand Avenue in South San Francisco, CA. The proposed project is referred to as the Project in this memorandum. The Project site is bounded by Sylvester Road to the east, E Grand Avenue to the north, Associated Road to the south and the Highway 101 northbound off ramp to the west. Figure 1 details a site vicinity map, and Figure 2 shows the current site plan. The development is planned to comprise 2 buildings, both provide office space for R&D uses. Several R&D sites, including Genentech's large biotech campus on the San Francisco Bay, already exist on the East Side. This memorandum documents the findings of a transportation study to assess the potential effects of the proposed development, including the site visit observations, site plan and document review, travel demand and trip distribution, and operational analysis. This Project is located very close to the proposed South San Francisco Caltrain Station Eastern Access project. This study is based on the recommendations from the Eastern Access Study. This memorandum does not include TDM measures. An independent proposed TDM plan is provided by Silvani Transportation Consulting.

Figure 1: 100 East Grand Site Vicinity

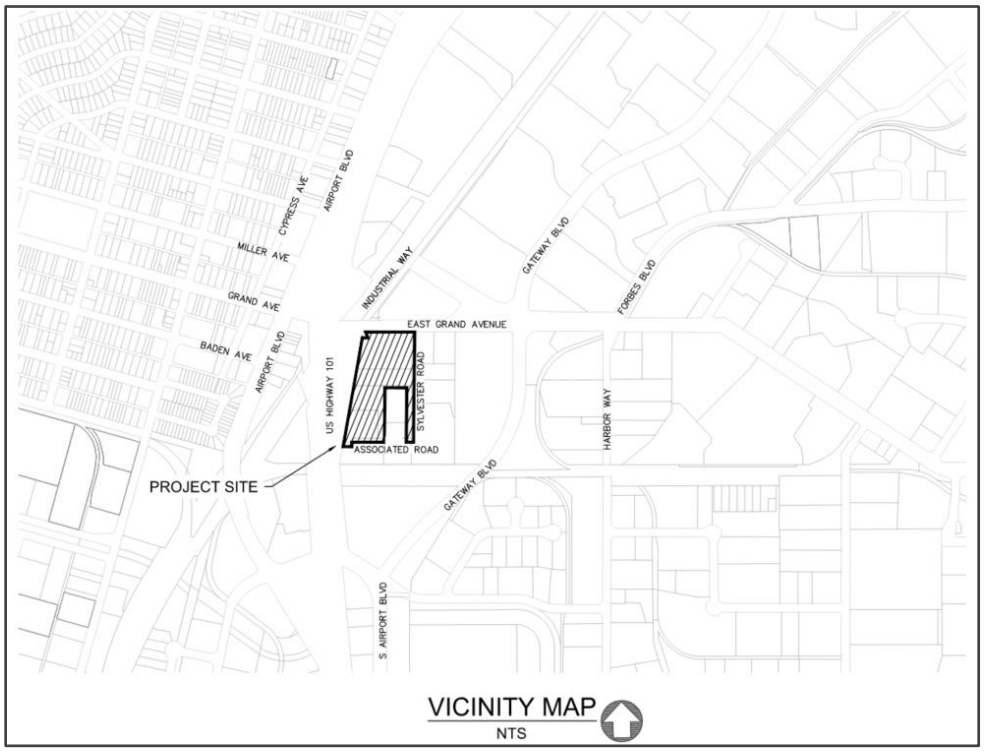
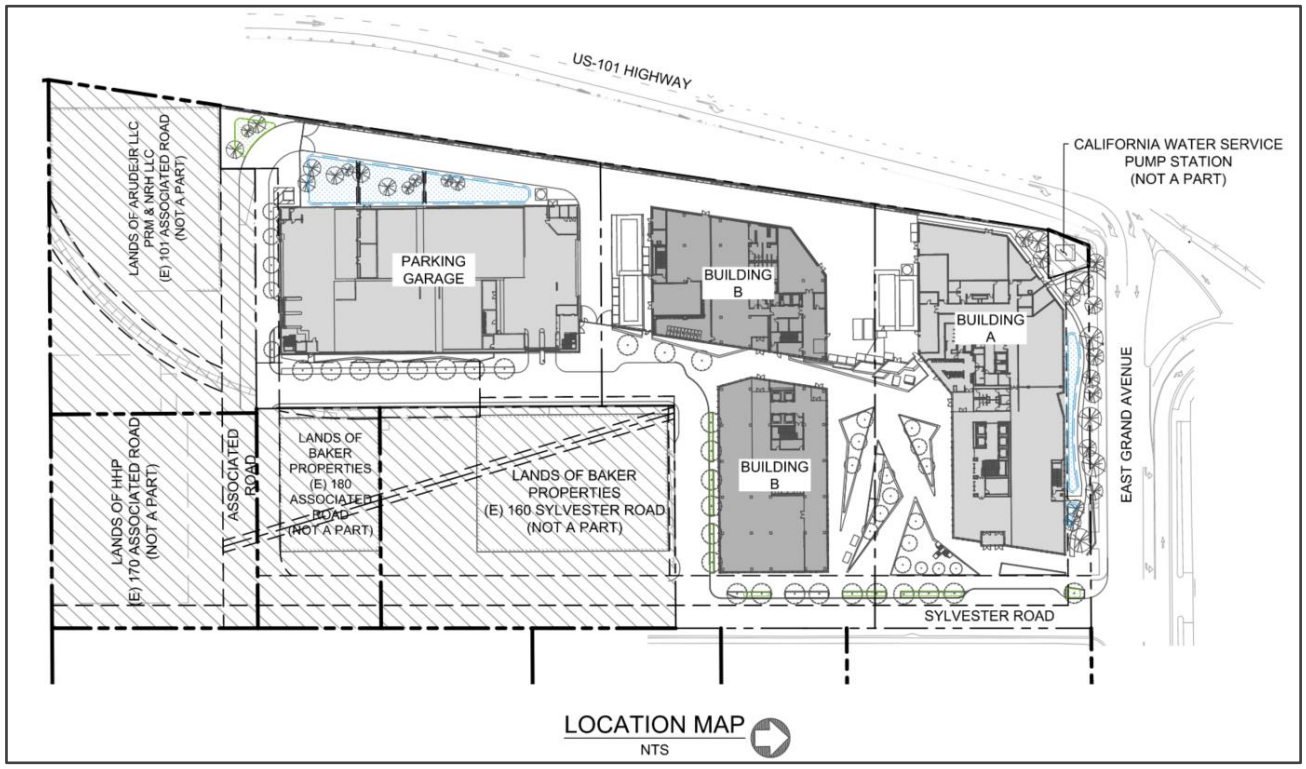


Figure 2: 100 East Grand Site Plan



FIELD OBSERVATIONS

Kittelson conducted a field visit on September 29th, 2021, to observe existing traffic patterns at the project site during both the AM and PM peak hour. The observations were impacted by Covid-19 and an on-going construction on the triangular island at the intersection of Highway 101 northbound off-ramp / Poletti Way and E Grand Avenue. Therefore, could represent a lower than typical traffic condition.

VEHICLE TRAFFIC

- Eastbound is the heavy movement along E Grand Avenue. Fewer than ten vehicles were observed on Sylvester Road during a 15-minute interval during the peak hour.
- No off-ramp queues were observed at East Grand Avenue.
- The meter for the Highway 101 on-ramp from Grand Avenue was not on during the observed peak hours.
- During the peak 15-minute intervals, eastbound queues at the intersection of Grand Avenue and E Grand Avenue spilled back along E Grand Avenue beyond Sylvester Road for more than one cycle. However, this queue did not extend to the Highway 101 northbound off-ramp at E Grand Avenue.

FREIGHT TRAFFIC & SHUTTLES

- Approximately 6% of the eastbound through traffic are heavy vehicles on E Grand Avenue.

- Employer shuttles were observed traveling eastbound on E Grand Avenue.

BICYCLES

- There is no existing bicycle lane on E. Grand Avenue and no bicycles were observed during the peak hours.

PEDESTRIANS

- Sidewalks and pedestrian signals are present along both the north and south side of E. Grand Avenue and Grand Avenue providing a pedestrian connection to the existing South San Francisco Caltrain Station located off Dubuque Avenue. However, there is no sidewalk along the western side of Sylvester Road and the sidewalk along the eastern side is mostly occupied by parked trucks or vehicles.
- Very low pedestrian volumes were observed on E Grand Avenue with two pedestrians observed during the AM peak hour and three during the PM peak hour.

PROJECT TRIP GENERATION

Table 1 summarizes the proposed land use based on a review of the development plan dated 9/22/2021 and confirmation on the proposed size of the café based on an email from ZGF Architects dated 10/12/2021. Table 1 also shows the estimated size of the existing light industrial buildings based on the dimensions measured using Google Maps.

Table 1: Proposed and Existing Lane Uses

Land Use	Size	Units
Proposed Building A		
Research & Development Center	250.430	1000 SF
Café (Fast Casual Restaurant)	8.871	1000 SF
Proposed Building B[1]		
Research & Development Center	206.292	1000 SF
Existing Building – 100 E Grand Avenue		
General Light Industrial	70.375	1000 SF
Existing Building – 105 Associated Road		
General Light Industrial	29.735	1000 SF

Note: 1 – Building B includes a conference center of 10,515 square feet, planned for the ground floor. This conference center is considered as part of the R&D land use.

Trip generation was estimated for both the proposed project and the existing land use at the project location to estimate the net new trips for future build conditions.

The trip generation of the existing land use at the project location was estimated based on the average trip rates as published in the Institute of Transportation (ITE) *Trip Generation Manual*, 11th Edition. Average trip generation rates were selected over the regression formula because of the limited sample size or the R-square lower than 0.75 for the regression formula as documented in the ITE Manual. Based on a review of available land use code categories, ITE land use code 110: "General Light Industrial" was deemed the most applicable

for both buildings located on the project site. Table 2 summarizes the resulting ITE-based trip generation estimate.

Table 2: ITE Trip Generation for Existing Land Use

Site	Weekday AM Peak Hour			Weekday PM Peak Hour		
	Total	In	Out	Total	In	Out
100 E Grand & 105 Associated	74	65	9	65	9	56

The trip generation potential of the proposed R&D facility was based on the average trip rates as published in Institute of Transportation (ITE) *Trip Generation Manual*, 11th Edition, for ITE land use code 760: "Research & Development Center". The developer has also proposed a café within Building A. After reviewing available land uses, ITE land use code 930: "Fast Casual Restaurant" was deemed most applicable. Table 3 and Table 4 summarize the resulting ITE-based trip generation estimate for Buildings A and B, respectively.

Table 3: ITE Trip Generation for Project Building A

Land Use	Weekday AM Peak Hour				Weekday PM Peak Hour			
	Avg. Trip Gen. Rate	Total	In	Out	Avg. Trip Gen. Rate	Total	In	Out
Research & Development Center	1.03	258	212	46	0.98	245	39	206
Fast Casual Restaurant	1.43	13	7	6	12.55	111	61	50

Source: ITE Trip Generation Manual 11th Edition

Table 4: ITE Trip Estimate for Project Building B

Land Use	Weekday AM Peak Hour				Weekday PM Peak Hour			
	Avg. Trip Gen. Rate	Total	In	Out	Avg. Trip Gen. Rate	Total	In	Out
Research & Development Center	1.03	202	166	36	0.98	192	31	161

Source: ITE Trip Generation Manual 11th Edition

In consideration of the mixed-use nature of the proposed café and R&D offices, the initial trip generation was reduced to account for internal trips based on the internal capture rates provided in the ITE *Trip Generation Manual*, 11th Edition. Additionally, the estimated trips generated by the café were reduced to account for pass-by trips as it is a retail location located near to a transit station. Because pass-by trip reduction rates are not available for ITE land use code 930: "Fast Casual Restaurant," the PM peak hour pass-by reduction rate for ITE land use code 932: "High-Turnover (Sit-Down) Restaurant" was applied to both the AM and PM peak hour trip estimates. The pass-by reduction, internal capture reduction, and resulting net new vehicle trips generated by the proposed project are summarized in Table 5.

As shown in Table 5, upon build-out, the proposed development is estimated to generate a total of 387 new weekday AM peak hour trips (314 inbound/73 outbound) and 398 new weekday PM peak hour trips (78 inbound/320 outbound).

The trip generation estimate as detailed in Table 5 was carried forward for the following traffic volume development and operational analyses.

Table 5: Total ITE Trip Generation Estimate for Project

Total	Weekday AM Peak Hour			Weekday PM Peak Hour		
	Total	In	Out	Total	In	Out
Initial ITE Trip Generation						
Research & Development Center	460	378	82	437	70	367
Restaurant	13	7	6	111	61	50
Internal Capture	1.69% for AM Peak			8.76% for PM Peak		
External Trips						
Research & Development Center	456	376	80	413	60	353
Restaurant	9	5	4	87	47	40
Pass-by Trip	43% applied to Restaurant for both AM and PM[1]					
Trip Generation after Considering Internal Trips and Pass-by Trips						
Research & Development Center	456	376	80	413	60	353
Restaurant	5	3	2	50	27	23
Total	461	379	82	463	87	376
Existing Trip Credit						
General Light Industrial	74	65	9	65	9	56
Net New Trip						
Total Net New Vehicle Trips	387	314	73	398	78	320

Source: ITE Trip Generation Manual 11th Edition
1 - Based on survey data for Land use 932 High-Turnover (Sit-Down) Restaurant during PM peak hour. It's assumed the same percentage can be applied for AM peak hour. No data is available for 930 Fast Casual Restaurant.

VEHICLE TRIP DISTRIBUTION

This section summarizes the distribution of net new vehicle trips to vehicle movements at the three study intersections which included:

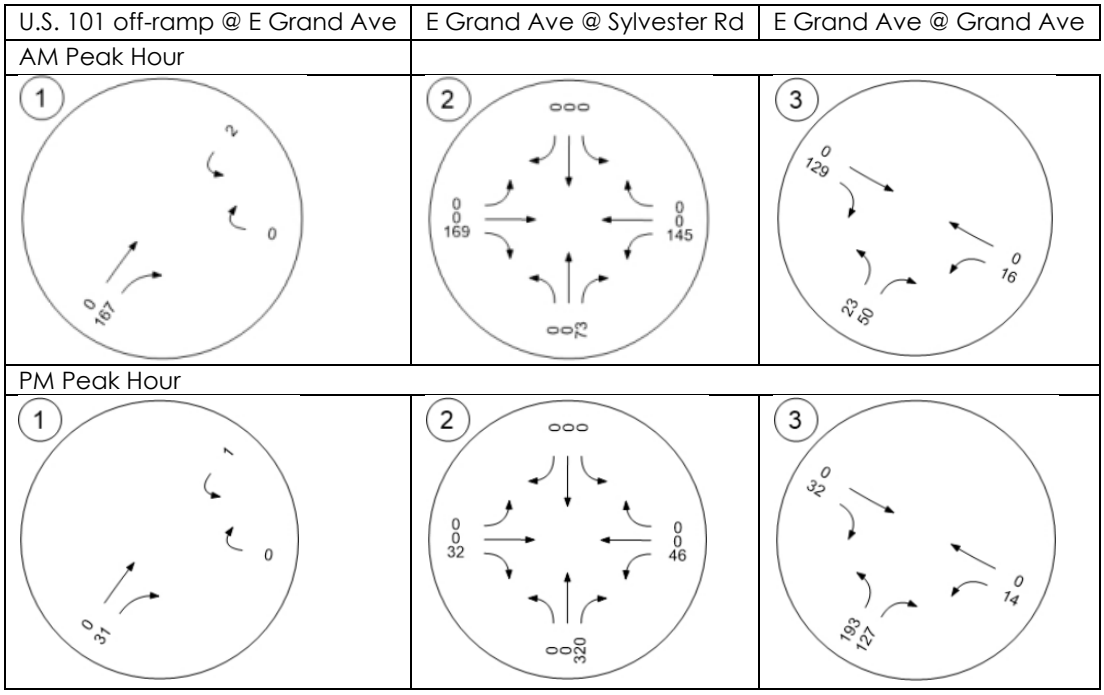
1. US 101 off-ramp/ Poletti Way and E Grand Avenue
2. Sylvester Road and E Grand Avenue
3. Grand Avenue and E Grand Avenue

The inbound net new trips were first distributed to the vehicle movements comprising volumes entering Sylvester Road at the Sylvester Road & East Grand Avenue intersection (Intersection 2) since the Project is accessed off Sylvester Road. At the same intersection, the outbound net new trips were distributed to the southbound movements. The volumes at the other two intersections were then distributed proportionally based on turning movement proportions from the 2040 volumes provided by Fehr & Peers[1]. The volume distributions were only done for the AM and PM peak hours because this is the most critical analysis period serving high in-

[1] This is a project for the South San Francisco Caltrain Station Eastern Access Study dated on October, 2021.

bound traffic through US 101 off-ramp and only the AM baseline volumes were available. The resulting project net new trips at the three study intersections are shown in Figure 3.

Figure 3: Net New Trip Distribution at Study Intersections



SITE PLAN REVIEW

This section details the findings of a site plan review for the proposed project. Topics covered include passenger loading demand and circulation.

Passenger Loading Demand

Passenger loading demand is estimated for the proposed project to evaluate whether adequate space to accommodate curbside passenger loading is provided. The extent of curbside space needed to accommodate this demand is based on the trip generation rates and the passenger loading demand methodology outlined in the City of San Francisco Guidelines. The City of South San Francisco doesn't have standards for passenger loading demand. We adopted the methodology in San Francisco Guidelines which would represent a more conservative requirement for estimating the loading demand. Table 6 presents the estimated demand of passenger loading spaces for the project. Building A and B each requires one loading space to meet the peak hour loading demand. The proposed project would provide three loading spaces for Building A and two loading spaces for Building B, sufficient to meet the passenger loading demand.

Table 6: Passenger Loading Demand (Peak Hour)

Land Use	Size (1,000 sq ft)	Person Trips (P)[1]	Loading Mode Type % (L)[2]	Average Stop Duration (D)[3] (minutes)	Peak Hour Loading Trips	Peak Hour Loading Demand (Spaces)[4]
Office - Building A	250.430	351	7.30%	1	26	0.4
Café - Building A	8.871	240	5.50%	1	13	0.2
Office - Building B	206.292	289	7.30%	1	21	0.4

Source: Kittelson, 2021; San Francisco TIA Guidelines, San Francisco Planning Department.
Assumptions:
[1] – person trip generation rates were based on urban high density from SF TIA Guidelines Appendix F, Table 1.
[2] – SF TIA Guidelines Appendix F, Table 4.
[3] – Loading/unloading durations are typically shorter than 1 minute based on previous local studies.
[4] – Loading demand (spaces per hour) = peak hour loading trips / (average duration * 60 minute)

Circulation Plan

Based on the circulation plan provided by ZGF dated on September 21, 2021, the proposed project will provide adequate pedestrian access and service access for freight trucks in addition to vehicular access. The circulation plan is attached as Appendix A. Key findings from this assessment are summarized in this section. Note that there are on-going discussions regarding the circulation needs for the South San Francisco Caltrain Station Eastern Access Study; there might be additional circulation improvements needed for this Project to meet the needs of Eastern Access.

PEDESTRIAN ACCESS

The current recommendations of the South San Francisco Caltrain Station Eastern Access Study include:

- Redesign and signalize East Grand/Poletti/US-101 Offramp and East Grand/Sylvester intersections to improve pedestrian connections
- Widen sidewalks on East Grand Avenue, Poletti Way, and Sylvester Road

To meet these recommendations, this Project will provide pedestrian access within the project limit, including:

- Internal circulation path through courtyard, plaza, and Building B drop-offs and parking with building entrances.
- Partially re-build Sylvester including the sidewalks (i.e., in front of the Buildings A and B).

BICYCLE ACCESS

- Bike riders can access the site through the pedestrian sidewalks. The project would provide a total of 132 long-term bike parking stalls including 63 for Building A and 69 for Building B. In addition, the project will provide 23 bike racks throughout the site. This is higher than the bicycle parking requirements per zoning section 220.330.008 of 79 short-term bike racks (10% of vehicular parking stalls) and 16 long-term bike stalls (1 per 50 vehicular stalls).

SERVICE ACCESS

- The project will provide shared loading dock between Buildings A and B with additional service yard on the southwest corner of Building B.
- Service trucks access by Sylvester Road and Associated Road.
- Kittelson reviewed the truck turn templates for a WB-40, SU30, and a Front Load Truck as these vehicles enter and exit the site. All three trucks were able to navigate through the site without obstruction.

OPERATIONAL ANALYSIS

Based on the HCM 6th methodology, intersection analyses were performed at the three study intersections using PTV's Vistro 2022 software. A total of four scenarios were assessed for both the AM and PM peak hours. These scenarios included:

1. Scenario 1: 2019 existing
2. Scenario 2: 2040 Eastern Access Study without-project
3. Scenario 3: 2040 Eastern Access Study with-project
4. Scenario 4: 2040 Eastern Access Study with-Project & improvements

Both Scenario 3 and 4 were performed using the 2040 East Access Study with-project traffic volumes. Scenario 3 is the same concept geometry and signal timing as provided by Eastern Access Study Project team. Scenario 4 is with Kittelson's recommended signal timing improvements to improve the operational performance for the three study intersections.

The existing volumes were developed based on the following data sources:

- 2019 counts at E Grand Avenue & Grand Avenue
- 2019 PeMS counts at US 101 off-ramp
- Streetlight data for 2019 weekday averages, provided by the City of South San Francisco
- Turning movements proportions based on the 2040 East Access Study

The 2040 without-project volumes were developed based on the 2040 with-project volume data from Caltrain Station East Access Study provided by Fehr & Peers. The 2040 with-project volume data reflects the City's land use forecasts for the area buildout as of fall 2021, including the project at 100 E Grand Ave. Therefore, the 2040 without-project volumes are developed by extracting the project volume from the with-project volumes.

SCENARIO 1: EXISTING CONDITIONS (2019)

The existing conditions scenario features the existing geometry and intersection controls present at the three study intersections along East Grand Avenue. Existing traffic volumes were estimated through:

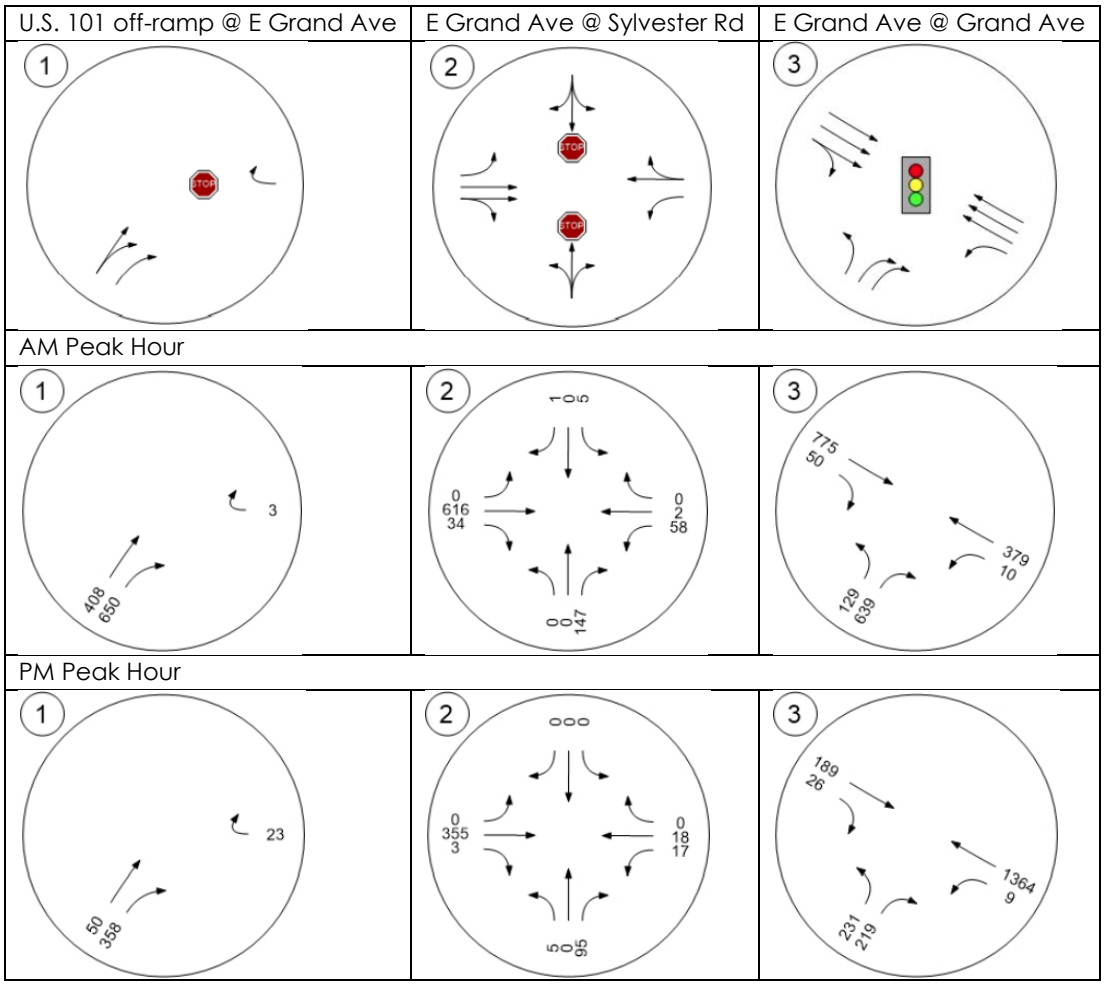
- Westbound and eastbound peak hour volumes on E. Grand Avenue were determined using 2019 counts at E Grand Avenue & Grand Avenue (Intersection 3) and distributed to the other two intersections based

on the turning movement proportions from Streetlight data or the 2040 volumes from the East Access Study.

- The US 101 off-ramp volume is controlled by the corresponding PeMS counts on the same day as the available 2019 counts for Intersection 1 and distributed to the left-turn and through movements based on the turning movement proportions that are consistent with the 2040 volumes from the East Access Study.

The resulting volumes used in the analysis for Scenario 1 are shown in Figure 4. Details on the count data and volume estimation process are included in Appendix B.

Figure 4: Study Intersections Configuration and Volumes – Existing Conditions



SCENARIO 2: EAST ACCESS STUDY WITHOUT PROJECT

Fehr & Peers provided the 2040 volumes based on their analysis for the city's General Plan which included the proposed Project at 100 E Grand Avenue. The volumes for this without-project scenario were calculated using the provided 2040 volumes minus the trip generation for the Project.

This scenario analyzes the concept geometry, intersection control, and signal timing provided by Fehr & Peers, the same as the recommended scenario from East Access Study. Note that signal timing is only provided for

AM pea hour. Kittelson optimized the splits for PM peak hour. Compared to existing conditions, this scenario includes the following improvements:

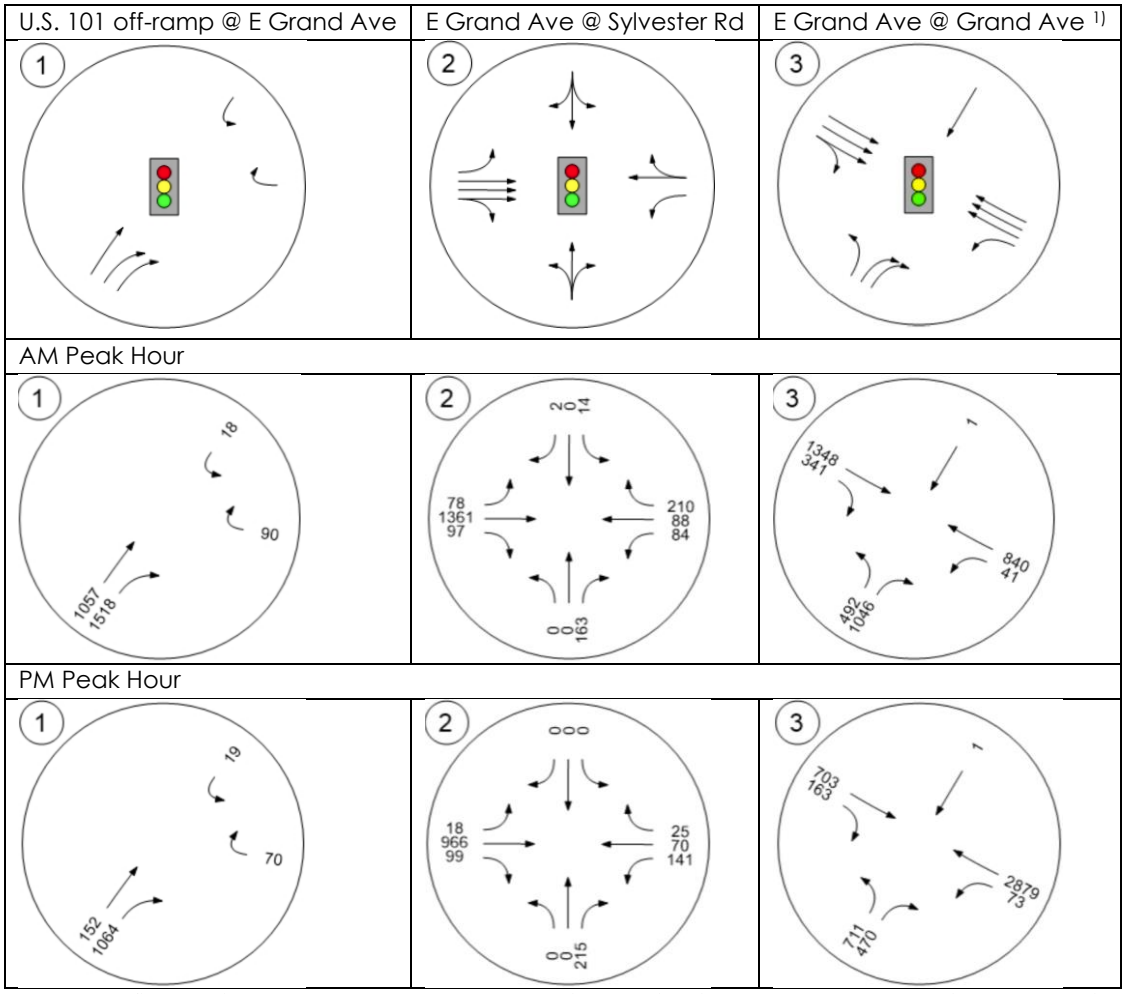
- The following two study intersections were upgraded from stop control to full signalization:
  - US 101 off-ramp & E Grand Ave
  - E Grand Ave and Sylvester Rd.
- One northbound right-turn lane was added on the US 101 off-ramp resulting in two right-turn lanes and one through lane.
- One eastbound through lane was added at Sylvester Rd. and E. Grand Avenue.

To accommodate the anticipated high pedestrian and bike volumes at US 101 off-ramp and E Grand Ave, the proposed signal timing for 2040 includes an exclusive pedestrian phase for this intersection. However, due to the limitation of Synchro based HCM 6th methodology on exclusive pedestrian phases, the Sychro file received from East Access Study, dated on October 18, 2021, didn't reflect the exclusive pedestrian phase's impact on signal operation performance correctly. Pedestrian and bicycle volumes at US 101 off-ramp and E Grand Ave is estimated to be 340 pedestrian and 200 bicycles during the peak hour based on the South San Francisco Caltrain Station Eastern Access Study report dated on October 2021.

This study uses the most updated Vistro 2022 software to perform operational analysis considering the impact of the proposed exclusive pedestrian phase using the HCM 6th Edition methods. Detailed analysis reports can be found in Appendix C – Operational Analysis Output Sheets.

Another note on the provided signal timing is the proposed pedestrian phase at E Grand Ave and Grand Ave includes a dummy westbound leg. This is kept for Scenario 2's analysis.

Figure 5: Study Intersections Configurations Volumes – East Access Study Scenario

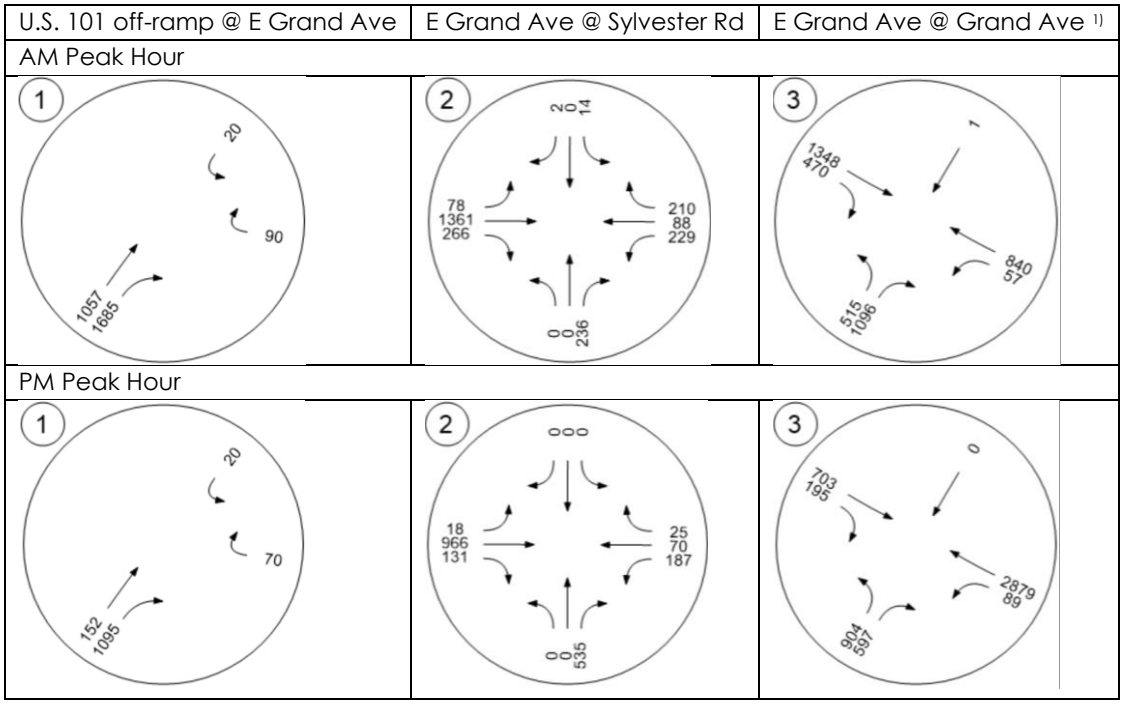


Note: 1) Confirmed with Fehr & Peers, the westbound with 1 vehicle is a dummy leg to code in the pedestrian phase, not a proposed geometry change for the future.

SCENARIO 3: EAST ACCESS STUDY WITH PROJECT

This scenario is the recommended East Access Study scenario with concept geometry, intersection control, signal timing, and volumes provided by Fehr & Peers. The volumes Include all 2040 growth under the General Plan (including the 100 E Grand Project) but excludes the 121 E Grand project. The geometry and signal timing are the same as in Scenario 2. Figure 6 shows the volumes used in analyzing this scenario.

Figure 6: Study Intersections Volumes – East Access Study Scenario: plus Project



Note: Confirmed with Fehr & Peers, the westbound with 0 vehicle is a dummy leg to code in the pedestrian phase, not a proposed geometry change for the future.

SCENARIO 4: EAST ACCESS STUDY WITH PROJECT WITH IMPROVEMENTS

With the same volumes as shown in Figure 6, this scenario includes improved signal timing to better serve the project and reduce intersection delay. Details of this scenario are included in Appendix C but highlights include:

- At US 101 off-ramp/ Poletti Way and E Grand Avenue
    - For the scope of this study, it is assumed the cycle lengths need to stay consistent with the Eastern Access Study because the three study intersections are part of a larger group of coordinated intersections studied by Eastern Access Study. Therefore, signal timing modifications were limited at this intersection and there was little improvement.
    - If the cycle length can be increased, the LOS can be improved to LOS D or better. But this will potentially change other coordinated signal timings beyond the three study intersections.
- At Sylvester Rd. and E Grand Avenue, the intersection performance can be improved to a LOS C for AM peak hour and D for PM peak hour, by allocating more green times to the northbound, eastbound left-turn, and westbound left-turn movements.

- At E Grand Avenue and Grand Avenue, the pedestrian phase setting was changed to be concurrent with vehicle phases, rather than adding a dummy phase as in Scenario 2 and 3. Therefore, we removed the westbound dummy leg as shown in Figure 6 for this intersection.

RESULT SUMMARY

Table 7 compares the results for all the four scenarios. Detailed reports on intersection configurations, volumes, and LOS analysis are included in Appendix C.

Table 7: Intersection Operational Analysis Results

Scenarios	Control Type	Intersection/ Movements	Delay (sec/veh) AM (PM)	LOS AM (PM)
Scenario 1: Existing Conditions [1]				
US 101 off-ramp/ Poletti Way and E Grand Ave	Stop	WBR (WBR)	11.0 (8.6)	B (A)
Sylvester Rd. and E Grand Ave.	Stop	SBL (NBL)	16.0 (12.6)	C (B)
E Grand Ave. and Grand Ave.	Signal	Intersection	20.9 (13.2)	C (B)
Scenario 2: 2040 East Access Study Scenario without Project [2]				
US 101 off-ramp/ Poletti Way and E Grand Ave	Signal	Intersection	65.1 (12.6)	E (B)
Sylvester Rd. and E Grand Ave.	Signal	Intersection	19.8 (26.9)	B (C)
E Grand Ave. and Grand Ave.	Signal	Intersection	71.4 (243.3)	E (F)
Scenario 3: 2040 East Access Scenario with Project [2]				
US 101 off-ramp/ Poletti Way and E Grand Ave	Signal	Intersection	66.1 (12.8)	E (B)
Sylvester Rd. and E Grand Ave.	Signal	Intersection	78.9 (47.0)	E (F)
E Grand Ave. and Grand Ave.	Signal	Intersection	94.7 (302.9)	F (F)
Scenario 4: Improved Scenario 3 [2] **(2040 East Access Scenario with Project)**				
US 101 off-ramp/ Poletti Way and E Grand Ave	Signal	Intersection	66.0 (12.8)	E (B)
Sylvester Rd. and E Grand Ave.	Signal	Intersection	32.2 (47.0)	C (D)
E Grand Ave. and Grand Ave.	Signal	Intersection	39.6 (68.2)	D (E)

Note: [1] – For stop-controlled intersections, the LOS for the worst movements is reported.
[2] – Eastern Access Study doesn't study PM peak hour scenario; the signal timing used for Scenario 2&3 PM in this study is optimized based on volumes.

All three intersections operate at LOS at or better than C under existing conditions.

Future scenarios are expected to experience more congestion given the volume increases. The with-project Scenario 3 results in much higher delays than the without-project Scenario 2. The PM delays at E Grand Avenue and Grand Avenue is especially high, which is because the signal timing was not optimized for PM peak hour.

Under Scenario 4, signal timing is adjusted at each intersection to optimize the operational operations in terms of LOS. Given the assumed cycle lengths based on East Access study, the study intersections can be expected to operate at or better than LOS E.

Additional findings regarding queues are summarized in Table 8:

- There are potentially queueing problems during the 2040 AM peak hour when the 95th percentile vehicle queue at US 101 off-ramp/Poletti Way/E Grand Ave are expected to extend up to 1,030 feet and spill back to the freeway mainline. This finding is consistent with the findings from Eastern Access Study. And Scenario 2: without-project is expected have a similar queuing issue on the US 101 off-ramp.
- Signal timing improvements in Scenario 4 was able to reduce the queue length on the eastbound at E Grand Ave and Grand Ave, but can't solve the queueing problems at Sylvester Rd.
- The project access through the Sylvester Road northbound is expected to have a long queue during the PM peak hour.

Table 8 Queue Lengths Results Comparison for Scenario 2: without-Project and Scenario 4: with-Project

Intersection	Critical Approach	Scenario 2: 95th Queue Length (ft) AM (PM)	Scenario 4: 95th Queue Length (ft) AM (PM)	Storage Length (ft)
US 101 off-ramp/ Poletti Way and E Grand Ave	NB	1,021 (50)	1,030 (50)	900
Sylvester Rd. and E Grand Ave.	WB	242 (254)	495 (450)	208
Sylvester Rd. and E Grand Ave.	NB	290 (357)	398 (775)	800
E Grand Ave. and Grand Ave.	EB	1,456 (2,936)	665 (956)	400

SUMMARY OF FINDINGS

The proposed project would provide sufficient transportation access to pedestrians/bikes, service trucks, and private vehicles. The provided passenger loading spaces are sufficient to serve passenger drop-off/pick-up activities. The operational analyses show that the net new trips generated by the proposed project will increase the average delays at intersection Sylvester and E Grand Ave, resulting in a LOS D in the PM peak hour. The US 101 off-ramp and E Grand Ave is expected to maintain the same LOS for with and without project volumes. The intersection at Grand Ave and E Grand Ave is expected to experience heavy volume increases on Grand Ave in 2040. With the signal timing in Scenario 4, the performance can be improved to a LOS D during the AM peak hour and a LOS E during the PM peak hour.

There are potentially queueing problems during the 2040 AM peak hour. This is consistent with the findings from Eastern Access Study. The project access through the Sylvester Road northbound is expected to have a long queue during the PM peak hour

APPENDIX A – CIRCULATION PLAN

APPENDIX B - COUNTS & EXISTING VOLUMES

APPENDIX C - OPERATIONAL ANALYSIS OUTPUT SHEETS