Appendix D

Traffic Safety Study

Morrison Canyon Road Traffic Safety Study EIR

Prepared for the City of Fremont

Submitted by
W-Trans

March 3, 2020

TRAFFIC ENGINEERING
TRANSPORTATION PLANNING
Balancing Functionality and Livability since 1995
w-trans.com

This page intentionally left blank

Table of Contents

Introduction 1

Transportation Setting 3

Capacity Analysis 7

Alternative Modes 21

Conclusions 22

Study Participants and References 23

Figures

1. Project Area 2
2. Existing Lane Configurations 4
3. Existing Traffic Volumes 9
4. Cumulative Traffic Volumes 12
5. Project Traffic Volumes 15
6. Existing plus Project Traffic Volumes 17
7. Cumulative plus Project Traffic Volumes 19

Tables

1. Bicycle Facility Summary 5
2. Signalized Intersection Level of Service Criteria 7
3. Existing Peak Hour Intersection Levels of Service 10
4. Cumulative Peak Hour Intersection Levels of Service 11
5. Trip Generation Summary 13
6. Trip Distribution Assumptions 14
7. Existing Vehicle Miles Traveled 16
8. Existing plus Project Vehicle Miles Traveled 16
9. Existing and Existing plus Project Peak Hour Intersection Levels of Service 18
10. Cumulative and Cumulative plus Project Peak Hour Intersection Levels of Service 20

Appendices

A. Intersection Level of Service Calculations

This page intentionally left blank

Introduction

This report presents an analysis of the potential traffic impacts that would be associated with a road closure project proposed along Morrison Canyon Road between the midpoint of Morrison Canyon Road and Vargas Road in the City of Fremont. The traffic study was completed in accordance with the criteria established by the City of Fremont and is consistent with standard traffic engineering techniques.

Prelude

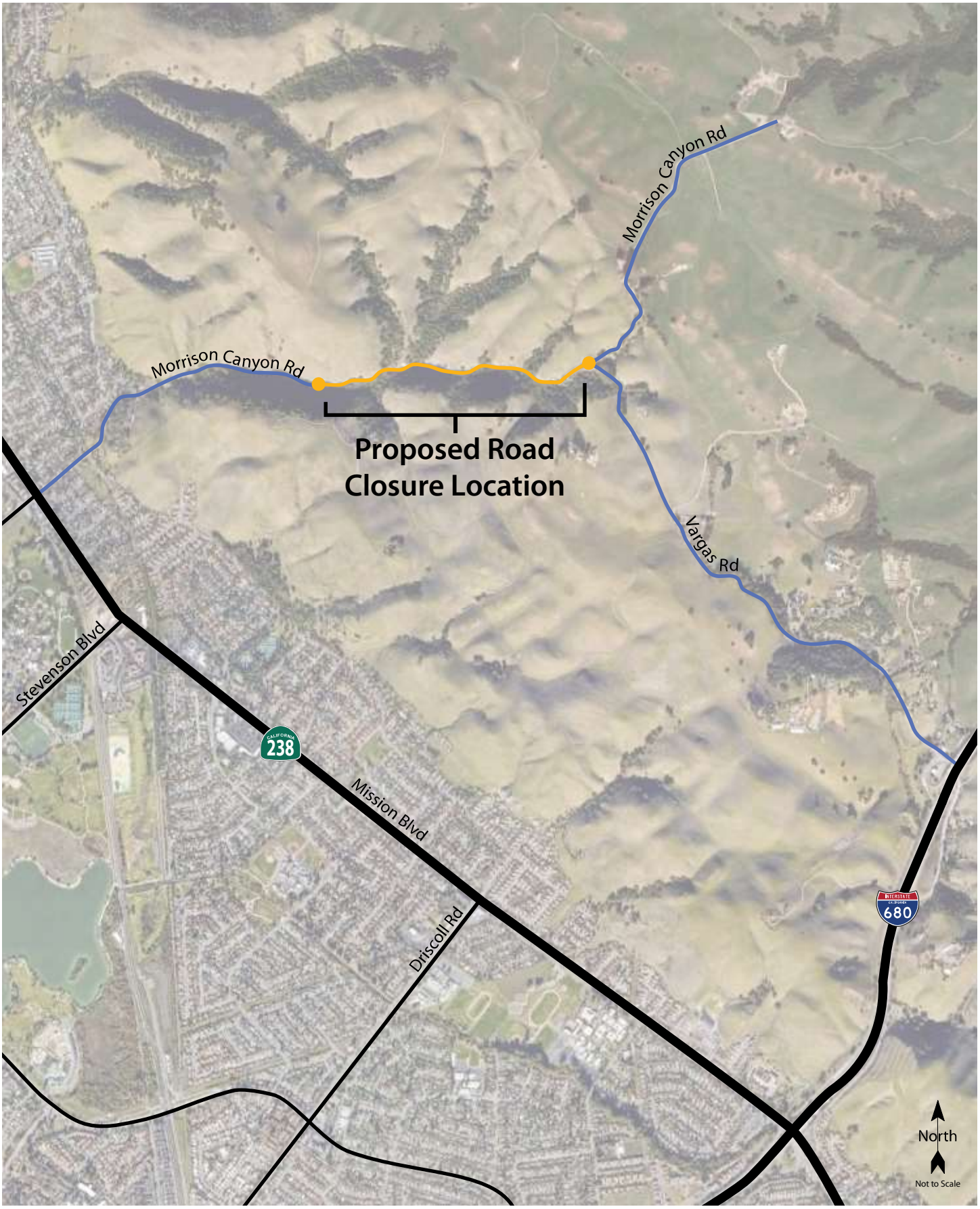
The purpose of a traffic impact study is to provide City staff and policy makers with data they can use to make an informed decision regarding the potential traffic impacts of a proposed project, and any associated improvements that would be required to mitigate these impacts to a level of insignificance as defined by the City's General Plan or other policies. Vehicular traffic impacts are typically evaluated by determining the number of generated trips that the proposed use would be expected to generate, assigning these trips to the surrounding street system based on existing travel patterns or anticipated travel patterns specific to the proposed project, then analyzing the impact the new traffic would be expected to have on critical intersections or roadway segments. Impacts relative to access for pedestrians, bicyclists, and to transit are also addressed.

Project Profile

Morrison Canyon Road east of Mission Boulevard is a narrow one-lane road that has historically provided access to the rural hillside properties in the Morrison Canyon and Vargas Road areas. Access of the roadway has become increasingly difficult due to several reasons, including an increase in cut-through vehicle traffic between regional roadways such as I-680, CA-84, and CA-238. Additionally, the increase in vehicle traffic has subsequently increased conflicts where there is two-way vehicle travel. The road is narrow at certain locations creating choke points as narrow as nine feet wide. As such, some vehicles are required to reverse in order to let oncoming vehicles pass. Further, the increase in vehicle traffic has coincided with the increased use of the roadway to access recreational hiking and bicycling trails within the area.

The proposed project consists of temporarily closing a 0.75-mile segment of Morrison Canyon Road to vehicle traffic from the "middle" or midpoint of Morrison Canyon Road to Vargas Road. The roadway would remain accessible for emergency fire and police response purposes and would also allow access for residents in emergency situations.

The primary goals of the road closure are to eliminate cut-through traffic, allow the road to be primarily used as an emergency response route, and eliminate safety concerns surrounding two-way traffic on the narrow road. The location of the project site and road closure are shown in Figure 1.



frm043.ai 1/20

Morrison Canyon Road Traffic Safety Project

Figure 1 – Project Study Area

Transportation Setting

Operational Analysis

Study Area and Periods

The study area includes the following intersections:

1. Mission Boulevard/Niles Canyon Road
2. Mission Boulevard/Mowry Avenue
3. Mission Boulevard/Walnut Avenue
4. Mission Boulevard/Stevenson Avenue
5. Mission Boulevard north/I-680 SB Ramps
6. Mission Boulevard north/I-680 NB Ramps

Operating conditions during the weekday p.m. peak period were evaluated to capture the highest potential impacts for the proposed project as well as the highest volumes on the local transportation network. The p.m. peak hour typically occurs between 4:00 and 6:00 p.m. and reflects the highest level of congestion during the homeward bound commute.

Study Intersections

Mission Boulevard/Niles Canyon Road is a four-legged intersection including protected left-turn phasing for all approaches. Crosswalks are present across the north, east, and west legs accompanied by pedestrian signal heads and pedestrian push buttons.

Mission Boulevard/Mowry Avenue is a tee-intersection accompanied by a signalized driveway which functions as the east leg. Protected left-turn phasing is present for all approaches, in addition to crosswalks across the west and south legs. Pedestrian signal heads and push buttons are also present.

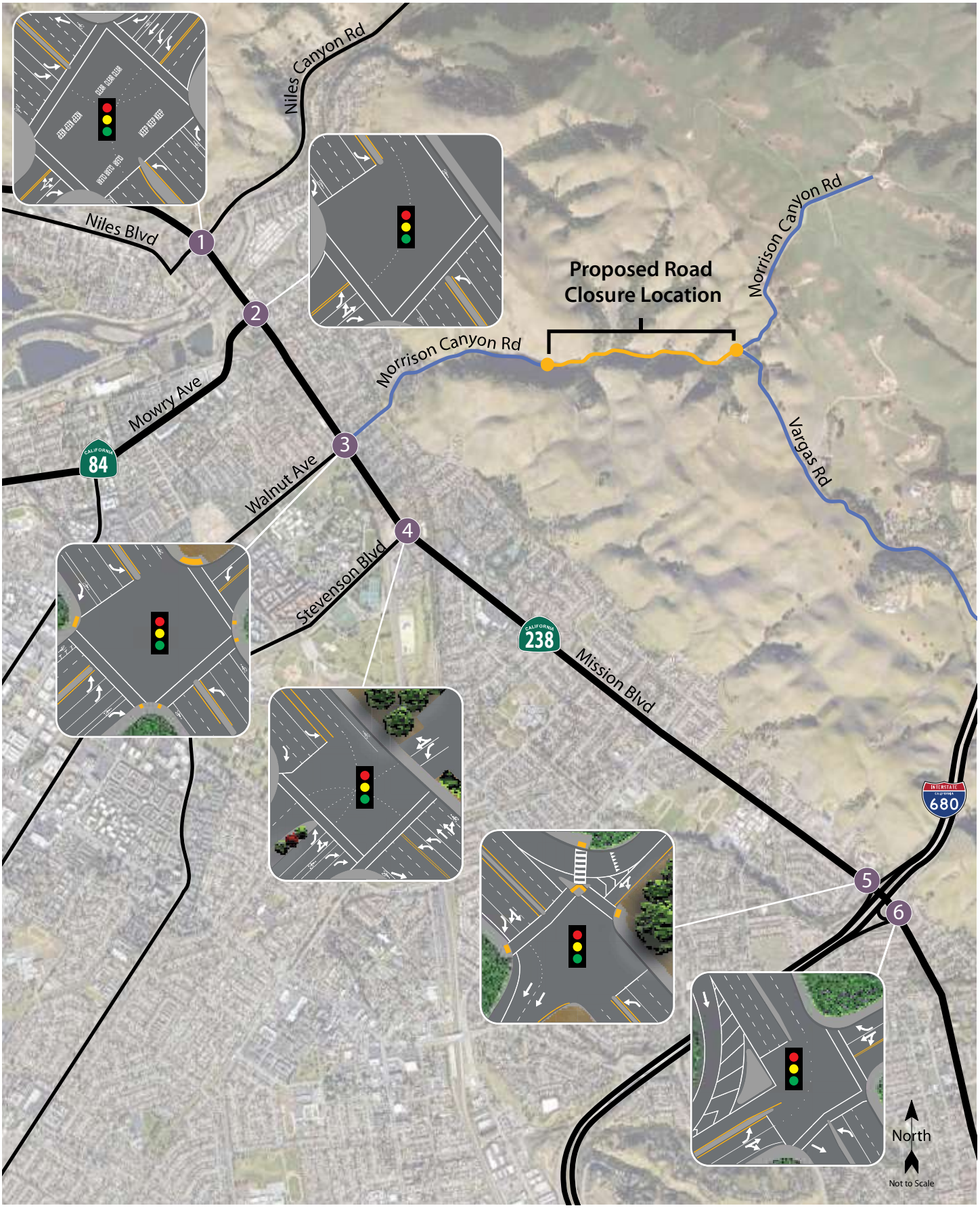
Mission Boulevard/Walnut Avenue-Morrison Canyon Road is a four-legged signalized intersection including protected left-turn phasing on all approaches except the eastern leg. Crosswalks are present across all legs with the exception of the northern approach.

Mission Boulevard/Stevenson Avenue is a four-legged signalized intersection consisting of a signalized driveway at the eastern approach. Crosswalks are present across the south and west legs in addition to pedestrian signal heads.

Mission Boulevard North/I-680 SB Ramps is a four-legged intersection with protected left-turn phasing on the approaches. The west leg is the on-ramp while the east leg is the off-ramp with the channelized right-turn. There are crosswalks with pedestrian signal heads on the southbound and westbound approaches.

Mission Boulevard North/I-680 NB Ramps is a four-legged intersection with protected left-turn phasing on all approaches. The west leg is the on- and off-ramps for I-680. There is a crosswalk with pedestrian signal heads across the south and east legs.

The locations of the study intersections and the existing lane configurations and controls are shown in Figure 2.



frm043.ai 1/20

Morrison Canyon Road Traffic Safety Project

Figure 2 – Existing Lane Configurations

Alternative Modes

Pedestrian Facilities

Pedestrian facilities typically include sidewalks, crosswalks, pedestrian signal phases, curb ramps, curb extensions, and various streetscape amenities such as lighting, benches, etc. In general, there are no pedestrian specific facilities (sidewalks, crosswalks, pedestrian signals, and curb ramps) in the vicinity of the proposed roadway closure site. It is noted that sidewalk gaps can be found along some of the roadways (Morrison Canyon Road) connecting to the project site, but specifically along the segment of the roadway which temporarily closed. Existing gaps and obstacles along the connecting roadways impact convenient and continuous access for pedestrians and present safety concerns in those locations where appropriate pedestrian infrastructure would address potential conflict points.

- **Morrison Canyon Road** – Sidewalk coverage is provided on Morrison Canyon Road between Mission Boulevard and approximately 350 feet east of the intersection at Yerba Buena Street. Sidewalks are provided along developed property frontages between Mission Boulevard and Yerba Buena Street accompanied by curb ramps at the majority of side street approaches while lighting is provided by overhead streetlights. Sidewalks are not provided between Vargas Road and 350 feet east of Yerba Buena Street.

Bicycle Facilities

The *Highway Design Manual*, Caltrans, 2017, classifies bikeways into four categories:

- **Class I Multi-Use Path** – a completely separated right-of-way for the exclusive use of bicycles and pedestrians with cross flows of motorized traffic minimized.
- **Class II Bike Lane** – a striped and signed lane for one-way bike travel on a street or highway.
- **Class III Bike Route** – signing only for shared use with motor vehicles within the same travel lane on a street or highway.
- **Class IV Bikeway** – also known as a separated bikeway, a Class IV Bikeway is for the exclusive use of bicycles and includes a separation between the bikeway and the motor vehicle traffic lane. The separation may include, but is not limited to, grade separation, flexible posts, inflexible physical barriers, or on-street parking.

In the project area, Class II bike lanes exist on Mission Boulevard between the city limits with Union City and I-680. Bicyclists ride in the roadway and/or on sidewalks along Morrison Canyon Road and Walnut Avenue. Table 1 summarizes the existing and planned bicycle facilities in the project vicinity, as contained in the City of Fremont Bicycle Master Plan, 2018.

Table 1 – Bicycle Facility Summary

Status Facility	Class	Length (miles)	Begin Point	End Point
Existing				
Mission Blvd North	II	5.60	Union City Limits	I-680
Walnut Ave	II	2.02	Mission Blvd	Argonaut Wy
Planned				
Morrison Canyon Rd	I	0.76	Midpoint of Road	Vargas Rd
Mission Blvd	IV	5.60	Union City Limits	I-680

Source: *City of Fremont Bicycle Master Plan, City of Fremont, 2018*

Transit Facilities

Alameda-Contra Costa County (AC) Transit provides fixed route bus service in Fremont and neighboring jurisdictions within the East Bay. Routes 99, 216, 217, 232, and 801 provide loop service to destinations throughout the City and stop on Mission Boulevard at various locations. The aforementioned routes operate Monday through Friday with approximately 30- to 60-minute headways between 6:00 a.m. and 8:30 p.m. Saturday service operates with approximately 60-minute headways between 5:00 a.m. and 12:00 a.m.

Two bicycles can be carried on most AC Transit buses. Bike rack space is on a first come, first served basis. Additional bicycles are allowed on AC Transit buses at the discretion of the driver.

Dial-a-ride, also known as paratransit, or door-to-door service, is available for those who are unable to independently use the transit system due to a physical or mental disability. Paratransit is designed to serve the needs of individuals with disabilities within Fremont and the greater San Francisco Bay area.

Capacity Analysis

Level of Service (LOS) is used to rank traffic operation on various types of facilities based on traffic volumes and roadway capacity using a series of letter designations ranging from A to F. Generally, Level of Service A represents free flow conditions and Level of Service F represents forced flow or breakdown conditions. A unit of measure that indicates a level of delay generally accompanies the LOS designation.

The study intersections were analyzed using methodologies published in the *Highway Capacity Manual* (HCM), Transportation Research Board, 2000. This source contains methodologies for various types of intersection control, all of which are related to a measurement of delay in average number of seconds per vehicle.

The study intersections were evaluated using the signalized methodology from the HCM. This methodology is based on factors including traffic volumes, green time for each movement, phasing, whether the signals are coordinated or not, truck traffic, and pedestrian activity. Average delay per vehicle in seconds is used as the basis for evaluation in this LOS methodology. For purposes of this study, delays were calculated using signal timing obtained from the City of Fremont and Caltrans.

The ranges of delay associated with the various levels of service are indicated in Table 2.

Table 2 – Signalized Intersection Level of Service Criteria

LOS A	Delay of 0 to 10 seconds. Most vehicles arrive during the green phase, so do not stop at all.
LOS B	Delay of 10 to 20 seconds. More vehicles stop than with LOS A, but many drivers still do not have to stop.
LOS C	Delay of 20 to 35 seconds. The number of vehicles stopping is significant, although many still pass through without stopping.
LOS D	Delay of 35 to 55 seconds. The influence of congestion is noticeable, and most vehicles have to stop.
LOS E	Delay of 55 to 80 seconds. Most, if not all, vehicles must stop and drivers consider the delay excessive.
LOS F	Delay of more than 80 seconds. Vehicles may wait through more than one cycle to clear the intersection.

Reference: *Highway Capacity Manual*, Transportation Research Board, 2000

Traffic Operation Standards

Alameda County Transportation Commission (ACTC)

Mission Boulevard is included in the ACTC regional network which has a performance standard for CMP facilities. However, based on the number of trips assumed to be redistributed, the net new peak hour trips would not approach 100 net new peak hour trips, and as such no CMP analysis would be required.

Caltrans

The I-680 ramp intersections are under the Caltrans jurisdiction. Caltrans has set forth guidelines for traffic operations based on measures of effectiveness (MOEs) for varying State Highway facilities. In general, Caltrans recommends a target LOS at the transition between LOS C and LOS D. If the existing location operates worse than the target LOS, then the existing LOS should be maintained.

City of Fremont

The City of Fremont, in its *General Plan,* has adopted the following Policy 3-4.2: Variable Level of Service Standards:

Adopt variable standards for traffic speed and travel delay that recognize the character of adjacent land uses, the functions of different streets, the different modes of transportation on a street or corridor, and other community development goals. The following standards shall apply:

For locations outside of the City Center, Town Centers, and Warm Springs BART Station area (as depicted on the Future Land Use Map), peak hour levels of service for signalized intersections should generally be maintained at Level of Service (LOS) "D" for minor arterials and collector streets, and LOS "E" for regional (CMA network) arterials. The design and construction of new signalized intersections and roadways in areas outside the City Center, Town Centers, and Warm Springs BART Station area should achieve a target operational capacity of midpoint LOS D or better upon completion.

For locations within the City Center, Town Centers, and Irvington and Warm Springs BART Station areas, and within PDA boundaries, peak hour LOS "E" or "F" may be acceptable. In these locations, the efficiency and convenience of vehicular operations must be balanced with the goal of increasing transit use, bicycling, and walking.

Where an intersection is projected to operate unacceptably under cumulative baseline conditions (without the influence of project-added traffic), the project's impact is considered to be significant only if the intersection's average delay increases by four seconds or more. This is consistent with standards applied in the General Plan analysis.

Intersections along Mission Boulevard (SR-238) and Niles Canyon Road (SR-84) are maintained by Caltrans and are State highway facilities. As stated in the Caltrans' Guide for the preparation of Traffic Impact Studies: "Caltrans endeavors to maintain a target LOS at the transition between LOS "C" and "D" on State highway facilities, however, Caltrans acknowledges that it may not always be feasible and recommends that the lead agency consult with Caltrans to determine the appropriate target LOS. If an existing State highway facility is operating at less than the appropriate target LOS, the existing MOE [Measure of Effectiveness] should be maintained." [1] Because the City of Fremont is the lead agency for this project, the LOS standards and impact criteria used in this report were based on City standards, as they better reflect local traffic conditions and local planning priorities in Fremont. This approach is consistent with previous traffic impact analyses conducted in the City of Fremont and is also consistent with CEQA.

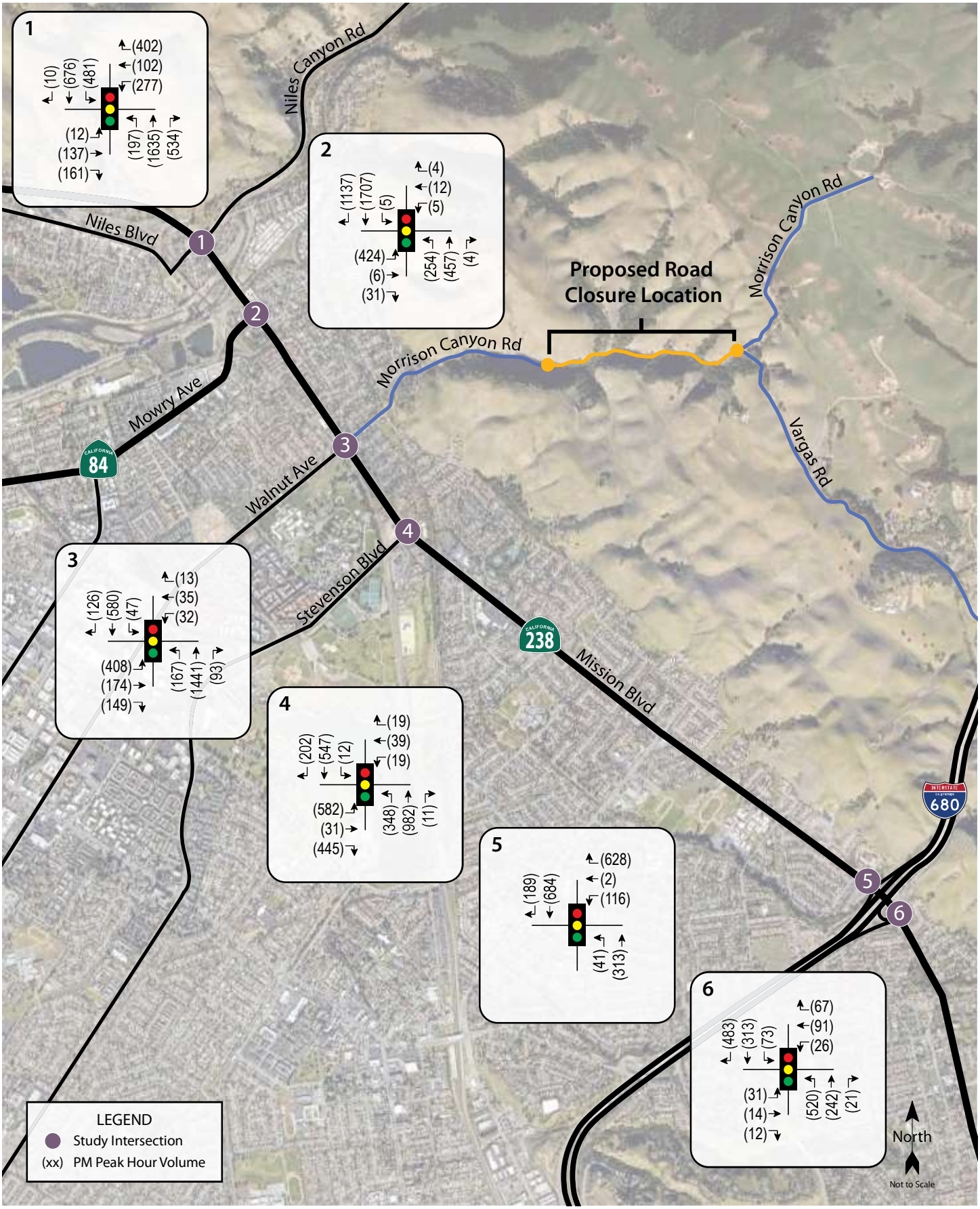
Existing Conditions

The Existing Conditions scenario provides an evaluation of operation based on conditions prior to the temporary road closure traffic volumes during the p.m. peak hour. This condition does not include project-generated redistributed traffic volumes along roadways and intersections located within the study area.

Intersection Levels of Service

Under existing conditions, all study intersections operate at LOS E or better. The existing traffic volumes are shown in Figure 3. A summary of the intersection level of service calculations is contained in Table 3, and copies of the Level of Service calculations are provided in Appendix A.

[1] Caltrans uses different Measures of Effectiveness (MOEs) to evaluate operations of different types of facilities. For example, both signalized and unsignalized intersections are analyzed based on average delay, in seconds per vehicle; this average delay is measured as part of Level of Service (LOS) analysis. For freeways and ramps, the Caltrans MOE is based on vehicle density per lane per mile, while for city streets, the MOE is vehicle speed.



frm043.ai 3/20

Morrison Canyon Road Traffic Safety Project

Figure 3 – Existing Traffic Volumes

Table 3 – Existing Peak Hour Intersection Levels of Service		
Study Intersection	**PM Peak Hour**	
	Delay	**LOS**
1. Mission Blvd/Niles Canyon Rd	42.6	D
2. Mission Blvd/Mowry Ave	58.8	E
3. Mission Blvd/Walnut Ave	35.2	D
4. Mission Blvd/Stevenson Ave	42.1	D
5. Mission Blvd North/I-680 SB Ramps	24.4	C
6. Mission Blvd North/I-680 NB Ramps	27.9	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service

Where LOS and delay under Existing conditions is characterized as LOS C and D, conditions in the field may be worse due to unserved demand. Specifically, unserved demand refers to the upstream and downstream congestion resulting in delays that are not captured by Synchro analysis. For example, vehicles approaching the intersection are underserved when they are unable to pass through the intersection due to queues and congestions. As such, the analysis software is does not always reflect and/or capture the queued operating conditions within the field.

Cumulative Conditions

Cumulative turning movement counts for the horizon year of 2040 were derived from previously approved transportation impact reports, including the Hobbs Property Housing Development Transportation Impact Analysis. Additionally, where future turning movement volumes were not readily available, growth factors ranging between one-half and two percent per annum were applied to the historical roadway segment volumes along of Mission Boulevard, Mowry Avenue, Walnut Avenue, and Niles Boulevard.

The General Plan EIR Mitigation Monitoring Program (City of Fremont, 2011b) identifies a mitigation measure at the Mission Boulevard (SR-238)/Mowry Avenue and Mission Boulevard (SR-238)/Niles Boulevard intersections (General Plan EIR Impact TRA-15). Based on the mitigation measures, the following changes will occur:

- Mowry Avenue eastbound at Mission Boulevard (SR-238) will be modified from one left, one through-left and one right turn lane to include two left-turn lanes and one through/right-turn lane;
- Mission Boulevard (SR-238) northbound at Mowry Avenue will be modified from one left- turn lane, two through lanes, and one shared right turn/through lane to one left-turn lane, one through lanes, and one shared through/right-turn lane;
- Mission Boulevard (SR-238) southbound at Mowry Avenue will change from having one left-turn lane, three through lanes and one right-turn lane to having one left-turn lane, four through lanes, and one shared through/right-turn lane;
- At the Mission Boulevard (SR-238) / Niles Boulevard - Niles Canyon Road intersection, the traffic signal will be modified to include protected left-turn phasing, along with a change to the Niles Boulevard approach from a shared left-through-right lane and one right-turn lane to one right-turn lane and one shared left-through lane, which is expected to be remodeled within the available right-of-way and avoid relocation of utilities. (General Plan EIR TRA-14).

For the purposes of identifying the potential impacts associated with the proposed project, these General Plan EIR mitigation measures are assumed to be fully implemented by 2040 and are included in the Cumulative No-Project and Cumulative plus Project scenarios.

Under these conditions, the intersection located at Mission Boulevard/Mowry Avenue and is expected to operate deficiently. These results are summarized in Table 4 and Cumulative volumes are shown in Figure 4.

Table 4 – Cumulative Peak Hour Intersection Levels of Service

Study Intersection	PM Peak Hour	
	Delay	LOS
1. Mission Blvd/Niles Canyon Rd	54.7	D
2. Mission Blvd/Mowry Ave	**99.1**	**F**
3. Mission Blvd/Walnut Ave-Morrison Canyon Rd	56.8	E
4. Mission Blvd/Stevenson Ave	79.3	E
5. Mission Blvd North/I-680 SB Ramps	45.9	D
6. Mission Blvd North/I-680 NB Ramps	67.4	E

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; **Bold** text = deficient operation

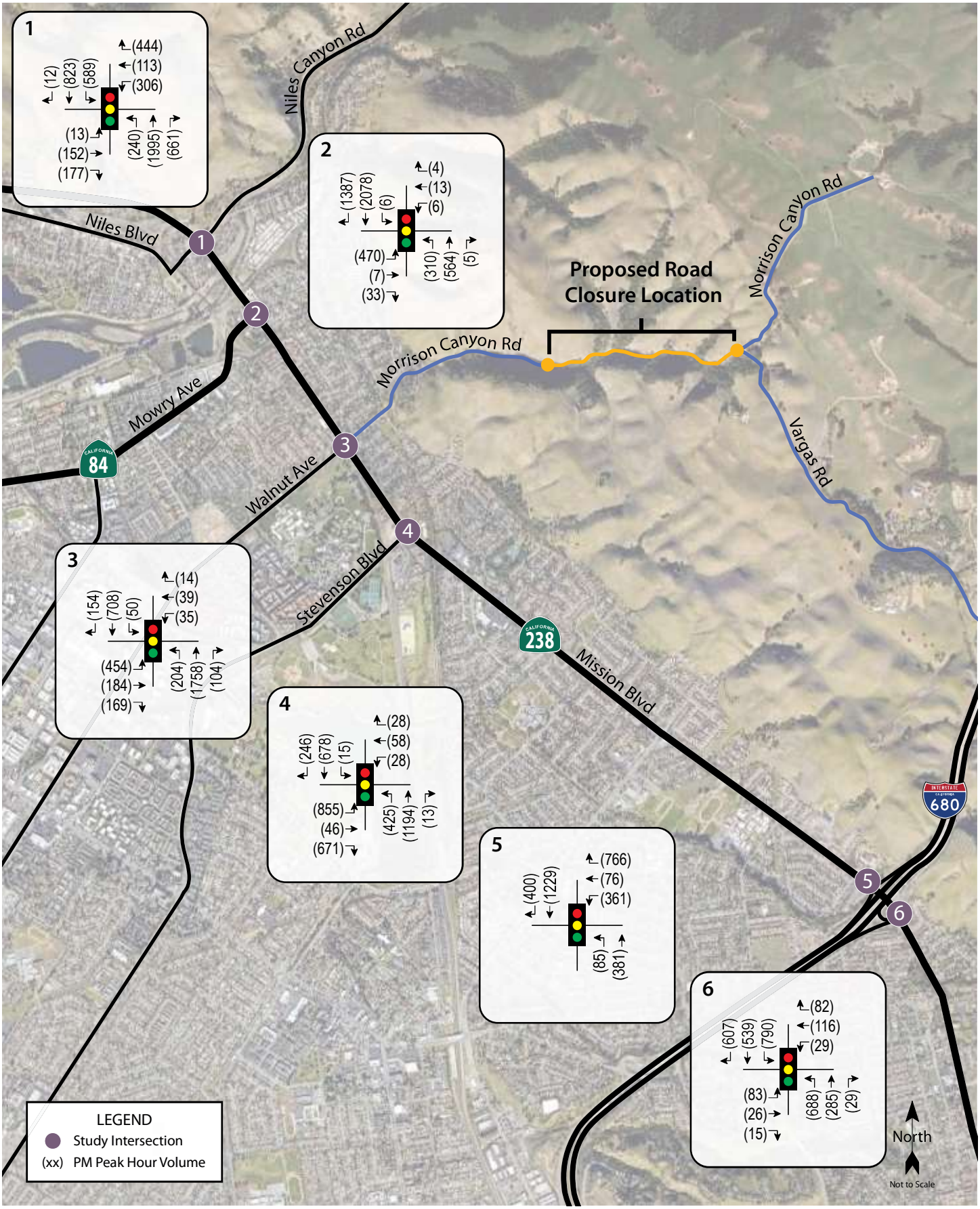
Project Description

The proposed project consists of a roadway closure along Morrison Canyon Road for a distance of approximately 0.75 miles west of the intersection of Morrison Canyon Road/Vargas Road. The road closure would continue to allow pedestrians and cyclists to access the roadway. Additionally, the roadway would remain accessible for local emergency fire and police response purposes and allow access for residents in emergency situations. The project would install permanent barriers at the bottom and top of "middle" Morrison Canyon Road.

Trip Redistribution

The anticipated trip generation (or redistribution of trips) for the proposed project was estimated using segment counts provided by City staff recorded between October 23 and 25, 2018, as well as turning movement counts collected on April 29, 2019. The trip redistribution potential of the project as planned was developed using the aforementioned traffic counts.

Based on the comparison of vehicle volumes before and after the temporary roadway closure, the proposed project is expected to generate an average of 396 trips per day, including 150 trips during the p.m. peak hour. The expected trip redistribution as a result of the road closure is based on the largest difference in average trips observed on Morrison Canyon Road before (October 2018) and after (November 2018) the road closure. The trip generation table is shown in Table 5.



frm043.ai 1/20

Morrison Canyon Road Traffic Safety Project

Figure 4 – Cumulative Traffic Volumes

Table 5 – Trip Generation Summary					
Land Use	**Units**	**Daily**		**PM Peak Hour**	
		Rate	**Trips**	**Rate**	**Eastbound Trips**
Proposed					
Temporary Road Closure	N/A	N/A*	396	N/A*	150
Total			**396**		**150**

Note: * = Daily and P.M. peak hour trips developed based on observed roadway segment counts

While trips generated from proposed projects are typically generated between the hours of 4:00 and 6:00 p.m., the largest difference in trips due to the roadway closure was observed at 3:15 p.m. The difference of 150 trips observed between 3:15 p.m. and 4:15 p.m. is approximately 20 trips higher than volumes observed during the typical peak period between 4:00 and 6:00 p.m. For this reason, the difference of 150 trips was used for analysis to conservatively account for the redistribution of trips attributable to the roadway closure. The difference in trips is shown below in Plate 1.

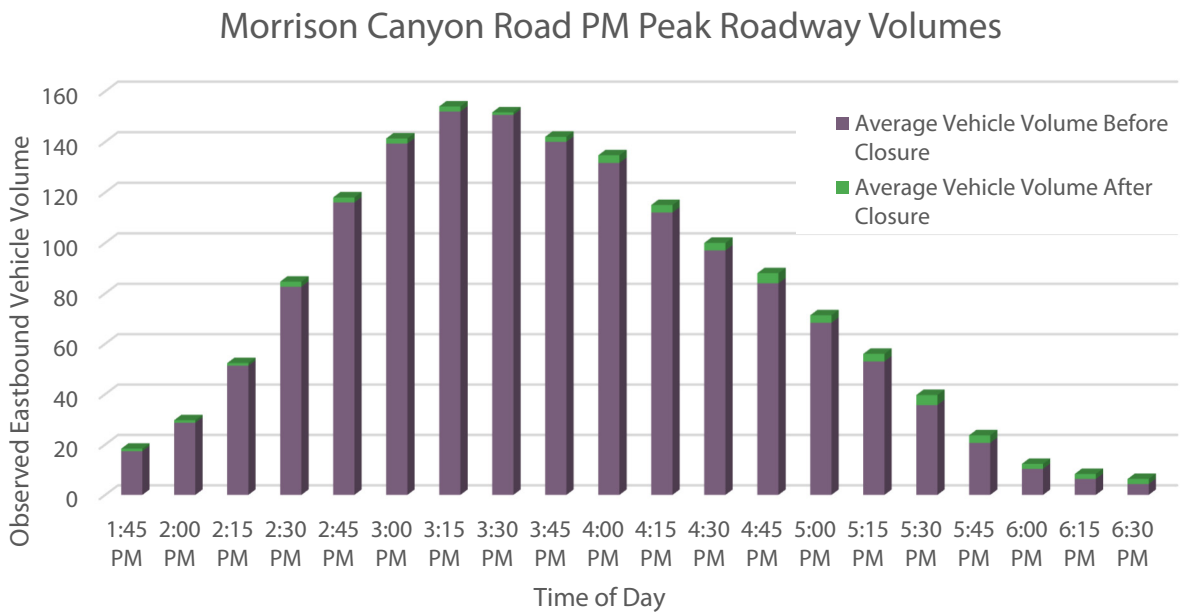


Plate 1 Morrison Canyon Road PM Peak Roadway Volumes

It is noted that while a road closure project would remove trips along the roadway segment in question, the majority of vehicles accessing Morrison Canyon Road are considered to be cut-through traffic attempting to by-pass northbound p.m. commute congestion along I-680. As a result, the trips which would be restricted from traveling along the closed segment of Morrison Canyon Road are assumed to be added back to the "typical" routes including Mission Boulevard, Niles Canyon Road, and I-680. As such, the trips are not new trips added to the existing network, but rather reassigned to the typical homeward bound commute routes.

Trip Assignment

The pattern used to reallocate project trips to the street network was determined by engineering judgement, and employment patterns for residents of the San Francisco Bay Area as well as the Tri-Valley Region based on data from the 2010 Census for work-to-home trips. It should be noted that upon review of the volumes along the Morrison Canyon Road both before and after the temporary road closure, the number of vehicles traveling westbound was minimal. For this reason, no westbound trips were assigned along the study roadways. Based on the applied assumptions shown in Table 5, the following distribution assumptions are proposed. The applied trip assignment assumptions and resulting trips are shown in Table 6 and volumes shown in Figure 5

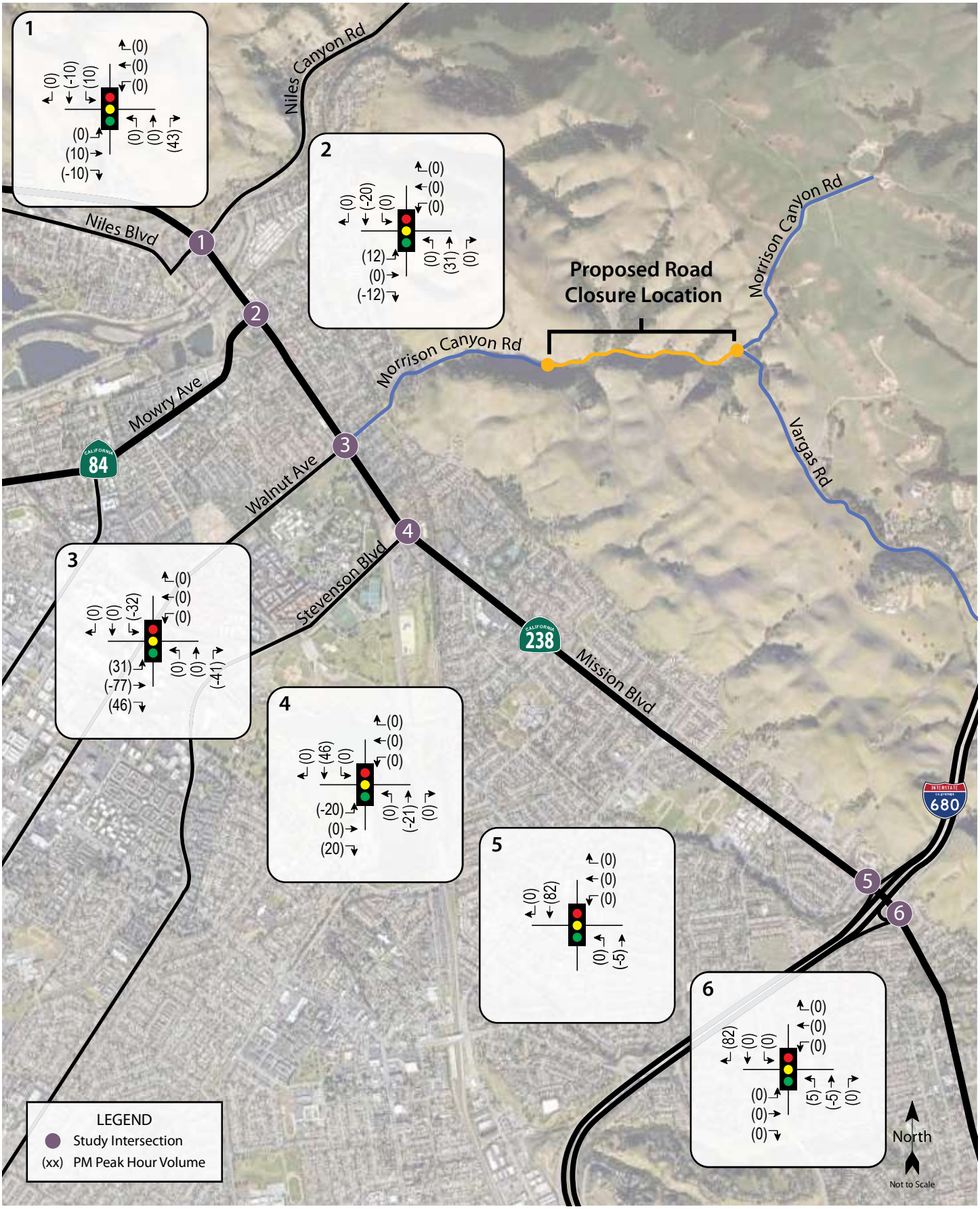
Table 6 – Trip Assignment Assumptions

Route	Percent	Daily Trips	PM Trips
From Mission Blvd north of Niles Canyon Rd (to SR-84)	7%	26	10
From Niles Canyon Rd west of Mission Blvd (to SR-84)	7%	26	10
From Mowry Ave west of Mission Blvd (to SR-84)	8%	32	12
From Walnut Ave west of Mission Blvd (to SR-84)	21%	82	31
From Walnut Ave west of Mission Blvd (to I-680)	31%	122	46
From Stevenson Ave west of Mission Blvd (to I-680)	13%	53	20
From South of Stevenson via Mission Blvd southbound	11%	42	16
From Mission Blvd south of I-680 On-Ramp (northbound)	3%	13	5
TOTAL	**100%**	**396**	**150**

Vehicle Miles Traveled (VMT)

Senate Bill (SB) 743 established a change in the metric to be applied to determining traffic impacts associated with development projects. Rather than the delay-based criteria associated with a Level of Service analysis, the change in Vehicle Miles Traveled (VMT) as a result of a project will be the basis for determining California Environmental Quality Act (CEQA) impacts with respect to transportation and traffic.

Vehicle miles traveled under Existing conditions was derived based on the assumed trip assignment patterns and the number of vehicles traveling eastbound on Morrison Canyon Road and subsequently on to I-680. Based on the assumptions the VMT under Existing conditions is 3,219 miles per day as shown below in Table 7.



frm043.ai 3/20

Morrison Canyon Road Traffic Safety Project

Figure 5 – Project Traffic Volumes

Table 7 – Existing Vehicle Miles Traveled					
Segment	**From**	**To**	**Daily Trips**	**Distance**	**VMT**
Mission Blvd	Niles Blvd	Walnut Ave	52	0.94	49
Mission Blvd	Mowry Ave	Walnut Ave	32	0.61	20
Morrison Canyon Rd	Mission Blvd	I-680	396	3.88	1,536
I-680	Vargas Rd	SR-84 (Sunol)	396	3.75	1,486
Mission Blvd	Stevenson Blvd	Walnut Ave	53	0.41	22
Mission Blvd	Driscoll Rd	Walnut Ave	42	1.62	69
Mission Blvd	I-680 Off-Ramps	Walnut Ave	13	2.84	37
Total					**3,219**

Note: VMT = Vehicle Miles Traveled

VMT under Existing plus Project conditions are based on the redistributed trip pattern as a result of the roadway closure, as well as the respective volumes along each route. Based on the trip pattern assumptions, the VMT under Existing plus Project conditions is expected to be 2,931 miles per day as shown below in Table 8.

Table 8 – Existing plus Project Vehicle Miles Traveled					
Segment	**From**	**To**	**Daily Trips**	**Distance**	**VMT**
Niles Canyon Rd	Mission Blvd	I-680 (Sunol)	166	7.56	1,256
Mission Blvd	Mowry Ave	Niles Blvd	32	0.33	11
Mission Blvd	Walnut Ave	Niles Blvd	82	0.94	77
Mission Blvd	Walnut Ave	I-680	121	2.84	344
Mission Blvd	Stevenson Blvd	I-680	53	2.43	129
Mission Blvd	Driscoll Rd	I-680 Ramps	42	1.22	52
I-680 Span	Mission Blvd	SR-84	230	4.61	1,062
Total					**2,931**

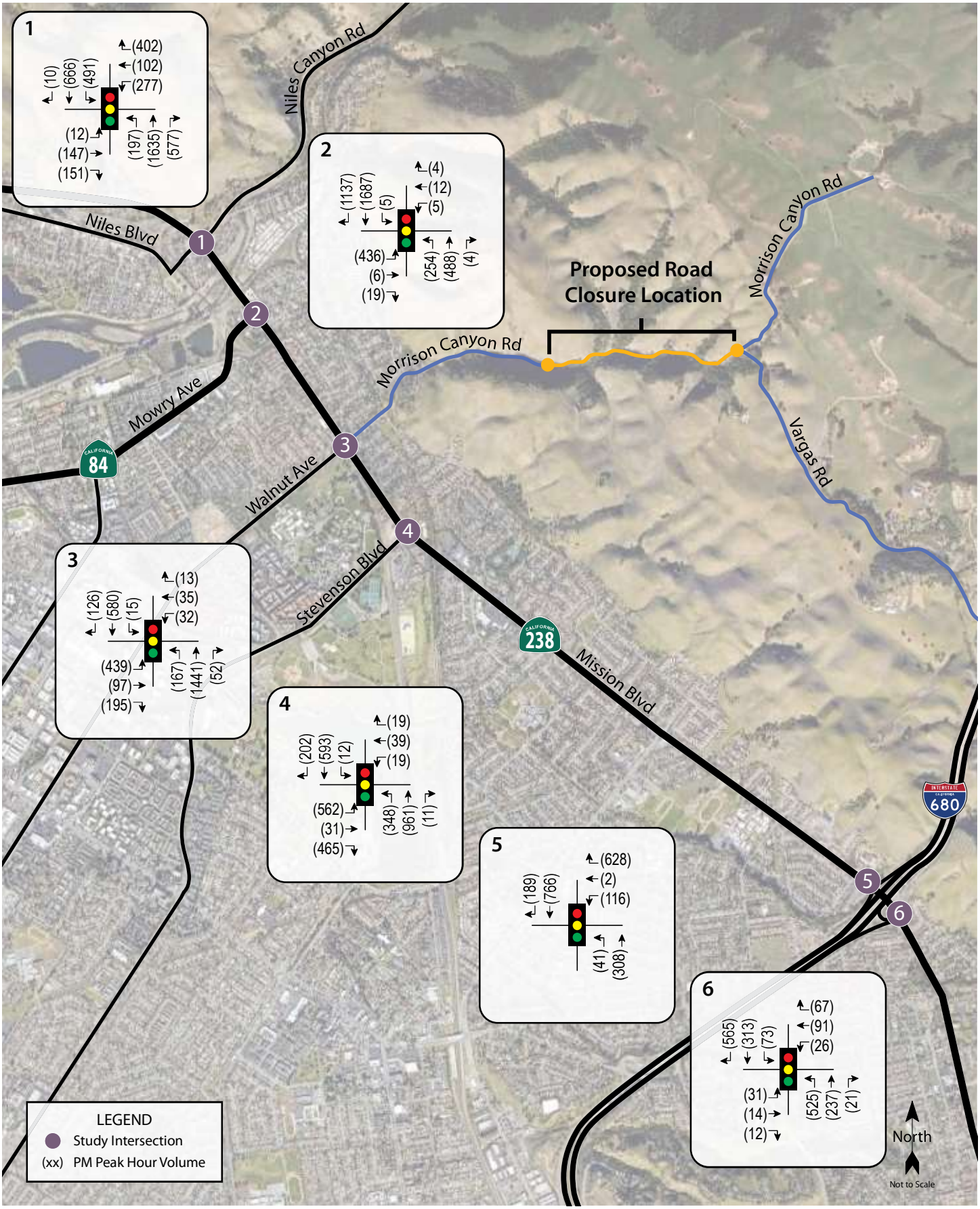
Note: VMT = Vehicle Miles Traveled

In comparison to Existing conditions, the road closure is expected to result in 396 redistributed daily trips and a decrease in VMT of 288 miles per day.

Intersection Operation

Existing plus Project Conditions

Upon the redistribution of project-related traffic, the study intersections are expected to operate at LOS E or better. These results are summarized in Table 9. Project traffic volumes under Existing plus Project conditions are shown in Figure 6.



frm043.ai 1/20

Morrison Canyon Road Traffic Safety Project

Figure 6 – Existing plus Project Traffic Volumes

Table 9 – Existing and Existing plus Project Peak Hour Intersection Levels of Service				
Study Intersection	**Existing Conditions PM Peak**		**Existing plus Project PM Peak**	
	Delay	**LOS**	**Delay**	**LOS**
1. Mission Blvd/Niles Canyon Rd	42.6	D	42.6	D
2. Mission Blvd/Mowry Ave	58.8	E	59.6	E
3. Mission Blvd/Walnut Ave	35.2	D	32.6	C
4. Mission Blvd/Stevenson Ave	42.1	D	41.9	D
5. Mission Blvd North/I-680 SB Ramps	24.4	C	24.2	C
6. Mission Blvd North/I-680 NB Ramps	27.9	C	30.2	C

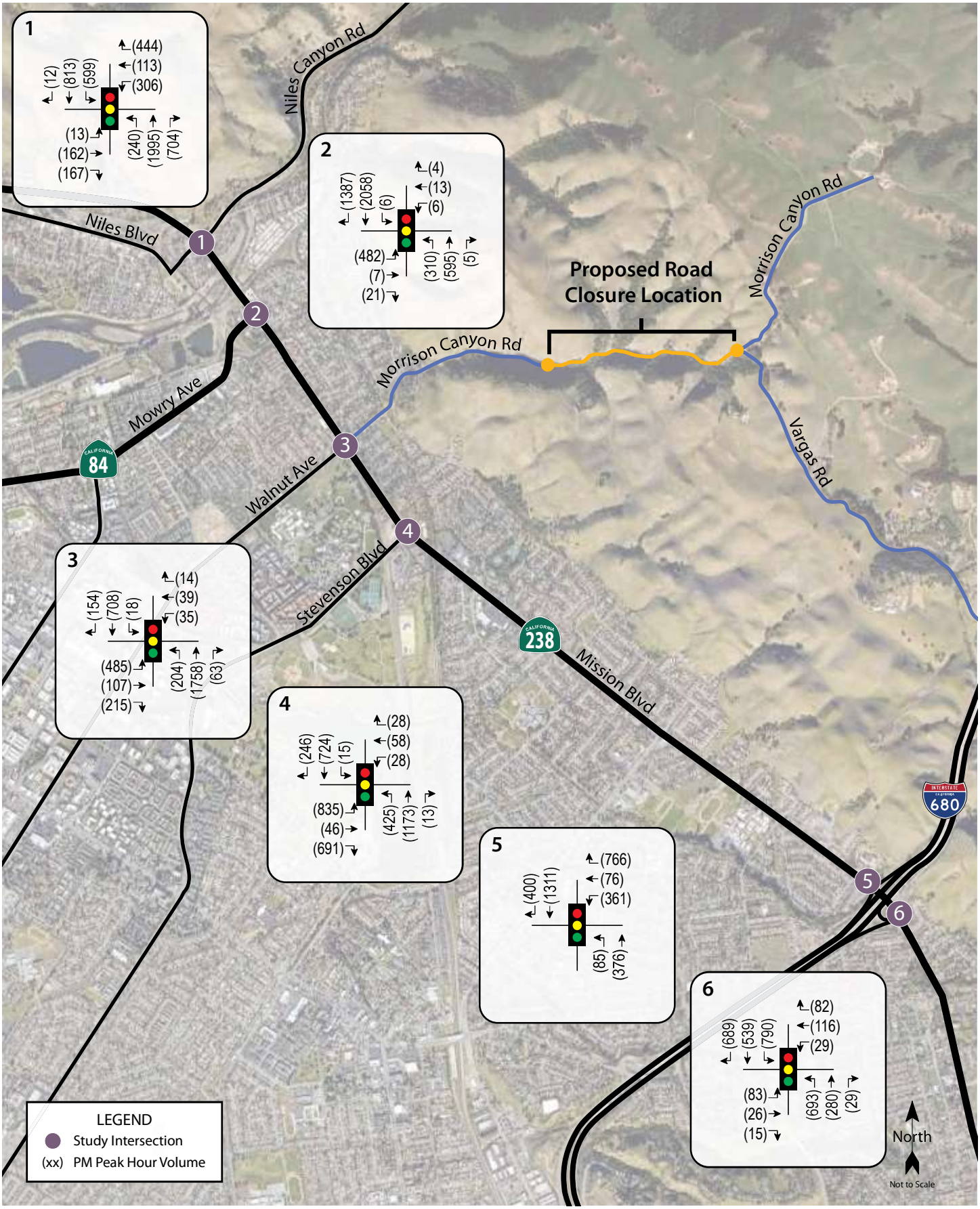
Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service

It is noted that with the redistribution of project-related traffic volumes, the average delay at the intersections including Mission Boulevard/Walnut Avenue, Mission Boulevard/Stevenson Avenue, and Mission Blvd/I-680 SB Ramps would decrease during the p.m. peak hour. While this is counter-intuitive, this condition occurs when a project adds trips to movements that are currently underutilized or have delays that are below the intersection average, resulting in a better balance between approaches and lower overall average delay. If a project adds traffic predominantly to the right-turn or through movement, which has an average delay that is lower than the average for the intersection as a whole, then it can result in a slight reduction in the overall average delay. The conclusion could incorrectly be drawn that the project actually improves operation based on this data alone; however, it is more appropriate to conclude that the project trips are expected to make use of excess capacity, so drivers individually will experience little, if any, change in conditions as a result of the project.

Cumulative plus Project Conditions

With project-related redistributed traffic added to 2040 Cumulative volumes, the study intersections are expected to operate acceptably with the exception of Mission Boulevard/Mowry Avenue. Even with implementation of the General Plan EIR mitigation measures discussed above, the intersection at Mission Boulevard/Mowry Avenue would continue to operate at LOS F during the p.m. peak hour under Cumulative plus Project conditions.

It should be noted that with the redistribution of project-related traffic volumes, the average delay at the intersections of Mission Boulevard/Walnut Avenue, Mission Boulevard/Stevenson Avenue would slightly decrease during the p.m. peak hour. These results are summarized in Table 10 and Cumulative plus Project volumes are shown in Figure 7.



frm043.ai 1/20

Morrison Canyon Road Traffic Safety Project

Figure 7 – Cumulative plus Project Traffic Volumes

Table 10 – Cumulative and Cumulative plus Project Peak Hour Intersection Levels of Service				
Study Intersection	**Cumulative Conditions PM Peak**		**Cumulative plus Project PM Peak**	
	Delay	**LOS**	**Delay**	**LOS**
1. Mission Blvd/Niles Canyon Rd	76.5	E	77.8	E
2. Mission Blvd/Mowry Ave	**99.1**	**F**	**82.1**	**F**
3. Mission Blvd/Walnut Ave	56.8	E	40.8	D
4. Mission Blvd/Stevenson Ave	79.3	E	78.5	E
5. Mission Blvd/I-680 SB Ramps	45.9	D	47.7	D
6. Mission Blvd North/I-680 NB Ramps	67.4	E	77.7	E

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; **Bold** text = deficient operation

Finding – The study intersections are expected to continue operating acceptably upon the redistribution of project-generated traffic with the exception of Mission Boulevard/Mowry Avenue.

Alternative Modes

Pedestrian and Bicycle Facilities

Given the rural characteristics of the Morrison Canyon Road, it is reasonable to assume that some project community members will want to walk and/or bicycle in the project area.

Morrison Canyon Road – Sidewalks do not exist along the length of the proposed roadway closure. However, the closure of the roadway to through vehicles would enhance safety for pedestrians and cyclists as the potential for conflict with vehicles would be reduced.

Finding – Pedestrian and bicycle facilities would be enhanced under project conditions as the interaction with passenger vehicles would be substantially reduced.

Transit

There are no existing transit routes which provide service along the study roadway. However, the project would result in additional vehicles traveling along specific sections of Mission Boulevard. The project would not result in the removal and/or relocation of transit facilities, nor would it result in a decrease in access. The additional vehicles added to Mission Boulevard are not expected to significantly impact transit accessibility or travel speeds.

Finding – Transit facilities serving the project site are expected to remain the same with or without the proposed roadway closure project.

Conclusions

Conclusions

- The proposed project is expected to redistribute an average of 396 trips per day, including 150 p.m. peak hour trips.
- VMT as a result of the redistribution of project trips is expected to decrease by approximately 288 miles per day.
- The study intersections operate acceptably overall during the p.m. peak hour under existing conditions.
- Under Cumulative conditions the study intersections are expected to operate acceptably during the p.m. peak hour at LOS E or better with the exception of Mission Boulevard/Mowry Avenue.
- Upon applying redistributed project trips to Existing volumes, the study intersections are expected to continue operating acceptably.
- Upon applying redistributed project trips to Cumulative volumes, the study intersections are expected to continue operating acceptably with the exception of Mission Boulevard/Mowry.
- While LOS F is expected to be maintained at the intersection of Mission Boulevard/Mowry Avenue under Cumulative plus Project conditions, the delay is expected to improve. This is largely due to the change in intersection geometry 'associated with the General Plan EIR recommended mitigation measures. As such, no significant impact is expected as a result of the project.

Study Participants and References

Study Participants

Principal in Charge	Mark E. Spencer, TE
Assistant Planner	Andre Huff
Graphics	Katia Wolf
Editing/Formatting	Hannah Yung-Boxdell
Quality Control	Dalene J. Whitlock, PE, PTOE

References

2010 US Census Data
AC Transit, http://www.actransit.org/maps/
City of Fremont General Plan, City of Fremont, 2011
City of Fremont Bicycle Master Plan, City of Fremont, 2018
Highway Capacity Manual, Transportation Research Board, 2000
Highway Design Manual, 6th Edition, California Department of Transportation, 2017
Senate Bill No. 743, California Legislative Information,
http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB743

FRM043

This page intentionally left blank

Appendix A

Intersection Level of Service Calculations

This page intentionally left blank

HCM Signalized Intersection Capacity Analysis
1: Mission Blvd & Niles Blvd/Niles Canyon Rd

12/09/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	12	137	161	277	102	402	197	1632	534	481	676	10
Future Volume (vph)	12	137	161	277	102	402	197	1632	534	481	676	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.7	4.7	5.8	5.8	5.3	4.2	5.8	5.8	5.3	5.8	
Lane Util. Factor		0.95	0.95	0.97	1.00	1.00	1.00	0.91	1.00	0.97	0.91	
Frpb, ped/bikes		1.00	0.98	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		0.99	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1733	1471	3433	1863	1570	1770	5085	1583	3433	5071	
Flt Permitted		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1733	1471	3433	1863	1570	1770	5085	1583	3433	5071	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	13	144	169	292	107	423	207	1718	562	506	712	11
RTOR Reduction (vph)	0	3	134	0	0	158	0	0	167	0	1	0
Lane Group Flow (vph)	0	171	18	292	107	265	207	1718	395	506	722	0
Confl. Peds. (#/hr)	1		4	4		1	4			1		4
Turn Type	Split	NA	Perm	Split	NA	pm+ov	Prot	NA	Perm	Prot	NA	
Protected Phases	4	4		3	3	1	5	2		1	6	
Permitted Phases			4			3			2			
Actuated Green, G (s)		16.0	16.0	14.5	14.5	37.6	18.1	57.3	57.3	23.1	63.4	
Effective Green, g (s)		16.0	16.0	14.5	14.5	37.6	18.1	57.3	57.3	23.1	63.4	
Actuated g/C Ratio		0.12	0.12	0.11	0.11	0.28	0.14	0.43	0.43	0.17	0.48	
Clearance Time (s)		4.7	4.7	5.8	5.8	5.3	4.2	5.8	5.8	5.3	5.8	
Vehicle Extension (s)		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Lane Grp Cap (vph)		209	177	375	203	445	241	2199	684	598	2426	
v/s Ratio Prot		c0.10		c0.09	0.06	0.10	0.12	c0.34		c0.15	0.14	
v/s Ratio Perm			0.01			0.07			0.25			
v/c Ratio		0.82	0.10	0.78	0.53	0.60	0.86	0.78	0.58	0.85	0.30	
Uniform Delay, d1		56.8	51.9	57.4	55.8	40.9	56.0	32.2	28.4	53.0	21.0	
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		20.6	0.1	9.0	1.1	1.4	24.1	2.8	3.5	10.3	0.3	
Delay (s)		77.4	52.0	66.4	56.9	42.3	80.0	35.1	32.0	63.2	21.3	
Level of Service		E	D	E	E	D	F	D	C	E	C	
Approach Delay (s)		65.5			52.8			38.1			38.6	
Approach LOS		E			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	42.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	132.5	Sum of lost time (s)	21.6
Intersection Capacity Utilization	85.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	424	6	31	5	12	4	245	457	4	5	1707	1137
Future Volume (vph)	424	6	31	5	12	4	245	457	4	5	1707	1137
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.1	5.1	5.1		4.3		4.8	5.8		4.8	5.8	5.8
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.91		1.00	0.91	1.00
Frpb, ped/bikes	1.00	1.00	0.99		1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		0.98		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1688	1561		1797		1770	5079		1770	5085	1548
Flt Permitted	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1688	1561		1797		1770	5079		1770	5085	1548
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	442	6	32	5	12	4	255	476	4	5	1778	1184
RTOR Reduction (vph)	0	0	26	0	4	0	0	0	0	0	0	417
Lane Group Flow (vph)	225	223	6	0	18	0	255	480	0	5	1778	767
Confl. Peds. (#/hr)			2									1
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	24.5	24.5	24.5		4.6		24.0	80.1		0.8	56.9	56.9
Effective Green, g (s)	24.5	24.5	24.5		4.6		24.0	80.1		0.8	56.9	56.9
Actuated g/C Ratio	0.19	0.19	0.19		0.04		0.18	0.62		0.01	0.44	0.44
Clearance Time (s)	5.1	5.1	5.1		4.3		4.8	5.8		4.8	5.8	5.8
Vehicle Extension (s)	5.0	5.0	5.0		3.0		3.0	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	316	318	294		63		326	3129		10	2225	677
v/s Ratio Prot	c0.13	0.13			c0.01		c0.14	0.09		0.00	0.35	
v/s Ratio Perm			0.00									c0.50
v/c Ratio	0.71	0.70	0.02		0.29		0.78	0.15		0.50	0.80	1.13
Uniform Delay, d1	49.4	49.3	43.0		61.1		50.5	10.6		64.4	31.6	36.5
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	9.1	8.5	0.1		2.5		11.6	0.1		34.4	3.1	77.5
Delay (s)	58.5	57.8	43.0		63.6		62.1	10.7		98.8	34.7	114.1
Level of Service	E	E	D		E		E	B		F	C	F
Approach Delay (s)		57.2			63.6			28.5			66.5	
Approach LOS		E			E			C			E	

Intersection Summary			
HCM 2000 Control Delay	58.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	106.5%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	408	174	149	32	35	13	167	1441	93	47	580	126
Future Volume (vph)	408	174	149	32	35	13	167	1441	93	47	580	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.6	3.6	3.6	4.1	4.1		3.6	5.3		3.6	5.3	5.3
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1552	1770	1788		1770	3507		1770	3539	1545
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1863	1552	1770	1788		1770	3507		1770	3539	1545
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	443	189	162	35	38	14	182	1566	101	51	630	137
RTOR Reduction (vph)	0	0	134	0	10	0	0	3	0	0	0	73
Lane Group Flow (vph)	443	189	28	35	42	0	182	1664	0	51	630	64
Confl. Peds. (#/hr)			6				2					2
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	7	7		8	8		5	2		1	6	
Permitted Phases			7									6
Actuated Green, G (s)	22.2	22.2	22.2	9.6	9.6		21.2	73.3		8.3	60.4	60.4
Effective Green, g (s)	22.2	22.2	22.2	9.6	9.6		21.2	73.3		8.3	60.4	60.4
Actuated g/C Ratio	0.17	0.17	0.17	0.07	0.07		0.16	0.56		0.06	0.46	0.46
Clearance Time (s)	3.6	3.6	3.6	4.1	4.1		3.6	5.3		3.6	5.3	5.3
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		3.0	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	586	318	265	130	132		288	1977		113	1644	717
v/s Ratio Prot	c0.13	0.10		0.02	c0.02		0.10	c0.47		c0.03	0.18	
v/s Ratio Perm			0.02									0.04
v/c Ratio	0.76	0.59	0.10	0.27	0.32		0.63	0.84		0.45	0.38	0.09
Uniform Delay, d1	51.3	49.7	45.5	56.9	57.1		50.8	23.5		58.7	22.7	19.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.3	2.5	0.1	0.8	1.0		4.5	4.5		2.8	0.7	0.2
Delay (s)	56.6	52.2	45.6	57.7	58.1		55.2	28.1		61.5	23.3	19.7
Level of Service	E	D	D	E	E		E	C		E	C	B
Approach Delay (s)		53.3			57.9			30.8			25.1	
Approach LOS		D			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	35.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.6
Intersection Capacity Utilization	89.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	582	31	445	19	39	19	348	982	11	12	547	202
Future Volume (vph)	582	31	445	19	39	19	348	982	11	12	547	202
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.1	4.1	4.1	4.1	4.1		4.1	5.8		4.1	5.8	5.8
Lane Util. Factor	0.95	0.95	0.88	1.00	1.00		0.97	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00		1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1694	2750	1770	1762		3433	3532		1770	3539	1563
Flt Permitted	0.95	0.96	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1694	2750	1770	1762		3433	3532		1770	3539	1563
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	633	34	484	21	42	21	378	1067	12	13	595	220
RTOR Reduction (vph)	0	0	354	0	14	0	0	0	0	0	0	127
Lane Group Flow (vph)	335	332	130	21	49	0	378	1079	0	13	595	93
Confl. Peds. (#/hr)	1		1	1		1	7		2	2		1
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases			8									2
Actuated Green, G (s)	39.3	39.3	39.3	9.5	9.5		27.6	86.3		2.8	61.5	61.5
Effective Green, g (s)	39.3	39.3	39.3	9.5	9.5		27.6	86.3		2.8	61.5	61.5
Actuated g/C Ratio	0.25	0.25	0.25	0.06	0.06		0.18	0.55		0.02	0.39	0.39
Clearance Time (s)	4.1	4.1	4.1	4.1	4.1		4.1	5.8		4.1	5.8	5.8
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		1.3	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	423	426	692	107	107		607	1953		31	1395	616
v/s Ratio Prot	c0.20	0.20		0.01	c0.03		c0.11	c0.31		0.01	c0.17	
v/s Ratio Perm			0.05									0.06
v/c Ratio	0.79	0.78	0.19	0.20	0.46		0.62	0.55		0.42	0.43	0.15
Uniform Delay, d1	54.5	54.3	45.8	69.6	70.8		59.4	22.4		75.8	34.4	30.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	9.8	8.8	0.1	0.9	3.1		1.4	1.1		8.9	1.0	0.5
Delay (s)	64.3	63.1	46.0	70.5	73.8		60.8	23.6		84.7	35.4	30.9
Level of Service	E	E	D	E	E		E	C		F	D	C
Approach Delay (s)		56.2			73.0			33.2			35.0	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	42.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	156.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	80.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	116	2	628	41	313	0	0	766	189
Future Volume (vph)	0	0	0	116	2	628	41	313	0	0	766	189
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.7	4.7	3.7	5.5			5.5	5.5
Lane Util. Factor					1.00	1.00	1.00	0.95			0.95	1.00
Frpb, ped/bikes					1.00	0.98	1.00	1.00			1.00	1.00
Flpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	1.00
Frt					1.00	0.85	1.00	1.00			1.00	0.85
Flt Protected					0.95	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)					1775	1557	1770	3539			3539	1583
Flt Permitted					0.95	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)					1775	1557	1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	126	2	683	45	340	0	0	833	205
RTOR Reduction (vph)	0	0	0	0	0	265	0	0	0	0	0	105
Lane Group Flow (vph)	0	0	0	0	128	418	45	340	0	0	833	100
Confl. Peds. (#/hr)	4					4			5	5		
Turn Type				Perm	NA	Perm	Prot	NA			NA	Perm
Protected Phases					4		1	6			2	
Permitted Phases				4		4						2
Actuated Green, G (s)					29.8	29.8	4.0	53.3			45.6	45.6
Effective Green, g (s)					29.8	29.8	4.0	53.3			45.6	45.6
Actuated g/C Ratio					0.32	0.32	0.04	0.57			0.49	0.49
Clearance Time (s)					4.7	4.7	3.7	5.5			5.5	5.5
Vehicle Extension (s)					4.0	4.0	3.5	3.5			3.5	3.5
Lane Grp Cap (vph)					566	497	75	2021			1729	773
v/s Ratio Prot							c0.03	0.10			c0.24	
v/s Ratio Perm					0.07	c0.27						0.06
v/c Ratio					0.23	0.84	0.60	0.17			0.48	0.13
Uniform Delay, d1					23.3	29.5	43.9	9.5			15.9	13.0
Progression Factor					1.00	1.00	1.00	1.00			1.00	1.00
Incremental Delay, d2					0.3	12.6	13.0	0.2			1.0	0.3
Delay (s)					23.6	42.1	56.8	9.7			16.9	13.4
Level of Service					C	D	E	A			B	B
Approach Delay (s)		0.0			39.2			15.2			16.2	
Approach LOS		A			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	24.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	93.3	Sum of lost time (s)	13.9
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Mission Boulevard & I-680 On-Ramp/Mission Road

01/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	31	14	12	26	91	67	520	242	21	73	313	483
Future Volume (vph)	31	14	12	26	91	67	520	242	21	73	313	483
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.7	3.7			3.7	3.7	3.5	4.7		3.7	4.7	4.7
Lane Util. Factor	0.95	0.95			1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.94			1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00			0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1610			1842	1583	1770	3487		1770	3539	1583
Flt Permitted	0.95	1.00			0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1610			1842	1583	1770	3487		1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	34	15	13	28	99	73	565	263	23	79	340	525
RTOR Reduction (vph)	0	12	0	0	0	63	0	4	0	0	0	426
Lane Group Flow (vph)	31	19	0	0	127	10	565	282	0	79	340	99
Confl. Peds. (#/hr)			45	45					6	6		
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases						3						6
Actuated Green, G (s)	4.5	4.5			11.9	11.9	36.9	45.2		7.6	16.1	16.1
Effective Green, g (s)	4.5	4.5			11.9	11.9	36.9	45.2		7.6	16.1	16.1
Actuated g/C Ratio	0.05	0.05			0.14	0.14	0.43	0.53		0.09	0.19	0.19
Clearance Time (s)	3.7	3.7			3.7	3.7	3.5	4.7		3.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	4.0		3.0	4.0	4.0
Lane Grp Cap (vph)	88	85			257	221	768	1854		158	670	299
v/s Ratio Prot	c0.02	0.01			c0.07		c0.32	0.08		0.04	c0.10	
v/s Ratio Perm						0.01						0.06
v/c Ratio	0.35	0.22			0.49	0.05	0.74	0.15		0.50	0.51	0.33
Uniform Delay, d1	38.8	38.6			33.8	31.6	20.0	10.1		36.9	30.9	29.8
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.4	1.3			1.5	0.1	3.7	0.2		2.5	2.7	3.0
Delay (s)	41.3	39.9			35.3	31.7	23.7	10.3		39.4	33.6	32.8
Level of Service	D	D			D	C	C	B		D	C	C
Approach Delay (s)		40.6			34.0			19.2			33.6	
Approach LOS		D			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	27.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	15.8
Intersection Capacity Utilization	77.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: Mission Blvd & Niles Blvd/Niles Canyon Rd

12/09/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	13	152	177	306	113	444	240	1995	661	589	823	12
Future Volume (vph)	13	152	177	306	113	444	240	1995	661	589	823	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.7	4.7		5.8	5.8	5.3	4.2	5.8	5.8	5.3	5.8	
Lane Util. Factor	1.00	1.00		0.97	1.00	1.00	1.00	0.91	1.00	0.97	0.91	
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.92		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1694		3433	1863	1562	1770	5085	1583	3433	5072	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1694		3433	1863	1562	1770	5085	1583	3433	5072	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	14	160	186	322	119	467	253	2100	696	620	866	13
RTOR Reduction (vph)	0	27	0	0	0	118	0	0	186	0	1	0
Lane Group Flow (vph)	14	319	0	322	119	349	253	2100	510	620	878	0
Confl. Peds. (#/hr)	1		4	4		1	4			1		4
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA	Perm	Prot	NA	
Protected Phases	7	4		3	8	1	5	2		1	6	
Permitted Phases						8			2			
Actuated Green, G (s)	5.1	19.3		17.6	31.8	51.5	20.1	49.4	49.4	19.7	50.1	
Effective Green, g (s)	5.1	19.3		17.6	31.8	51.5	20.1	49.4	49.4	19.7	50.1	
Actuated g/C Ratio	0.04	0.15		0.14	0.25	0.40	0.16	0.39	0.39	0.15	0.39	
Clearance Time (s)	4.7	4.7		5.8	5.8	5.3	4.2	5.8	5.8	5.3	5.8	
Vehicle Extension (s)	0.2	0.2		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Lane Grp Cap (vph)	70	256		473	464	630	278	1968	612	530	1991	
v/s Ratio Prot	0.01	c0.19		c0.09	0.06	0.09	0.14	c0.41		c0.18	0.17	
v/s Ratio Perm						0.14			0.32			
v/c Ratio	0.20	1.25		0.68	0.26	0.55	0.91	1.07	0.83	1.17	0.44	
Uniform Delay, d1	59.3	54.1		52.3	38.4	29.2	52.9	39.1	35.4	53.9	28.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.5	138.8		3.2	0.1	0.6	31.1	40.9	12.6	95.2	0.7	
Delay (s)	59.8	193.0		55.5	38.5	29.8	83.9	80.0	47.9	149.1	29.2	
Level of Service	E	F		E	D	C	F	F	D	F	C	
Approach Delay (s)		187.8			40.1			73.0			78.8	
Approach LOS		F			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	76.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	127.6	Sum of lost time (s)	21.6
Intersection Capacity Utilization	102.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	470	7	33	6	13	4	310	564	5	6	2078	1387
Future Volume (vph)	470	7	33	6	13	4	310	564	5	6	2078	1387
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.1	5.1			4.3		4.8	5.8		4.8	5.8	
Lane Util. Factor	0.97	1.00			1.00		1.00	0.91		1.00	0.81	
Frpb, ped/bikes	1.00	0.99			1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.88			0.98		1.00	1.00		1.00	0.94	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	1612			1798		1770	5079		1770	7028	
Flt Permitted	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	1612			1798		1770	5079		1770	7028	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	490	7	34	6	14	4	323	588	5	6	2165	1445
RTOR Reduction (vph)	0	27	0	0	4	0	0	0	0	0	87	0
Lane Group Flow (vph)	490	14	0	0	20	0	323	593	0	6	3523	0
Confl. Peds. (#/hr)			2									1
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	26.0	26.0			4.6		24.0	78.6		0.8	55.4	
Effective Green, g (s)	26.0	26.0			4.6		24.0	78.6		0.8	55.4	
Actuated g/C Ratio	0.20	0.20			0.04		0.18	0.60		0.01	0.43	
Clearance Time (s)	5.1	5.1			4.3		4.8	5.8		4.8	5.8	
Vehicle Extension (s)	5.0	5.0			3.0		3.0	5.0		3.0	5.0	
Lane Grp Cap (vph)	686	322			63		326	3070		10	2995	
v/s Ratio Prot	c0.14	0.01			c0.01		c0.18	0.12		0.00	c0.50	
v/s Ratio Perm												
v/c Ratio	0.71	0.04			0.32		0.99	0.19		0.60	1.77dr	
Uniform Delay, d1	48.5	42.0			61.2		52.9	11.5		64.4	37.3	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.4	0.1			2.9		47.2	0.1		70.6	83.2	
Delay (s)	52.9	42.1			64.1		100.1	11.6		135.0	120.5	
Level of Service	D	D			E		F	B		F	F	
Approach Delay (s)		52.1			64.1			42.8			120.5	
Approach LOS		D			E			D			F	

Intersection Summary			
HCM 2000 Control Delay	99.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	93.8%	ICU Level of Service	F
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	545	184	169	35	39	14	204	1758	104	50	708	154
Future Volume (vph)	545	184	169	35	39	14	204	1758	104	50	708	154
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.6	3.6	3.6	4.1	4.1		3.6	5.3		3.6	5.3	5.3
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1552	1770	1789		1770	3510		1770	3539	1545
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1863	1552	1770	1789		1770	3510		1770	3539	1545
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	592	200	184	38	42	15	222	1911	113	54	770	167
RTOR Reduction (vph)	0	0	147	0	10	0	0	3	0	0	0	95
Lane Group Flow (vph)	592	200	37	38	47	0	222	2021	0	54	770	72
Confl. Peds. (#/hr)			6				2					2
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	7	7		8	8		5	2		1	6	
Permitted Phases			7									6
Actuated Green, G (s)	26.3	26.3	26.3	9.6	9.6		21.1	70.2		7.3	56.4	56.4
Effective Green, g (s)	26.3	26.3	26.3	9.6	9.6		21.1	70.2		7.3	56.4	56.4
Actuated g/C Ratio	0.20	0.20	0.20	0.07	0.07		0.16	0.54		0.06	0.43	0.43
Clearance Time (s)	3.6	3.6	3.6	4.1	4.1		3.6	5.3		3.6	5.3	5.3
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		3.0	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	694	376	313	130	132		287	1895		99	1535	670
v/s Ratio Prot	c0.17	0.11		0.02	c0.03		0.13	c0.58		0.03	c0.22	
v/s Ratio Perm			0.02									0.05
v/c Ratio	0.85	0.53	0.12	0.29	0.35		0.77	1.07		0.55	0.50	0.11
Uniform Delay, d1	50.0	46.3	42.4	57.0	57.3		52.2	29.9		59.7	26.6	21.9
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	9.8	1.1	0.1	0.9	1.2		12.2	41.0		6.0	1.2	0.3
Delay (s)	59.8	47.5	42.5	57.9	58.4		64.4	70.9		65.8	27.8	22.2
Level of Service	E	D	D	E	E		E	E		E	C	C
Approach Delay (s)		54.0			58.2			70.2			28.9	
Approach LOS		D			E			E			C	

Intersection Summary			
HCM 2000 Control Delay	56.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.6
Intersection Capacity Utilization	101.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	855	46	671	28	58	28	425	1194	13	15	678	246
Future Volume (vph)	855	46	671	28	58	28	425	1194	13	15	678	246
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.1	4.1	4.1	4.1	4.1		4.1	5.8		4.1	5.8	5.8
Lane Util. Factor	0.95	0.95	0.88	1.00	1.00		0.97	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00		1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1694	2750	1770	1765		3433	3533		1770	3539	1563
Flt Permitted	0.95	0.96	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1694	2750	1770	1765		3433	3533		1770	3539	1563
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	929	50	729	30	63	30	462	1298	14	16	737	267
RTOR Reduction (vph)	0	0	316	0	13	0	0	1	0	0	0	130
Lane Group Flow (vph)	492	487	413	30	80	0	462	1311	0	16	737	137
Confl. Peds. (#/hr)	1		1	1		1	7		2	2		1
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases			8									2
Actuated Green, G (s)	54.5	54.5	54.5	13.3	13.3		12.9	67.3		2.8	57.2	57.2
Effective Green, g (s)	54.5	54.5	54.5	13.3	13.3		12.9	67.3		2.8	57.2	57.2
Actuated g/C Ratio	0.35	0.35	0.35	0.09	0.09		0.08	0.43		0.02	0.37	0.37
Clearance Time (s)	4.1	4.1	4.1	4.1	4.1		4.1	5.8		4.1	5.8	5.8
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		1.3	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	587	591	960	150	150		283	1524		31	1297	573
v/s Ratio Prot	c0.29	0.29		0.02	c0.05		c0.13	c0.37		0.01	c0.21	
v/s Ratio Perm			0.15									0.09
v/c Ratio	0.84	0.82	0.43	0.20	0.53		1.63	0.86		0.52	0.57	0.24
Uniform Delay, d1	46.7	46.4	38.9	66.4	68.4		71.5	40.1		75.9	39.5	34.3
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	10.1	9.1	0.3	0.7	3.6		300.2	6.6		13.7	1.8	1.0
Delay (s)	56.8	55.5	39.2	67.1	72.0		371.7	46.7		89.7	41.3	35.3
Level of Service	E	E	D	E	E		F	D		F	D	D
Approach Delay (s)		48.9			70.8			131.4			40.5	
Approach LOS		D			E			F			D	

Intersection Summary			
HCM 2000 Control Delay	79.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	156.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	361	76	766	85	381	0	0	1229	400
Future Volume (vph)	0	0	0	361	76	766	85	381	0	0	1229	400
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.7	4.7	3.7	5.5			5.5	5.5
Lane Util. Factor					1.00	1.00	1.00	0.95			0.95	1.00
Frpb, ped/bikes					1.00	0.98	1.00	1.00			1.00	1.00
Flpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	1.00
Frt					1.00	0.85	1.00	1.00			1.00	0.85
Flt Protected					0.96	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)					1789	1553	1770	3539			3539	1583
Flt Permitted					0.96	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)					1789	1553	1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	392	83	833	92	414	0	0	1336	435
RTOR Reduction (vph)	0	0	0	0	0	223	0	0	0	0	0	155
Lane Group Flow (vph)	0	0	0	0	475	610	92	414	0	0	1336	280
Confl. Peds. (#/hr)	4					4			5	5		
Turn Type				Perm	NA	Perm	Prot	NA			NA	Perm
Protected Phases					4		1	6			2	
Permitted Phases				4		4						2
Actuated Green, G (s)					58.0	58.0	9.3	74.6			61.6	61.6
Effective Green, g (s)					58.0	58.0	9.3	74.6			61.6	61.6
Actuated g/C Ratio					0.41	0.41	0.07	0.52			0.43	0.43
Clearance Time (s)					4.7	4.7	3.7	5.5			5.5	5.5
Vehicle Extension (s)					4.0	4.0	3.5	3.5			3.5	3.5
Lane Grp Cap (vph)					726	630	115	1848			1526	682
v/s Ratio Prot							c0.05	0.12			c0.38	
v/s Ratio Perm					0.27	c0.39						0.18
v/c Ratio					0.65	0.97	0.80	0.22			0.88	0.41
Uniform Delay, d1					34.3	41.5	65.8	18.4			37.1	28.1
Progression Factor					1.00	1.00	1.00	1.00			1.00	1.00
Incremental Delay, d2					2.4	28.0	32.3	0.3			7.3	1.8
Delay (s)					36.6	69.5	98.1	18.7			44.4	29.9
Level of Service					D	E	F	B			D	C
Approach Delay (s)		0.0			57.6			33.2			40.9	
Approach LOS		A			E			C			D	

Intersection Summary			
HCM 2000 Control Delay	45.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	142.8	Sum of lost time (s)	13.9
Intersection Capacity Utilization	75.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Mission Boulevard & I-680 On-Ramp/Mission Road

01/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	83	26	15	29	116	82	688	285	29	790	539	607
Future Volume (vph)	83	26	15	29	116	82	688	285	29	790	539	607
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.7	3.7			3.7	3.7	3.5	4.7		3.7	4.7	4.7
Lane Util. Factor	0.95	0.95			1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.96			1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	0.98			0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1648			1844	1583	1770	3477		1770	3539	1583
Flt Permitted	0.95	0.98			0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1648			1844	1583	1770	3477		1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	90	28	16	32	126	89	748	310	32	859	586	660
RTOR Reduction (vph)	0	8	0	0	0	77	0	5	0	0	0	346
Lane Group Flow (vph)	67	59	0	0	158	12	748	337	0	859	586	314
Confl. Peds. (#/hr)			45	45					6	6		
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases						3						6
Actuated Green, G (s)	9.8	9.8			14.7	14.7	43.6	20.7		48.5	25.8	25.8
Effective Green, g (s)	9.8	9.8			14.7	14.7	43.6	20.7		48.5	25.8	25.8
Actuated g/C Ratio	0.09	0.09			0.13	0.13	0.40	0.19		0.44	0.24	0.24
Clearance Time (s)	3.7	3.7			3.7	3.7	3.5	4.7		3.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	4.0		3.0	4.0	4.0
Lane Grp Cap (vph)	150	147			247	212	704	657		783	833	372
v/s Ratio Prot	c0.04	0.04			c0.09		0.42	0.10		c0.49	0.17	
v/s Ratio Perm						0.01						c0.20
v/c Ratio	0.45	0.40			0.64	0.06	1.06	0.51		1.10	0.70	0.85
Uniform Delay, d1	47.3	47.1			44.9	41.3	33.0	39.9		30.5	38.3	39.9
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.1	1.8			5.4	0.1	51.7	2.9		62.0	4.9	20.5
Delay (s)	49.4	48.9			50.3	41.5	84.7	42.7		92.5	43.3	60.4
Level of Service	D	D			D	D	F	D		F	D	E
Approach Delay (s)		49.1			47.1			71.5			68.7	
Approach LOS		D			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	67.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	109.5	Sum of lost time (s)	15.8
Intersection Capacity Utilization	94.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: Mission Blvd & Niles Blvd/Niles Canyon Rd

12/09/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	12	137	151	277	102	402	197	1635	577	481	676	10
Future Volume (vph)	12	137	151	277	102	402	197	1635	577	481	676	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.7	4.7	5.8	5.8	5.3	4.2	5.8	5.8	5.3	5.8	
Lane Util. Factor		0.95	0.95	0.97	1.00	1.00	1.00	0.91	1.00	0.97	0.91	
Frpb, ped/bikes		1.00	0.98	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		0.99	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1735	1471	3433	1863	1570	1770	5085	1583	3433	5071	
Flt Permitted		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1735	1471	3433	1863	1570	1770	5085	1583	3433	5071	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	13	144	159	292	107	423	207	1721	607	506	712	11
RTOR Reduction (vph)	0	3	126	0	0	158	0	0	180	0	1	0
Lane Group Flow (vph)	0	170	17	292	107	265	207	1721	427	506	722	0
Confl. Peds. (#/hr)	1		4	4		1	4			1		4
Turn Type	Split	NA	Perm	Split	NA	pm+ov	Prot	NA	Perm	Prot	NA	
Protected Phases	4	4		3	3	1	5	2		1	6	
Permitted Phases			4			3			2			
Actuated Green, G (s)		15.9	15.9	14.5	14.5	37.6	18.1	57.3	57.3	23.1	63.4	
Effective Green, g (s)		15.9	15.9	14.5	14.5	37.6	18.1	57.3	57.3	23.1	63.4	
Actuated g/C Ratio		0.12	0.12	0.11	0.11	0.28	0.14	0.43	0.43	0.17	0.48	
Clearance Time (s)		4.7	4.7	5.8	5.8	5.3	4.2	5.8	5.8	5.3	5.8	
Vehicle Extension (s)		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Lane Grp Cap (vph)		208	176	375	204	445	241	2200	685	598	2428	
v/s Ratio Prot		c0.10		c0.09	0.06	0.10	0.12	c0.34		c0.15	0.14	
v/s Ratio Perm			0.01			0.07			0.27			
v/c Ratio		0.82	0.10	0.78	0.52	0.60	0.86	0.78	0.62	0.85	0.30	
Uniform Delay, d1		56.8	51.9	57.4	55.7	40.9	55.9	32.2	29.2	52.9	21.0	
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		20.6	0.1	9.0	1.1	1.4	24.1	2.9	4.2	10.3	0.3	
Delay (s)		77.4	52.0	66.4	56.8	42.3	80.0	35.1	33.4	63.2	21.3	
Level of Service		E	D	E	E	D	E	D	C	E	C	
Approach Delay (s)		65.9			52.7			38.3			38.5	
Approach LOS		E			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	42.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	132.4	Sum of lost time (s)	21.6
Intersection Capacity Utilization	85.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: Mission Blvd & Mowry/Driveway

12/09/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	436	6	19	5	12	4	245	457	4	5	1687	1137
Future Volume (vph)	436	6	19	5	12	4	245	457	4	5	1687	1137
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.1	5.1	5.1		4.3		4.8	5.8		4.8	5.8	5.8
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.91		1.00	0.91	1.00
Frpb, ped/bikes	1.00	1.00	0.99		1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		0.98		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1687	1561		1797		1770	5079		1770	5085	1548
Flt Permitted	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1687	1561		1797		1770	5079		1770	5085	1548
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	454	6	20	5	12	4	255	476	4	5	1757	1184
RTOR Reduction (vph)	0	0	16	0	4	0	0	0	0	0	0	419
Lane Group Flow (vph)	232	228	4	0	18	0	255	480	0	5	1757	765
Confl. Peds. (#/hr)			2									1
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	24.9	24.9	24.9		4.6		24.0	79.7		0.8	56.5	56.5
Effective Green, g (s)	24.9	24.9	24.9		4.6		24.0	79.7		0.8	56.5	56.5
Actuated g/C Ratio	0.19	0.19	0.19		0.04		0.18	0.61		0.01	0.43	0.43
Clearance Time (s)	5.1	5.1	5.1		4.3		4.8	5.8		4.8	5.8	5.8
Vehicle Extension (s)	5.0	5.0	5.0		3.0		3.0	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	321	323	298		63		326	3113		10	2210	672
v/s Ratio Prot	c0.14	0.14			c0.01		c0.14	0.09		0.00	0.35	
v/s Ratio Perm			0.00									c0.49
v/c Ratio	0.72	0.71	0.01		0.29		0.78	0.15		0.50	0.80	1.14
Uniform Delay, d1	49.3	49.1	42.6		61.1		50.5	10.7		64.4	31.7	36.8
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	9.5	8.5	0.0		2.5		11.6	0.1		34.4	3.1	79.6
Delay (s)	58.8	57.7	42.6		63.6		62.1	10.9		98.8	34.8	116.3
Level of Service	E	E	D		E		E	B		F	C	F
Approach Delay (s)		57.6			63.6			28.6			67.7	
Approach LOS		E			E			C			E	

Intersection Summary			
HCM 2000 Control Delay	59.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	106.5%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	439	79	195	32	35	13	167	1441	52	15	580	126
Future Volume (vph)	439	79	195	32	35	13	167	1441	52	15	580	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.6	3.6	3.6	4.1	4.1		3.6	5.3		3.6	5.3	5.3
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1552	1770	1788		1770	3521		1770	3539	1545
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1863	1552	1770	1788		1770	3521		1770	3539	1545
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	477	86	212	35	38	14	182	1566	57	16	630	137
RTOR Reduction (vph)	0	0	174	0	10	0	0	2	0	0	0	76
Lane Group Flow (vph)	477	86	38	35	42	0	182	1621	0	16	630	61
Confl. Peds. (#/hr)			6				2					2
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	7	7		8	8		5	2		1	6	
Permitted Phases			7									6
Actuated Green, G (s)	23.2	23.2	23.2	9.6	9.6		22.5	76.8		3.8	58.1	58.1
Effective Green, g (s)	23.2	23.2	23.2	9.6	9.6		22.5	76.8		3.8	58.1	58.1
Actuated g/C Ratio	0.18	0.18	0.18	0.07	0.07		0.17	0.59		0.03	0.45	0.45
Clearance Time (s)	3.6	3.6	3.6	4.1	4.1		3.6	5.3		3.6	5.3	5.3
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		3.0	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	612	332	276	130	132		306	2080		51	1581	690
v/s Ratio Prot	c0.14	0.05		0.02	c0.02		0.10	c0.46		0.01	c0.18	
v/s Ratio Perm			0.02									0.04
v/c Ratio	0.78	0.26	0.14	0.27	0.32		0.59	0.78		0.31	0.40	0.09
Uniform Delay, d1	51.0	46.0	45.0	56.9	57.1		49.5	20.2		61.8	24.2	20.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	6.0	0.3	0.2	0.8	1.0		3.1	3.0		3.5	0.8	0.3
Delay (s)	57.0	46.3	45.1	57.7	58.1		52.6	23.1		65.3	24.9	21.0
Level of Service	E	D	D	E	E		D	C		E	C	C
Approach Delay (s)		52.5			57.9			26.1			25.1	
Approach LOS		D			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	32.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.6
Intersection Capacity Utilization	81.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	562	31	465	19	39	19	348	961	11	12	593	202
Future Volume (vph)	562	31	465	19	39	19	348	961	11	12	593	202
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.1	4.1	4.1	4.1	4.1		4.1	5.8		4.1	5.8	5.8
Lane Util. Factor	0.95	0.95	0.88	1.00	1.00		0.97	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00		1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1694	2750	1770	1762		3433	3532		1770	3539	1563
Flt Permitted	0.95	0.96	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1694	2750	1770	1762		3433	3532		1770	3539	1563
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	611	34	505	21	42	21	378	1045	12	13	645	220
RTOR Reduction (vph)	0	0	382	0	14	0	0	0	0	0	0	116
Lane Group Flow (vph)	324	321	123	21	49	0	378	1057	0	13	645	104
Confl. Peds. (#/hr)	1		1	1		1	7		2	2		1
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases			8									2
Actuated Green, G (s)	37.9	37.9	37.9	9.5	9.5		27.7	87.7		2.8	62.8	62.8
Effective Green, g (s)	37.9	37.9	37.9	9.5	9.5		27.7	87.7		2.8	62.8	62.8
Actuated g/C Ratio	0.24	0.24	0.24	0.06	0.06		0.18	0.56		0.02	0.40	0.40
Clearance Time (s)	4.1	4.1	4.1	4.1	4.1		4.1	5.8		4.1	5.8	5.8
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		1.3	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	408	411	668	107	107		609	1985		31	1424	629
v/s Ratio Prot	c0.19	0.19		0.01	c0.03		c0.11	c0.30		0.01	c0.18	
v/s Ratio Perm			0.04									0.07
v/c Ratio	0.79	0.78	0.18	0.20	0.46		0.62	0.53		0.42	0.45	0.17
Uniform Delay, d1	55.4	55.2	46.8	69.6	70.8		59.3	21.3		75.8	34.0	29.8
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	10.2	9.3	0.1	0.9	3.1		1.4	1.0		8.9	1.0	0.6
Delay (s)	65.6	64.5	46.9	70.5	73.8		60.7	22.4		84.7	35.1	30.4
Level of Service	E	E	D	E	E		E	C		F	D	C
Approach Delay (s)		57.1			73.0			32.5			34.6	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	41.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	156.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	80.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	116	2	628	41	308	0	0	766	189
Future Volume (vph)	0	0	0	116	2	628	41	308	0	0	766	189
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.7	4.7	3.7	5.5			5.5	5.5
Lane Util. Factor					1.00	1.00	1.00	0.95			0.95	1.00
Frpb, ped/bikes					1.00	0.98	1.00	1.00			1.00	1.00
Flpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	1.00
Frt					1.00	0.85	1.00	1.00			1.00	0.85
Flt Protected					0.95	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)					1775	1557	1770	3539			3539	1583
Flt Permitted					0.95	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)					1775	1557	1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	126	2	683	45	335	0	0	833	205
RTOR Reduction (vph)	0	0	0	0	0	271	0	0	0	0	0	104
Lane Group Flow (vph)	0	0	0	0	128	412	45	335	0	0	833	101
Confl. Peds. (#/hr)	4					4			5	5		
Turn Type				Perm	NA	Perm	Prot	NA			NA	Perm
Protected Phases					4		1	6			2	
Permitted Phases				4		4						2
Actuated Green, G (s)					29.3	29.3	4.0	53.3			45.6	45.6
Effective Green, g (s)					29.3	29.3	4.0	53.3			45.6	45.6
Actuated g/C Ratio					0.32	0.32	0.04	0.57			0.49	0.49
Clearance Time (s)					4.7	4.7	3.7	5.5			5.5	5.5
Vehicle Extension (s)					4.0	4.0	3.5	3.5			3.5	3.5
Lane Grp Cap (vph)					560	491	76	2032			1738	777
v/s Ratio Prot							c0.03	0.09			c0.24	
v/s Ratio Perm					0.07	c0.26						0.06
v/c Ratio					0.23	0.84	0.59	0.16			0.48	0.13
Uniform Delay, d1					23.4	29.6	43.6	9.3			15.7	12.8
Progression Factor					1.00	1.00	1.00	1.00			1.00	1.00
Incremental Delay, d2					0.3	12.4	12.4	0.2			0.9	0.3
Delay (s)					23.7	42.0	56.0	9.5			16.7	13.2
Level of Service					C	D	E	A			B	B
Approach Delay (s)		0.0			39.1			15.0			16.0	
Approach LOS		A			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	24.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	92.8	Sum of lost time (s)	13.9
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Mission Boulevard & I-680 On-Ramp/Mission Road

01/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	31	14	12	26	91	67	525	237	21	73	313	565
Future Volume (vph)	31	14	12	26	91	67	525	237	21	73	313	565
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.7	3.7			3.7	3.7	3.5	4.7		3.7	4.7	4.7
Lane Util. Factor	0.95	0.95			1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.94			1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00			0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1609			1842	1583	1770	3486		1770	3539	1583
Flt Permitted	0.95	1.00			0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1609			1842	1583	1770	3486		1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	34	15	13	28	99	73	571	258	23	79	340	614
RTOR Reduction (vph)	0	12	0	0	0	63	0	4	0	0	0	442
Lane Group Flow (vph)	31	19	0	0	127	10	571	277	0	79	340	172
Confl. Peds. (#/hr)			45	45					6	6		
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases						3						6
Actuated Green, G (s)	4.5	4.5			11.9	11.9	37.5	45.7		7.6	16.0	16.0
Effective Green, g (s)	4.5	4.5			11.9	11.9	37.5	45.7		7.6	16.0	16.0
Actuated g/C Ratio	0.05	0.05			0.14	0.14	0.44	0.53		0.09	0.19	0.19
Clearance Time (s)	3.7	3.7			3.7	3.7	3.5	4.7		3.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	4.0		3.0	4.0	4.0
Lane Grp Cap (vph)	88	84			256	220	776	1863		157	662	296
v/s Ratio Prot	c0.02	0.01			c0.07		c0.32	0.08		0.04	0.10	
v/s Ratio Perm						0.01						c0.11
v/c Ratio	0.35	0.22			0.50	0.05	0.74	0.15		0.50	0.51	0.58
Uniform Delay, d1	39.1	38.8			34.0	31.9	19.9	10.1		37.1	31.3	31.7
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.4	1.3			1.5	0.1	3.6	0.2		2.5	2.8	8.1
Delay (s)	41.5	40.2			35.5	32.0	23.5	10.2		39.7	34.1	39.8
Level of Service	D	D			D	C	C	B		D	C	D
Approach Delay (s)		40.8			34.2			19.2			37.9	
Approach LOS		D			C			B			D	

Intersection Summary			
HCM 2000 Control Delay	30.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	85.5	Sum of lost time (s)	15.8
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: Mission Blvd & Niles Blvd/Niles Canyon Rd

12/09/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	13	162	167	306	113	444	240	1995	704	599	823	12
Future Volume (vph)	13	162	167	306	113	444	240	1995	704	599	823	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.7	4.7		5.8	5.8	5.3	4.2	5.8	5.8	5.3	5.8	
Lane Util. Factor	1.00	1.00		0.97	1.00	1.00	1.00	0.91	1.00	0.97	0.91	
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.92		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1704		3433	1863	1562	1770	5085	1583	3433	5072	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1704		3433	1863	1562	1770	5085	1583	3433	5072	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	14	171	176	322	119	467	253	2100	741	631	866	13
RTOR Reduction (vph)	0	23	0	0	0	106	0	0	188	0	1	0
Lane Group Flow (vph)	14	324	0	322	119	361	253	2100	553	631	878	0
Confl. Peds. (#/hr)	1		4	4		1	4			1		4
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA	Perm	Prot	NA	
Protected Phases	7	4		3	8	1	5	2		1	6	
Permitted Phases						8			2			
Actuated Green, G (s)	5.1	22.3		18.5	35.7	58.4	21.6	53.4	53.4	22.7	55.6	
Effective Green, g (s)	5.1	22.3		18.5	35.7	58.4	21.6	53.4	53.4	22.7	55.6	
Actuated g/C Ratio	0.04	0.16		0.13	0.26	0.42	0.16	0.39	0.39	0.16	0.40	
Clearance Time (s)	4.7	4.7		5.8	5.8	5.3	4.2	5.8	5.8	5.3	5.8	
Vehicle Extension (s)	0.2	0.2		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Lane Grp Cap (vph)	65	274		458	480	658	276	1960	610	562	2036	
v/s Ratio Prot	0.01	c0.19		c0.09	0.06	0.09	0.14	c0.41		c0.18	0.17	
v/s Ratio Perm						0.14			0.35			
v/c Ratio	0.22	1.18		0.70	0.25	0.55	0.92	1.07	0.91	1.12	0.43	
Uniform Delay, d1	64.8	58.1		57.4	40.8	30.1	57.6	42.6	40.2	57.9	30.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.6	113.5		4.0	0.1	0.5	32.3	42.5	19.5	76.4	0.7	
Delay (s)	65.4	171.6		61.3	40.9	30.6	89.9	85.1	59.7	134.3	30.7	
Level of Service	E	F		E	D	C	F	F	E	F	C	
Approach Delay (s)		167.5			42.9			79.4			74.0	
Approach LOS		F			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	77.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	138.5	Sum of lost time (s)	21.6
Intersection Capacity Utilization	102.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	482	7	21	6	13	4	310	595	5	6	2058	1387
Future Volume (vph)	482	7	21	6	13	4	310	595	5	6	2058	1387
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.1	5.1			4.3		4.8	5.8		4.8	5.8	
Lane Util. Factor	0.97	1.00			1.00		1.00	0.91		1.00	0.81	
Frpb, ped/bikes	1.00	0.99			1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.89			0.98		1.00	1.00		1.00	0.94	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	1633			1798		1770	5079		1770	7024	
Flt Permitted	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	1633			1798		1770	5079		1770	7024	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	502	7	22	6	14	4	323	620	5	6	2144	1445
RTOR Reduction (vph)	0	18	0	0	4	0	0	0	0	0	74	0
Lane Group Flow (vph)	502	11	0	0	20	0	323	625	0	6	3515	0
Confl. Peds. (#/hr)			2									1
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	29.6	29.6			7.2		25.0	91.4		1.8	68.2	
Effective Green, g (s)	29.6	29.6			7.2		25.0	91.4		1.8	68.2	
Actuated g/C Ratio	0.20	0.20			0.05		0.17	0.61		0.01	0.45	
Clearance Time (s)	5.1	5.1			4.3		4.8	5.8		4.8	5.8	
Vehicle Extension (s)	5.0	5.0			3.0		3.0	5.0		3.0	5.0	
Lane Grp Cap (vph)	677	322			86		295	3094		21	3193	
v/s Ratio Prot	c0.15	0.01			c0.01		c0.18	0.12		0.00	c0.50	
v/s Ratio Perm												
v/c Ratio	0.74	0.04			0.23		1.09	0.20		0.29	1.72dr	
Uniform Delay, d1	56.6	48.7			68.7		62.5	13.1		73.5	40.9	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.3	0.1			1.4		80.2	0.1		7.4	50.9	
Delay (s)	61.9	48.8			70.2		142.7	13.2		80.8	91.8	
Level of Service	E	D			E		F	B		F	F	
Approach Delay (s)		61.1			70.2			57.3			91.8	
Approach LOS		E			E			E			F	

Intersection Summary			
HCM 2000 Control Delay	82.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	93.9%	ICU Level of Service	F
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	485	107	215	35	39	14	204	1758	63	18	708	154
Future Volume (vph)	485	107	215	35	39	14	204	1758	63	18	708	154
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.6	3.6	3.6	4.1	4.1		3.6	5.3		3.6	5.3	5.3
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1552	1770	1789		1770	3521		1770	3539	1545
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1863	1552	1770	1789		1770	3521		1770	3539	1545
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	527	116	234	38	42	15	222	1911	68	20	770	167
RTOR Reduction (vph)	0	0	190	0	10	0	0	2	0	0	0	94
Lane Group Flow (vph)	527	116	44	38	47	0	222	1977	0	20	770	73
Confl. Peds. (#/hr)			6				2					2
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	7	7		8	8		5	2		1	6	
Permitted Phases			7									6
Actuated Green, G (s)	24.6	24.6	24.6	9.6	9.6		22.6	75.7		3.5	56.6	56.6
Effective Green, g (s)	24.6	24.6	24.6	9.6	9.6		22.6	75.7		3.5	56.6	56.6
Actuated g/C Ratio	0.19	0.19	0.19	0.07	0.07		0.17	0.58		0.03	0.44	0.44
Clearance Time (s)	3.6	3.6	3.6	4.1	4.1		3.6	5.3		3.6	5.3	5.3
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		3.0	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	649	352	293	130	132		307	2050		47	1540	672
v/s Ratio Prot	c0.15	0.06		0.02	c0.03		0.13	c0.56		0.01	c0.22	
v/s Ratio Perm			0.03									0.05
v/c Ratio	0.81	0.33	0.15	0.29	0.35		0.72	0.96		0.43	0.50	0.11
Uniform Delay, d1	50.5	45.6	44.0	57.0	57.3		50.7	25.9		62.3	26.5	21.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	7.5	0.4	0.2	0.9	1.2		8.2	13.1		6.1	1.2	0.3
Delay (s)	57.9	46.0	44.2	57.9	58.4		58.9	39.0		68.4	27.7	22.1
Level of Service	E	D	D	E	E		E	D		E	C	C
Approach Delay (s)		52.7			58.2			41.0			27.5	
Approach LOS		D			E			D			C	

Intersection Summary			
HCM 2000 Control Delay	40.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.6
Intersection Capacity Utilization	92.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	835	46	691	28	58	28	425	1173	13	15	724	246
Future Volume (vph)	835	46	691	28	58	28	425	1173	13	15	724	246
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.1	4.1	4.1	4.1	4.1		4.1	5.8		4.1	5.8	5.8
Lane Util. Factor	0.95	0.95	0.88	1.00	1.00		0.97	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00		1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1694	2750	1770	1765		3433	3532		1770	3539	1563
Flt Permitted	0.95	0.96	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1694	2750	1770	1765		3433	3532		1770	3539	1563
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	908	50	751	30	63	30	462	1275	14	16	787	267
RTOR Reduction (vph)	0	0	332	0	13	0	0	1	0	0	0	122
Lane Group Flow (vph)	481	477	419	30	80	0	462	1288	0	16	787	145
Confl. Peds. (#/hr)	1		1	1		1	7		2	2		1
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases			8									2
Actuated Green, G (s)	54.5	54.5	54.5	13.3	13.3		12.9	67.3		2.8	57.2	57.2
Effective Green, g (s)	54.5	54.5	54.5	13.3	13.3		12.9	67.3		2.8	57.2	57.2
Actuated g/C Ratio	0.35	0.35	0.35	0.09	0.09		0.08	0.43		0.02	0.37	0.37
Clearance Time (s)	4.1	4.1	4.1	4.1	4.1		4.1	5.8		4.1	5.8	5.8
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		1.3	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	587	591	960	150	150		283	1523		31	1297	573
v/s Ratio Prot	c0.29	0.28		0.02	c0.05		c0.13	c0.36		0.01	c0.22	
v/s Ratio Perm			0.15									0.09
v/c Ratio	0.82	0.81	0.44	0.20	0.53		1.63	0.85		0.52	0.61	0.25
Uniform Delay, d1	46.3	46.0	39.0	66.4	68.4		71.5	39.7		75.9	40.2	34.5
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	8.7	7.9	0.3	0.7	3.6		300.2	6.0		13.7	2.1	1.1
Delay (s)	55.0	53.9	39.3	67.1	72.0		371.7	45.7		89.7	42.4	35.5
Level of Service	E	D	D	E	E		F	D		F	D	D
Approach Delay (s)		47.8			70.8			131.7			41.4	
Approach LOS		D			E			F			D	

Intersection Summary			
HCM 2000 Control Delay	78.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	156.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	89.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	361	76	766	85	376	0	0	1331	400
Future Volume (vph)	0	0	0	361	76	766	85	376	0	0	1331	400
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.7	4.7	3.7	5.5			5.5	5.5
Lane Util. Factor					1.00	1.00	1.00	0.95			0.95	1.00
Frpb, ped/bikes					1.00	0.98	1.00	1.00			1.00	1.00
Flpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	1.00
Frt					1.00	0.85	1.00	1.00			1.00	0.85
Flt Protected					0.96	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)					1789	1553	1770	3539			3539	1583
Flt Permitted					0.96	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)					1789	1553	1770	3539			3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	392	83	833	92	409	0	0	1447	435
RTOR Reduction (vph)	0	0	0	0	0	242	0	0	0	0	0	143
Lane Group Flow (vph)	0	0	0	0	475	591	92	409	0	0	1447	292
Confl. Peds. (#/hr)	4					4			5	5		
Turn Type				Perm	NA	Perm	Prot	NA			NA	Perm
Protected Phases					4		1	6			2	
Permitted Phases				4		4						2
Actuated Green, G (s)					56.1	56.1	9.3	77.5			64.5	64.5
Effective Green, g (s)					56.1	56.1	9.3	77.5			64.5	64.5
Actuated g/C Ratio					0.39	0.39	0.06	0.54			0.45	0.45
Clearance Time (s)					4.7	4.7	3.7	5.5			5.5	5.5
Vehicle Extension (s)					4.0	4.0	3.5	3.5			3.5	3.5
Lane Grp Cap (vph)					697	605	114	1907			1587	710
v/s Ratio Prot							c0.05	0.12			c0.41	
v/s Ratio Perm					0.27	c0.38						0.18
v/c Ratio					0.68	0.98	0.81	0.21			0.91	0.41
Uniform Delay, d1					36.4	43.2	66.4	17.3			37.0	26.8
Progression Factor					1.00	1.00	1.00	1.00			1.00	1.00
Incremental Delay, d2					3.0	30.5	33.4	0.3			9.5	1.8
Delay (s)					39.4	73.7	99.7	17.5			46.5	28.6
Level of Service					D	E	F	B			D	C
Approach Delay (s)		0.0			61.3			32.6			42.3	
Approach LOS		A			E			C			D	

Intersection Summary			
HCM 2000 Control Delay	47.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	143.8	Sum of lost time (s)	13.9
Intersection Capacity Utilization	78.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Mission Boulevard & I-680 On-Ramp/Mission Road

01/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	83	26	15	29	116	82	693	280	29	790	539	689
Future Volume (vph)	83	26	15	29	116	82	693	280	29	790	539	689
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.7	3.7			3.7	3.7	3.5	4.7		3.7	4.7	4.7
Lane Util. Factor	0.95	0.95			1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.96			1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	0.98			0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1648			1844	1583	1770	3476		1770	3539	1583
Flt Permitted	0.95	0.98			0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1648			1844	1583	1770	3476		1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	90	28	16	32	126	89	753	304	32	859	586	749
RTOR Reduction (vph)	0	8	0	0	0	77	0	5	0	0	0	356
Lane Group Flow (vph)	67	59	0	0	158	12	753	331	0	859	586	393
Confl. Peds. (#/hr)			45	45					6	6		
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases						3						6
Actuated Green, G (s)	9.8	9.8			14.7	14.7	42.6	21.7		47.5	26.8	26.8
Effective Green, g (s)	9.8	9.8			14.7	14.7	42.6	21.7		47.5	26.8	26.8
Actuated g/C Ratio	0.09	0.09			0.13	0.13	0.39	0.20		0.43	0.24	0.24
Clearance Time (s)	3.7	3.7			3.7	3.7	3.5	4.7		3.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	4.0		3.0	4.0	4.0
Lane Grp Cap (vph)	150	147			247	212	688	688		767	866	387
v/s Ratio Prot	c0.04	0.04			c0.09		0.43	0.10		c0.49	0.17	
v/s Ratio Perm						0.01						c0.25
v/c Ratio	0.45	0.40			0.64	0.06	1.09	0.48		1.12	0.68	1.02
Uniform Delay, d1	47.3	47.1			44.9	41.3	33.4	38.9		31.0	37.4	41.4
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.1	1.8			5.4	0.1	63.0	2.4		70.7	4.2	49.9
Delay (s)	49.4	48.9			50.3	41.5	96.4	41.3		101.7	41.7	91.3
Level of Service	D	D			D	D	F	D		F	D	F
Approach Delay (s)		49.1			47.1			79.4			82.1	
Approach LOS		D			D			E			F	

Intersection Summary			
HCM 2000 Control Delay	77.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	109.5	Sum of lost time (s)	15.8
Intersection Capacity Utilization	100.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			