Memo

Date:	Thursday, October 25, 2018
Project:	South Mountain Freeway
To:	Kurt Watzek, HDR
From:	Ed Liebsch, HDR
Subject:	Air Quality Assessment for Ivanhoe Street Traffic Interchange FEIS Re-evaluation #10

Introduction

The purpose of this memorandum is to provide a re-evaluation of air quality requirements that were addressed in the 2015 South Mountain Freeway (SMF), Interstate 10 (I-10, Papago Freeway) to I-10 (Maricopa Freeway) Final Environmental Impact Statement (FEIS) and Record of Decision (ROD), based on the proposed project to add the Ivanhoe Street Traffic Interchange (TI) to the SMF (see Figures 1 and 2). Table 1 provides a listing of those air quality requirements, and a summary of conclusions for each requirement for this re-evaluation, the basis for which are discussed in more detail below Table 1.

Table 1. Proposed Ivanhoe Street Traffic Interchange: Re-evaluation of SMF Air Quality Requirements

Air Quality Requirement	Conclusions of Ivanhoe Street TI Re-evaluation
Regional emissions (under Transportation Conformity) of ozone precursors	The proposed TI project would tend to reduce regional emissions because of improved traffic operations at intersections vs. without the TI. The project is included in an approved RTP and TIP with regional conformity analysis, as amended and approved by FHWA on July 17, 2018. The latest State Transportation Improvement Program (STIP) amendment #36 was approved by FHWA and the Federal Transit Administration on August 18, 2018. Therefore, Transportation Conformity regional emissions requirements have been satisfied.
Particulate matter 10 micrometers or less in diameter (PM_{10}) hot-spots	The TI project is not a “project of air quality concern” per 40 CFR 93.123(b) based on evaluation of a current traffic analysis, current project air quality criteria, and interagency

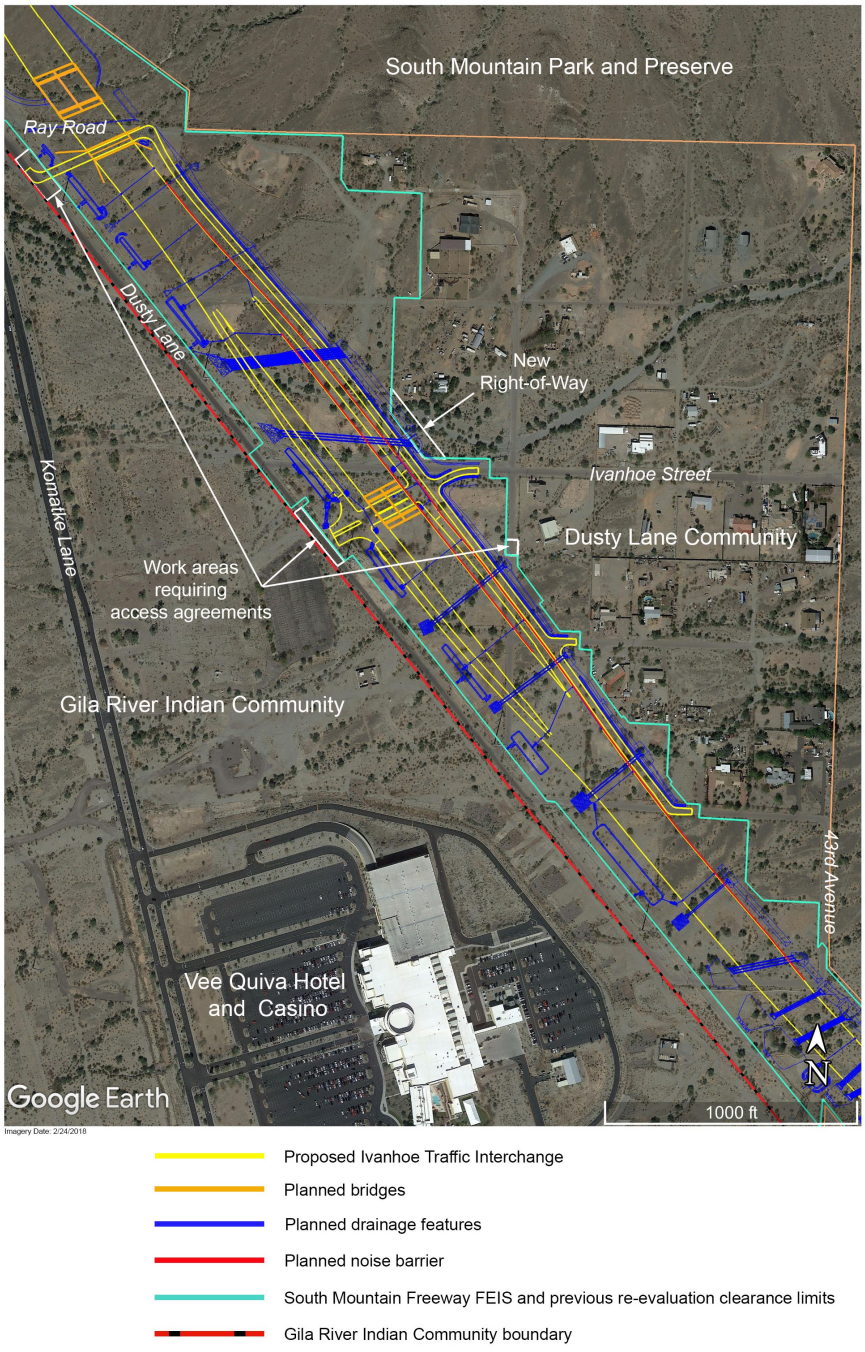
Air Quality Requirement	Conclusions of Ivanhoe Street TI Re-evaluation
(under Transportation Conformity)	consultation. Therefore, additional PM_{10} hot-spot analysis is not required under Transportation Conformity rules.
Carbon monoxide (CO) hot-spots (under Transportation Conformity)	The TI project effects on CO would be less than for other interchanges previously analyzed for the FEIS because of lower intersection traffic levels, and the project would not create Level of Service (LOS) "D" or worse intersections. Therefore, CO hot-spot analysis is not required under Transportation Conformity rules.
Mobile Source Air Toxics (MSATs) per FHWA Policy	The TI project would not measurably change regional or study area MSAT emissions vs. no-action because there would be minimal changes in vehicle miles travelled (VMT). No additional analysis is warranted under current FHWA policy.
Construction emissions & General Conformity	The TI project construction would modify two previously analyzed dry stream crossings subject to USACE approval under General Conformity air quality rules (40 CFR 93, Subpart B). However, the emissions change from the modification would still leave relevant construction emissions far below General Conformity *de minimis* thresholds.

For the purposes of this discussion, "no action" case represents the implementation of the SMF without addition of the proposed TI at Ivanhoe Street.

The project area compliance status with respect to National Ambient Air Quality Standards (NAAQS) has not changed since approval of the ROD in March 5, 2015 for the SMF. The only new NAAQS implemented since that time is the 2015 ozone NAAQS of 70 parts per billion (ppb). The project area is still a "moderate" nonattainment area for the prior 2008 ozone NAAQS of 75 ppb. Effective August 3, 2018, The U.S. Environmental Protection Agency (USEPA) designated the Phoenix-Mesa area (including the project area of the proposed Ivanhoe Street TI) as a "marginal" nonattainment area for the 2015 ozone NAAQS. Thus the area is designated nonattainment for both the 2008 and 2015 ozone NAAQS. The project area is still a maintenance area for the carbon monoxide (CO) NAAQS and a "serious" nonattainment area for the 24-hour NAAQs for particulate matter 10 micrometers or less in diameter (PM_{10}).

Figure 1. South Mountain Freeway Location Map

Figure 2. Proposed Ivanhoe Street Traffic Interchange



Regional Emissions

Under Transportation Conformity rules, regional emissions due to transportation plans, programs and projects must not interfere with approved plans to bring a nonattainment area into attainment with NAAQS, and must not interfere with plans to maintain compliance with NAAQs in maintenance areas.

By adding the proposed TI to the SMF near Ivanhoe Street, there would be somewhat better access to and from addresses near Ivanhoe Street, thus tending to shorten trips that would otherwise need to use the Estrella Drive or other nearby interchanges that are already included in the approved SMF, or other routes. The proposed project to place a TI at Ivanhoe Street would tend to lessen congestion vs. no-action and would have minimal effects on regional VMT. Both of these improvements will likely tend to reduce regional air pollutant emissions associated with highway vehicle traffic.

Transportation Conformity requirements in 40 CFR 93, Subpart A, with respect to regional emissions budgets, are assumed to be met if the proposed project is included in a conforming (approved) regional transportation plan (RTP) and transportation improvement program (TIP). The project is included in an approved RTP and TIP (July 17, 2018), and the latest STIP amendment #36 was approved by FHWA and the Federal Transit Administration on August 18, 2018.

PM_{10} Hot-Spots

A Project of Air Quality Concern Questionnaire (POAQCQ) was prepared (see Attachment A) to assess the proposed project in relation to project types in 40 CFR 93.123(b) requiring a quantitative analysis of local particulate emissions (hot spots) in nonattainment or maintenance areas: the SMF is located within the Phoenix PM-10 Nonattainment Area for PM_{10}. Project types that have been specifically defined to cause local air quality concerns include:

- Projects on new highways that have more than 125,000 annual average daily traffic (AADT) and 8 percent or more of the AADT is diesel truck traffic
- Expansion of a highway that affects a congested intersection that operates (or will operate, for a new intersection) at a Level-of-Service (LOS) of D, E, or F and that expansion has a significant increase in the number of diesel trucks
- Projects in areas or affecting sites that are identified in an applicable PM_{10} implementation plan as sites of violation or possible violation

Traffic projections for 2040 for the road network within the study area were obtained from the Maricopa Association of Governments (MAG) Regional Travel Demand Model. The traffic data indicates there will be no significant increase in the percentage of diesel trucks as a result of the TI project. The highest traffic volumes projected on the freeway mainline in the area, just west of Ivanhoe Street, without the TI is 115,673 vehicles per day, including 23,415 diesel trucks, and with the TI is 116,016 vehicles per day, including 23,370 diesel trucks, a diesel truck decrease of 0.2 percent. The new TI would provide access to a mostly residential area with limited commercial, industrial, or other land use activities that typically attract commercial truck traffic.

A traffic report (see Attachment B) was prepared by HDR dated October 10, 2018 that modeled the Ivanhoe Street TI intersection for LOS as well as the nearby TI at Estrella Drive. The results indicate that all of the intersections at these two TIs would operate at a LOS of C or better (the LOS estimates are A and B), with or without the Ivanhoe Street TI.

The PM_{10} implementation plan revision issued by MAG (*2012 Five Percent Plan for the Maricopa County Nonattainment Area) was* approved by the USEPA on May 30, 2014. This implementation plan does not identify the Ivanhoe Street area or interchanges in general, as sites of existing or potential violation. Additionally, the PM_{10} hot-spot analyses for the SMF FEIS involved traffic interchanges with much higher total and diesel vehicle traffic levels. The intersections for the Ivanhoe Street traffic interchange have volumes of total traffic and diesel vehicle traffic less than the 40th Street and Broadway Avenue signalized intersection previously analyzed for PM_{10} hot spot in the FEIS. Therefore, the prior analyses conducted for transportation conformity and NEPA purposes in the FEIS demonstrate that the proposed Ivanhoe Street traffic interchange would not cause or contribute to violations of the PM_{10} NAAQS. It is clear from the prior analyses that the proposed Ivanhoe Street traffic interchange is not a site of violation or potential violation of the PM_{10} NAAQS.

Based on the 2040 traffic data and analysis, the proposed Ivanhoe Street TI is not a Project of Air Quality Concern and will not require a PM_{10} hot-spot analysis. Interagency consultation with the EPA, ADEQ, MAG and Maricopa County Air Quality Department was completed on October 24, 2018 in accordance with 40 CFR 93.105. The USEPA concurred that the project is not a project of air quality concern (see Attachment A).

CO Hot-Spots

Transportation Conformity rules require hot-spot analysis for CO (or equivalent/approved screening analysis) for roadway project in NAAQS nonattainment or maintenance areas where the project would affect an intersection with a LOS of “D” or worse, or would change the LOS to “D” or worse as a result of project implementation.

The traffic report prepared by HDR for this project, dated October 10, 2018 (Attachment B), shows that LOS would be “C” or better at the adjacent Estrella Drive TI if there is no action. Including the proposed TI, the report documents that the intersections at the Estrella Drive TIs and at the Ivanhoe Street TI would be LOS “C” or better. Therefore, no hot-spot analysis for CO is required under Transportation Conformity rules. Note that CO hot-spot analysis was completed under the 2015 FEIS for other, busier intersections along the SMF, and no adverse air quality impacts were found in those analyses.

Mobile Source Air Toxics (MSATs)

A quantitative analysis of MSAT emissions was performed as part of the 2015 FEIS for the SMF. That analysis concluded that traffic-related MSAT emissions in the project study area in 2035, for the preferred alternative for SMF implementation, would be less than 1 percent higher than for the no-action alternative. It also concluded that MSAT emissions for project implementation would be significantly lower than baseline (2012) emissions.

The Federal Highway Administration (FHWA) has updated their MSAT analysis policy/guidance since the 2015 FEIS. The current policy dated October 16, 2016, updated the prior policy from December 2012, by incorporating emissions estimates that take into account three additional USEPA rules to control motor vehicle emissions, using the latest version of the Motor Vehicle Emissions Simulator (MOVES 2014a) software. The latest updated policy shows that, consistent with the earlier policy and MOVES projections, MSAT emissions will drop dramatically in the coming decades, even with substantial increases in VMT.

Implementation of the proposed Ivanhoe Street TI project would not affect the MSAT conclusions from the 2015 FEIS with respect to the SMF project, in light of the latest FHWA guidance. In addition, the proposed Ivanhoe Street TI would have little effect on MSAT emissions, as the project would cause minimal changes in regional VMT and congestion. Based on this finding, there is no need for additional quantitative MSAT emissions analysis for the proposed Ivanhoe Street TI project.

Construction Emissions & General Conformity

The addition of the Ivanhoe Street TI to the SMF would not include any additional (compared to the SMF project) stream crossings subject to USACE approval. However, a culvert associated with a permitted dry stream crossing in the vicinity of Ivanhoe Street would require an extension in length. The very slight increase in construction activity associated with the longer culvert would not cause the construction-related emissions to exceed the General Conformity *de minimis* emissions thresholds. The prior General conformity emissions analysis for the SMF project showed total emissions from construction of all stream crossings combined to be far below the *de minimis* emissions thresholds. Therefore, General Conformity requirements of 40 CFR 93, Subpart B do not apply to the Ivanhoe Street TI project.

Attachment A

Project of Air Quality Concern Questionnaire

and

Interagency Consultation E-mails

Project Level PM Quantitative Hot-Spot Analysis – Project of Air Quality Concern Questionnaire

Project Setting and Description

The Arizona Department of Transportation (ADOT) is the sponsor of the construction and operation of the South Mountain Freeway. The freeway will constitute a section of the Regional Freeway and Highway System, the Loop 202, which is also referred to as State Route (SR) 202L. The project is in the southwestern portion of the Phoenix metropolitan area in Maricopa County, Arizona (see map below). The approximately 22-mile-long freeway will be constructed as an eight-lane divided, access-controlled facility, with four travel lanes in each direction. Three lanes will be for general purpose use and one lane will be dedicated to high-occupancy vehicle use.

South Mountain Freeway
Federal-aid Project Number: NH-202-D(ADY)
ADOT Project Number: 202L MA 054 H5764 01D (H8827 01C)

Figure 1

Project Location Map

Not to scale

N

June 5, 2018

At the time of the Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) a traffic interchange slightly west of 51st Avenue was included within the project scope. The intersection was offset and 51st Avenue was realigned to create a more perpendicular intersection that resulted in minimized right-of-way (ROW) needs. After the ROD, ADOT determined that the design of this concept would impact two Gila River Indian Community (Community) well sites that were held in trust. ADOT does not have eminent domain authority to acquire these well sites, so the interchange was redesigned and relocated to Estrella Drive during final design. Relocating the 51st Avenue interchange to Estrella Drive resulted in a net decrease in total ROW needed for the project while still providing similar access and mobility to the area surrounding 51st Avenue and Estrella Drive (See Figure 2).

The area surrounding 51st Avenue and Estrella Drive is agricultural with a few low-density residential properties. The only major traffic generator in the area is the Vee Quiva hotel and casino located on Community land approximately 2 miles south and east of the Estrella Road traffic interchange. A concern shared by the City of Phoenix and Maricopa County (who maintain 51st Avenue and Estrella Drive outside of the ADOT ROW) is the potential traffic impacts at the existing rural-type intersections from casino traffic. To alleviate these concerns, ADOT provided traffic projections for the intersection of 51st Avenue and Estrella Drive to the two agencies.

In order to improve traffic efficiency and operation at the Estrella Drive TI, reduce traffic along 51st Avenue, and address Community requests to improve access to the Community, ADOT is addressing the addition of a new traffic interchange near Ivanhoe Street (See Figure 2). The freeway plans already included a bridge over Ivanhoe Street to accommodate access to the remaining homes north of the freeway within the Dusty Lane community (DLC). The DLC is a County island east of 51st Avenue tucked between the South Mountain Park/Preserve and the Community that includes a collection of low-density large-lot residences. Based on public outreach and discussions with the DLC, no direct access to the DLC will be constructed with the TI. Instead access to the DLC will continue via existing Dusty Lane which will cross under the freeway at the Ray Road alignment and continue on the north side of the freeway to Ivanhoe Street. The Community plans to relocate Komatke Lane or construct a new arterial road that connects to the new TI to improve traffic flow on the Community arterial road system.

This questionnaire was prepared to address air quality issues related to the proposed Ivanhoe Street traffic interchange. In this questionnaire, the “Build scenario” refers to the condition in which the Ivanhoe Street traffic interchange is constructed as part of the larger 22-mile freeway project. The “No Build scenario” refers to the condition in which the larger 22-mile freeway project is constructed, but no ramps nor a connection to Ivanhoe Street are included.

The proposed project is located in the Maricopa County (Phoenix) Non-Attainment Area for particulates 10 microns in diameter or less (PM_{10}). The Maricopa Association of Governments (MAG) issued the 2012 Five Percent Plan for the Maricopa County Nonattainment Area, and the Arizona Department of Environmental Quality (ADEQ) submitted it to the US Environmental Protection Agency (EPA) on May 25, 2012. The US EPA approved this State Implementation Plan (SIP) Revision on May 30, 2014.

The following agencies would be included on interagency consultation and provide input to the Project of Air Quality Concern Questionnaire: EPA, ADEQ, MAG, and the Maricopa County Air Quality Department.

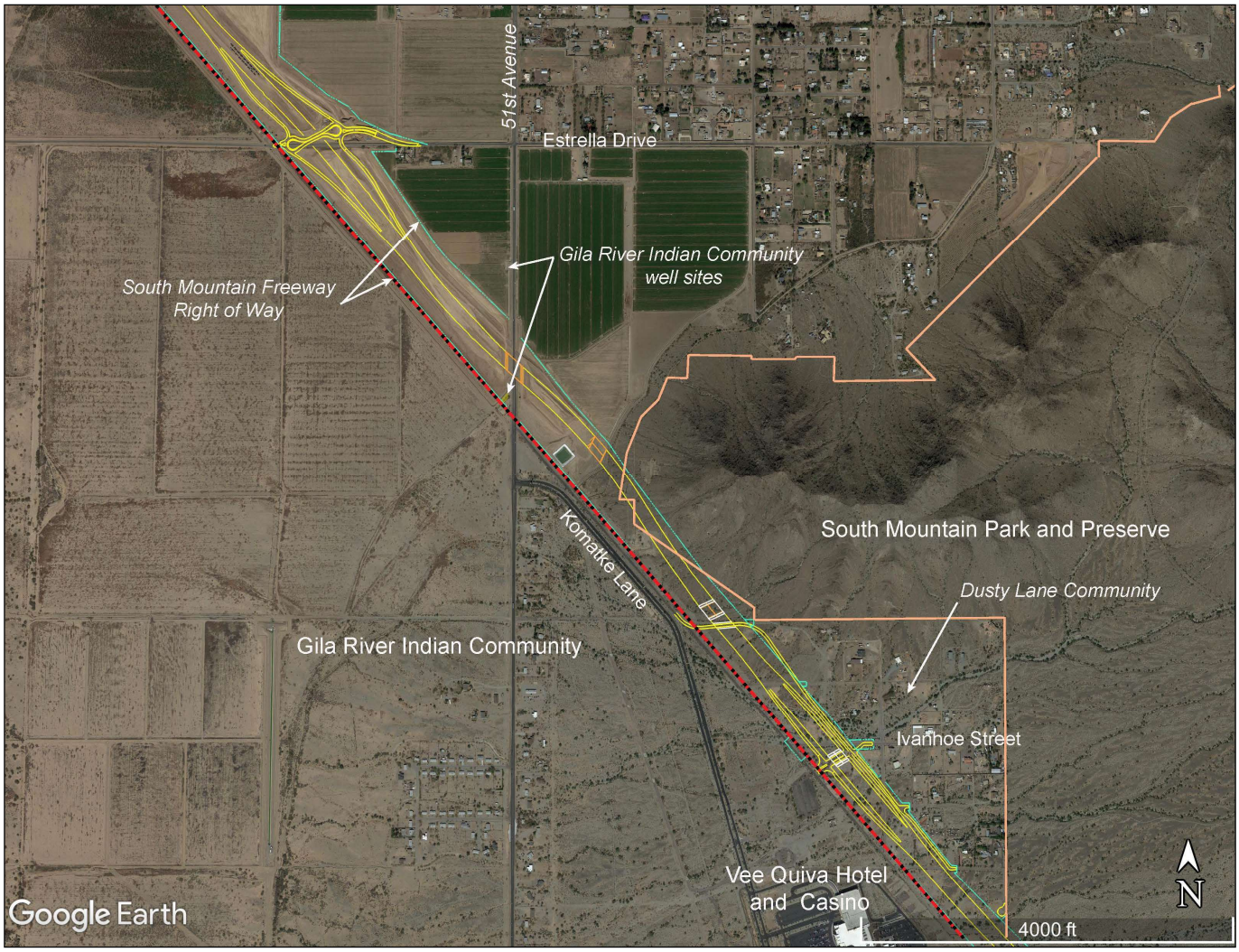


Figure 2 – South Mountain Freeway - Ivanhoe Traffic Interchange Vicinity

Project Assessment

The following questionnaire is used to compare the proposed project with a list of project types in 40 Code of Federal Regulations (CFR) 93.123(b) requiring a quantitative analysis of local particulate emissions (hot spots) in nonattainment or maintenance areas, which include:

i) New highway projects that have a significant number of diesel vehicles, and expanded highway projects that have a significant increase in the number of diesel vehicles;
ii) Projects affecting intersections that are at Level-of-Service D, E, or F with a significant number of diesel vehicles, or those that will change to Level-of-Service D, E, or F because of an increase in traffic volumes from a significant number of diesel vehicles related to the project;

iii) New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location;
iv) Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location; and
v) Projects in or affecting locations, areas, or categories of sites which are identified in the PM_{10} or $PM_{2.5}$ applicable implementation plan or implementation plan submission, as appropriate, as sites of violation or possible violation.

If the project matches one of the listed project types in 40 CFR 123(b)(1) above, it is considered a project of local air quality concern and the hot-spot demonstration must be based on quantitative analysis methods in accordance to 40 CFR 93.116(a) and the consultation requirements of 40 CFR 93.105(c)(1)(i). If the project does not require a PM hotspot analysis, a qualitative assessment will be developed that demonstrates that the project will not contribute to any new localized violations, increase the frequency of severity of any existing violations, or delay the timely attainment of any NAAQS or any required emission reductions or milestones in any nonattainment or maintenance area.

On March 10, 2006, EPA published *PM2.5 and PM10 Hot-Spot Analyses in Project-Level Transportation Conformity Determinations for the New PM2.5 and Existing PM10 National Ambient Air Quality Standards; Final Rule,* describing the types of projects that would be considered a project of air quality concern and that require a hot-spot analysis (71 *Federal Register* 12468–12511). Specifically, on page 12491, EPA provided the following clarification: "Some examples of *projects of air quality concern* that would be covered by § 93.123(b)(1)(i) and (ii) are: A project on a new highway or expressway that serves a significant volume of diesel truck traffic, such as facilities with greater than 125,000 annual average daily traffic (AADT) and 8% or more of such AADT is diesel truck traffic;" ... "Expansion of an existing highway or other facility that affects a congested intersection (operated at Level-of-Service D, E, or F) that has a significant increase in the number of diesel trucks …" These examples will be used as the baseline for determining whether the project is a project of air quality concern.

New Highway Capacity

Is this a New highway project that has a significant number of diesel vehicles?

Example: total traffic volumes >125,000 annual average daily traffic (AADT) and truck volumes >10,000 diesel trucks per day (8% of total traffic).

NO – The project being considered is a service traffic interchange, not a new highway or freeway corridor.

Expanded Highway Capacity

Is this an expanded highway project that has a significant increase in the number of diesel vehicles?

Example: the build scenario of the expanded highway or expressway causes a significant increase in the number of diesel trucks compared with the no-build scenario, truck volumes > 8% of the total traffic.

NO – No significant increase in the percentage of diesel trucks in the design year (2040) would occur between the Build and No Build scenarios. The highest traffic volumes on the freeway main line within the study area are located just east of Ivanhoe Street. At this location, the 2040 daily traffic projection for the Build scenario

is 117,293 vehicles per day (vpd); this includes 23,422 diesel trucks (15,594 heavy trucks and 7,828 medium trucks). As a conservative estimate, it is assumed that ALL medium and heavy trucks are diesel trucks, which would represent 20.0% of total traffic under this alternative. With the Build scenario, the total number of vehicles is projected to increase by 1,620 vpd, but trucks increase by only 7 vpd when compared to the No Build scenario (see Table 1). The overall truck or diesel truck volumes are virtually the same for the Build scenario compared with the No Build scenario.

Table 1. Traffic Data for SR 202L east of Ivanhoe Street

Parameter	2040 No Build	2040 Build	Difference between Build and No Build	% Difference between Build and No Build
Average daily traffic volumes	115,673	117,293	1,620	1.4%
Diesel truck volume (medium and heavy)	23,415	23,422	7	0%
% Diesel trucks (medium and heavy)	20%	20%	0	0%

Projects with Congested Intersections

Is this a project that affects a congested intersection (LOS D or greater) that has a significant number of diesel trucks, OR will change LOS to D or greater because of increase traffic volumes for significant number of diesel trucks related to the project?

NO – This project will not affect an existing congested intersection that has a significant number of diesel trucks.

Two signalized intersections are proposed for the Ivanhoe Street traffic interchange: one on the northern side of the South Mountain Freeway and one on the southern side. The LOS projections for these two intersections (HDR Traffic Report, Draft August 21, 2018), the adjacent traffic interchange at Estrella Drive, and the Estrella Drive and 51st Avenue intersection are tabulated in Tables 2 and 3 for the No Build and Build scenarios, respectively, for the 2040 design year. Because the LOS values are “C” or better for all intersections under both the No Build and Build scenarios, no quantitative PM_{10} hot-spot analysis is required.

Table 2. Level of Service for No Build Scenario in 2040

Interchange	Intersection	AM peak hour		PM peak hour	
		Delay (seconds)	LOS	Delay (seconds)	LOS
Estrella Drive	East	7	A	10	A
	West	8	A	9	A
N/A	Estrella Drive and 51st Avenue	13	B	11	B

Table 3. Level of Service for Build Scenario in 2040

Interchange	Intersection	AM peak hour		PM peak hour	
		Delay (seconds)	LOS	Delay (seconds)	LOS
Estrella Drive	East	6	A	7	A
	West	6	A	7	A
N/A	Estrella Drive and 51st Avenue	11	B	9	A
Ivanhoe Street	East	15	B	15	B
	West	8	A	6	A

New Bus and Rail Terminals

Does the project involve construction of a new bus or intermodal terminal that accommodates a significant number of diesel vehicles?

NO – These facilities are not included in the project.

Expanded Bus and Rail Terminals

Does the project involve an existing bus or intermodal terminal that has a large vehicle fleet where the number of diesel buses (or trains) increases by 50% or more, as measured by arrivals?

NO – These facilities are not included in the project.

Projects Affecting PM Sites of Violation or Possible Violation

Does the project affect locations, areas or categories of sites that are identified in the PM_{10} or $PM_{2.5}$ applicable plan or implementation plan submissions, as appropriate, as sites of violation or potential violation?

NO – The 2012 Five Percent Plan describes the PM_{10} emission inventory for the nonattainment area, which includes on-road emissions from paved road dust resuspension, unpaved roads, road construction, exhaust, and brake and tire wear. The implementation plan does not identify traffic intersections as sites of violation or possible violation. The plan emphasizes controlling fugitive dust from previously disturbed lots or undeveloped areas where the ground has been or is being disturbed.

Ambient PM_{10} monitors that have shown excessive levels/exceedances in recent years are located near the Salt River in southwestern Phoenix, at West 43rd Avenue (#6 on Attachment 1) and at the Durango Complex (#8 on Attachment 1). The EIS for the South Mountain Freeway included a quantitative PM_{10} hot-spot analysis for an intersection near the Salt River, at Broadway Road. The new traffic interchange at Ivanhoe Street would be over six miles from the Salt River, in an area where much of the land is undisturbed desert. The 2012 Five Percent Plan does not explicitly or implicitly identify the area of the Ivanhoe Street traffic interchange, or traffic interchange sites in general, as areas of existing or possible violation.

In addition, the prior quantitative PM_{10} hot-spot analyses for the South Mountain Freeway Final EIS involved traffic interchanges with much higher total and diesel vehicle traffic levels. Table 4 provides a comparison of the traffic projections for the Ivanhoe Street traffic interchange and the other interchange locations previously analyzed. The east and west intersections for the Ivanhoe Street traffic interchange have volumes of total traffic and diesel vehicle traffic less than both of the signalized intersections previously analyzed for PM_{10} hot spots in the Final EIS. Therefore, the prior analyses conducted for transportation conformity and National Environmental Policy Act purposes in the Final EIS demonstrate that the proposed Ivanhoe Street traffic interchange would not cause or contribute to violations of the PM_{10} NAAQS. It is clear from the prior analyses that the proposed Ivanhoe Street traffic interchange is not a site of violation or potential violation of the PM_{10} NAAQS.

Table 4. Comparison of 2040 Traffic Projections for Proposed Ivanhoe Street Traffic Interchange Signalized Intersections and the Intersections Analyzed in the South Mountain Freeway Final EIS

Signalized Intersection Location	Total Annual Average Daily Traffic Approach Volume	Diesel Vehicle Annual Average Daily Traffic Approach Volume
Ivanhoe Street Traffic Interchange – East	3,615	99
Ivanhoe Street Traffic Interchange – West	7,269	178
40th Street Traffic Interchange – North	25,190	1,850
40th Street Traffic Interchange – South	21,450	1,630
Broadway Road – East	35,160	3,210
Broadway Road – West	34,120	2,720

POAQC Determination

This project is not a Project of Air Quality Concern. The expanded highway access that would result from the proposed changes would not increase the total truck traffic under the 2040 Build scenario compared with the 2040 No Build scenario and would not create a condition with LOS D or worse with significant truck/diesel vehicle traffic. No substantial increase in the overall diesel truck volumes would occur in the 2040 Build condition compared with the 2040 No Build condition.

The project has been modeled to determine whether congested intersections exist in the project area. The project, when modeled for LOS in the 2040 Build scenario, does not show any decrease in LOS at the nearby Estrella Drive traffic interchange and all intersections at the Ivanhoe Street traffic interchange would have an LOS C or better and would not significantly increase the number of trucks in the project area. The intersections would not create an air quality concern for the project. The project would improve traffic circulation and LOS, which would result in improved air quality and traffic flow.

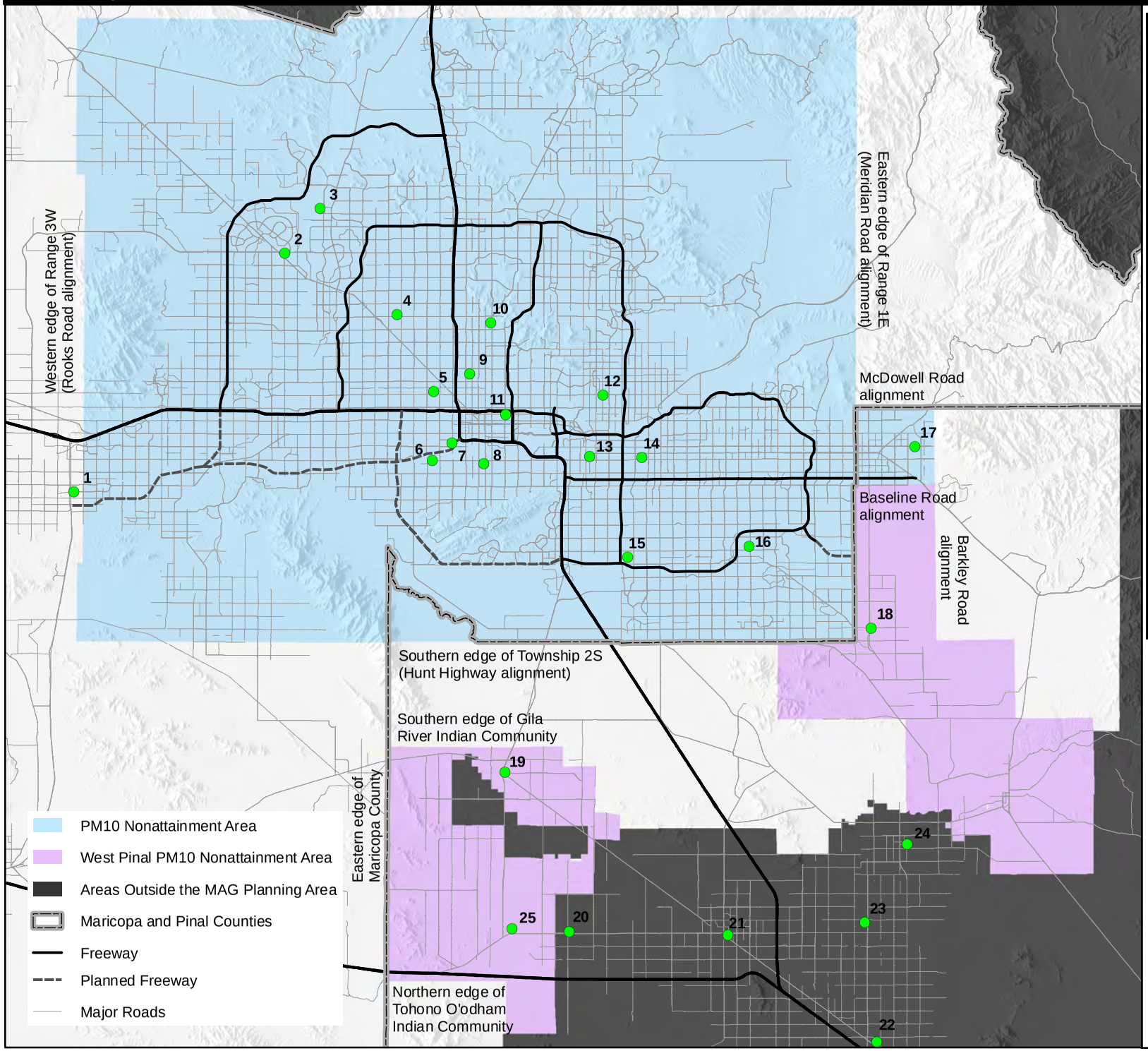
Therefore, ADOT is presenting this project for interagency consultation in accordance with 40 CFR 93.105, as a Project that is NOT of Air Quality Concern and thereby will not require a PM_{10} hot-spot analysis. While this project does not require a hot-spot analysis, other conformity provisions apply and will be addressed in the project re-evaluation.

Attachment 1

PM-10 Monitor Locations for Maricopa and Pinal Counties

PM-10 Nonattainment Area Boundary Map with Monitor Locations for Maricopa and Pinal Counties, Arizona

MARICOPA ASSOCIATION of GOVERNMENTS



#	Monitor Name
1	Buckeye
2	Dysart
3	Zuni Hills
4	Glendale
5	West Phoenix
6	West 43rd Avenue
7	Durango Complex
8	South Phoenix
9	JLG Supersite
10	North Phoenix
11	Central Phoenix
12	South Scottsdale
13	Tempe
14	Mesa
15	West Chandler
16	Higley
17	Apache Junction Fire Station
18	Combs School
19	(City of) Maricopa County Complex
20	Stanfield County Complex
21	Casa Grande Downtown
22	Eloy County Complex
23	Pinal County Housing Complex
24	Coolidge Maintenance Yard
25	Hidden Valley

Source: U.S. Environmental Protection Agency

Date: October 2018

From:	Dean Giles
To:	Beverly Chenausky
Subject:	RE: Interagency Consultation SR 202L (South Mountain Freeway) Ivanhoe Street Traffic Interchange H5764 H8827
Date:	Wednesday, October 24, 2018 11:22:08 AM
Attachments:	image001.png PM10_NAA_and_Monitors_2Counties.pdf

Hello Beverly,

As we discussed, an updated map for Attachment 1 is attached.

Thank you.

Dean

From: Beverly Chenausky <BChenausky@azdot.gov>
Sent: Wednesday, October 10, 2018 2:39 PM
To: Lindy Bauer <LBauer@azmag.gov>; 'Jerry Wamsley' <Wamsley.Jerry@epa.gov>; 'Johanna Kuspert - AQDX' <JKuspert@mail.maricopa.gov>; 'ADEQ Conformity' <Transportationconformity@azdeq.gov>
Cc: 'Clifton Meek' <meek.clifton@epa.gov>; 'Karina O'Conner' <Oconnor.Karina@epa.gov>; ADOTAirNoise <AdotAirNoise@azdot.gov>; Farhana Jesmin <FJesmin@azdot.gov>; 'Watzek, Kurt' <Kurt.Watzek@hdrinc.com>; Dean Giles <DGiles@azmag.gov>; Carmelo Acevedo <CAcevedo@azdot.gov>
Subject: Interagency Consultation SR 202L (South Mountain Freeway) Ivanhoe Street Traffic Interchange H5764 H8827

To Interested Parties:
ADOT is presenting the following project, **SR 202L (South Mountain Freeway), Ivanhoe Street Traffic Interchange,** for interagency consultation per 40 CFR 93.105 as a potential project that is not a project of Air Quality Concern and thereby will not require a PM10 hot-spot analysis. If through interagency consultation it is determined that this project will not require a hot-spot analysis, other conformity provisions apply and will be addressed in the air quality section of the environmental clearance. ADOT is requesting responses to the attached questionnaire within **10 business days**; a non-response will be interpreted as concurrence that the project is not a project of air quality concern and does not require a hot-spot analysis. If any consulted party believes this project should be treated as a project of air quality concern that requires a Quantitative PM hot-spot analysis, please document the appropriate section under 40 CFR 93.123 (b) that applies to the project and describe why the project should be treated as a project of air quality concern.

Beverly T. Chenausky
Air & Noise Program Manager
MD EM02, Room 41
1611 W. Jackson St.
Phoenix, AZ 85007
602.712.6269
azdot.gov

From:	Wamsley, Jerry
To:	Beverly Chenausky
Cc:	Lee, Anita; OConnor, Karina
Subject:	RE: Interagency Consultation SR 202L (South Mountain Freeway) Ivanhoe Street Traffic Interchange H5764 H8827
Date:	Wednesday, October 24, 2018 11:32:00 AM
Attachments:	image001.png

Hello Beverly,

Thank you for the opportunity to the review the Arizona Department of Transportation's (ADOT) Project of Air Quality Concern (POAQC) Questionnaire for the SR-202L Ivanhoe Street Traffic Interchange project within the Phoenix metro area and Maricopa County, dated October 10, 2018.

We concur that this project is not a project of air quality concern and does not require a particulate matter hot-spot analysis.

Sincerely,
Jerry Wamsley

From: Beverly Chenausky [mailto:BChenausky@azdot.gov]
Sent: Wednesday, October 10, 2018 2:39 PM
To: 'Lindy Bauer' <LBauer@azmag.gov>; Wamsley, Jerry <Wamsley.Jerry@epa.gov>; 'Johanna Kuspert - AQDX' <JKuspert@mail.maricopa.gov>; 'ADEQ Conformity' <Transportationconformity@azdeq.gov>
Cc: meek, clifton <meek.clifton@epa.gov>; OConnor, Karina <OConnor.Karina@epa.gov>; ADOTAirNoise <AdotAirNoise@azdot.gov>; Farhana Jesmin <FJesmin@azdot.gov>; 'Watzek, Kurt' <Kurt.Watzek@hdrinc.com>; Dean Giles <DGiles@azmag.gov>; Carmelo Acevedo <CAcevedo@azdot.gov>
Subject: Interagency Consultation SR 202L (South Mountain Freeway) Ivanhoe Street Traffic Interchange H5764 H8827

To Interested Parties:
ADOT is presenting the following project, **SR 202L (South Mountain Freeway), Ivanhoe Street Traffic Interchange,** for interagency consultation per 40 CFR 93.105 as a potential project that is not a project of Air Quality Concern and thereby will not require a PM10 hot-spot analysis. If through interagency consultation it is determined that this project will not require a hot-spot analysis, other conformity provisions apply and will be addressed in the air quality section of the environmental clearance. ADOT is requesting responses to the attached questionnaire within **10 business days**; a non-response will be interpreted as concurrence that the project is not a project of air quality concern and does not require a hot-spot analysis. If any consulted party believes this project should be treated as a project of air quality concern that requires a Quantitative PM hot-spot analysis, please document the appropriate section under 40 CFR 93.123 (b) that applies to the project and describe why the project should be treated as a project of air quality concern.

Beverly T. Chenausky

Air & Noise Program Manager

MD EM02, Room 41
1611 W. Jackson St.
Phoenix, AZ 85007
602.712.6269
azdot.gov

Environmental Planning

Attachment B

Traffic Study

for

Ivanhoe Street Traffic Interchange

South Mountain Freeway

Final Traffic Study in support of Reevaluation of the FEIS/ROD for Ivanhoe Street traffic interchange

Phoenix, Arizona
October 10, 2018

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Appendix A. – MAG model traffic projections, Build and No-Build scenario, 2040

Appendix B. – HCS Analysis Reports

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1 Project Description

ADOT is the sponsor of the construction and operation of the South Mountain Freeway. The freeway will constitute a section of the Regional Freeway and Highway System, the Loop 202 (also referred to as State Route 202L). The project is in the southwestern portion of the Phoenix metropolitan area in Maricopa County, Arizona (see Figure 1). The approximately 22-mile-long freeway will be constructed as an eight-lane divided, access-controlled facility, with four travel lanes in each direction. Three lanes will be for general purpose use and one lane will be dedicated to high-occupancy vehicle use.

The Final Environmental Impact Statement (FEIS) was released to the public in September, 2014, and the Record of Decision (ROD) for the project was approved on March 5, 2015. Based on coordination with the City of Phoenix, Gila River Indian Community (Community), and the public after the ROD, ADOT is conducting a Reevaluation of the FEIS/ROD to evaluate the impacts associated with adding a new traffic interchange at Ivanhoe Street.

The purpose of this report is to analyze traffic conditions for the Build (with the proposed interchange) and No-Build (without the proposed interchange) scenarios in the design year, 2040. The analysis also includes a comparison of the predicted traffic patterns with and without the proposed TI.

Figure 1- Study Location Map

2 Traffic Analysis Methodology

The design year for the traffic analysis was assumed to be 2040. The opening year for the traffic analysis was assumed to be 2020. The methodology used for the traffic analysis of freeway operations as well as for the signalized intersections is based on the Transportation Research Board's *Highway Capacity Manual* (HCM, 2010). The study area for the traffic analysis included the area between approximately ½-mile north of Estrella Drive to approximately ½-mile south of Ivanhoe Street, inclusive of Estrella Drive, 51st Avenue, Komatke Lane, and Dusty Lane within that area (see Figure 2).

As a result of the Ivanhoe Street Traffic Interchange Study public outreach and alternative development and screening process, the interchange will not provide direct access to the Dusty Lane Community if it is approved. To provide access to the community, Dusty Lane will be realigned and cross under the freeway on approximately the Ray Road alignment and connect to Ivanhoe Street and other local roads on the east side of the freeway.

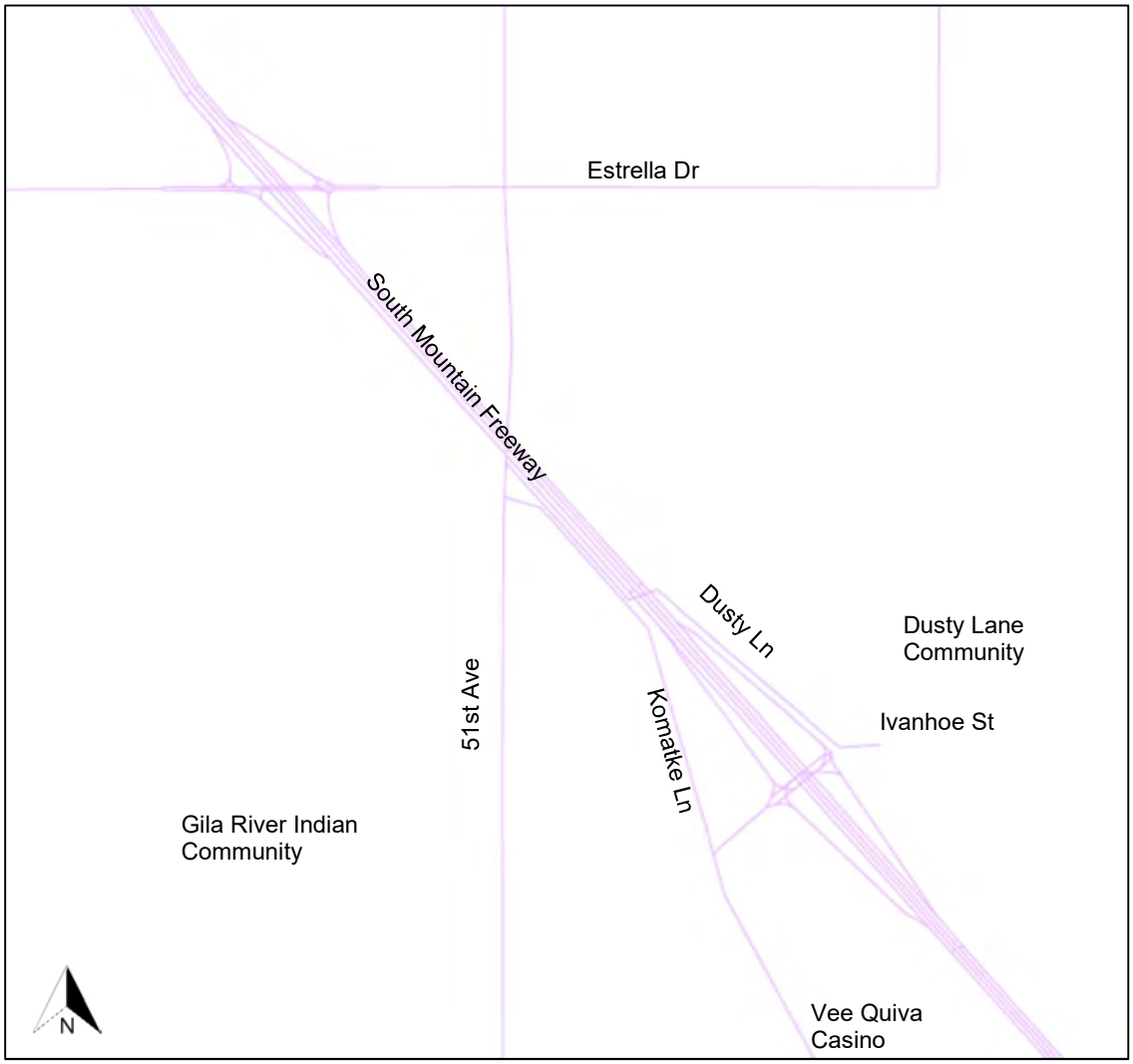


Figure 2 – MAG model road network within study area

2.1 TRAFFIC DATA COLLECTION

The traffic projections for 2040 for the road network within the study area were obtained from the Maricopa Association of Governments (MAG) Regional Travel Demand Model. The original model included a connection from Dusty Lane to Ivanhoe Street west of the freeway. To address the change in the model network to reflect the change to Dusty Lane, trips previously assigned to Dusty Lane were assigned to Komatke Lane and only local (Dusty Lane Community) trips were assigned to Dusty Lane.

The MAG traffic projections are provided in multiple periods: morning 3-hour (6-9 AM); midday 5-hour (9AM-2PM); evening 4-hour (2-6 PM); and overnight 12-hour (6 PM-6 AM). The sum of all of the periods represent the daily or 24-hour traffic volume. The traffic projections are also provided by vehicle class, including heavy and medium trucks. The focus of the analysis is on the morning (AM) and evening (PM) peak hour. To calculate the AM peak hour volume, the AM period volumes are divided by a factor of 2.72. PM period volumes are divided by 3.74 to calculate PM peak-hour volumes. The raw traffic projections in 2040 for the freeway main line, ramps, and ramp intersections are presented in Appendix A.

2.2 TRAFFIC ANALYSIS TOOLS

2.2.1 Freeway Main Line: HCS Analysis

Highway Capacity Software (HCS 7.0) was used to perform the traffic analysis of the freeway mainline. As described in HCM, the freeway traffic operational analysis introduces the Level of Service (LOS) concept. LOS is described by letters from A to F, with each letter describing different traffic flow and roadway characteristics, similar to a classroom grade. For instance, LOS A stands for free flow condition with almost no delays, while LOS F stands for worst conditions, with unacceptable congestion, long queues and delays.

Table 1 illustrates the Level of Service concept based on flow condition.

Table 1 – Highway Capacity Manual level of service criteria for freeway segments

Level of Service	Density range (passenger cars/mile/lane)		
	Basic	Weaving	Merge & Diverge
A	≤ 11	≤ 10	≤ 10
B	>11-18	>10-20	>10-20
C	>18-26	>20-28	>20-28
D	>26-35	>28-35	>28-35
E	>35-45	>35	>35
F	> 45	Demand exceeds capacity	Demand exceeds capacity

For analysis purpose, the freeway is split into following segments:

- Basic freeway segments: These are all the segments that lie outside of the weaving or ramp junction influence areas. These generally occur between successive off and on-ramps.
- Ramp junctions: The ramp junction is an area where a ramp enters or exits a freeway main line.
- Weaving segment: These are formed when an auxiliary lane is used to connect adjacent on and off ramps spaced less than 1.5 miles apart. A lane change of at least 1 lane is required for the traffic to either enter or leave the freeway main line.

HCS analysis was conducted for both the AM and PM peak hours. Inputs that were used in the analysis include:

- Peak Hour Factor – 0.94
- Truck % on main line Westbound – 17%
- Truck % on main line Eastbound – 11%
- Truck % on ramps – 1%
- Freeway Free Flow Speeds
  - Main line – 70 mph
  - Ramp – 45 mph

2.2.2 Traffic Interchanges: Synchro Analysis

The traffic analysis at the ramp intersections was performed using Synchro 9 software. Synchro is widely used for evaluating traffic delays and congestions based on traffic volumes, road geometry, and signal timings. It provides the outputs as LOS in terms of delay. Table 2 presents the level of service thresholds used in the analysis.

Table 2 – Highway Capacity Manual level of service criteria for signalized intersections

Level of service	Average control delay (seconds per vehicle)
A	≤ 10
B	>10-20
C	>20-35
D	>35-55
E	>55-80
F	> 80

Synchro analysis is performed for both AM and PM peak hours. Major inputs are traffic volumes, lane geometry, signal control, signal timing, and phasing. The signal cycle length and phasing is optimized during the analysis. The results include the delay and LOS for individual lane groups as well as for entire signalized intersection.

3 TRAFFIC DATA INPUTS & RESULTS

This section presents the data that was used in the traffic analysis as well as the operational analysis results from HSC and Synchro.

3.1 FREEWAY ANALYSIS

The data presented includes section ID, section name, segment type, direction, length, number of lanes, time period, and traffic volume. The LOS results are provided along with the data, so that the results can be easily interpreted. Detailed HCS reports are provided in Appendix B.

The analysis for the No-Build scenario is presented in Table 3. The analysis for the Build scenario is presented in Tables 4 and 5. Notable observations from the freeway analysis include:

1. For the No-Build scenario, all of the segments in both directions are LOS D or better.
2. For the Build scenario, all of the segments in both directions are LOS D or better.
3. Overall there is little or no change in the anticipated freeway operations with or without the proposed Ivanhoe Street traffic interchange.

Table 3 – Freeway level of service, westbound and eastbound, 2040, No-Build

Section ID	Section	Freeway segment type	Freeway direction	Time period	Level of service (LOS)	Segment length (feet)	Data input (2040 peak hour volumes)					
							Number of lanes	Mainline volume	Weaving lanes	Peak Hour volume	On-ramp volume	Off-ramp volume
1	Mainline on Ivanhoe St	Basic	WB	AM	C	Not required	3	3,375				
				PM	D			4,905				
2	Off-ramp @ Estrella Dr	Diverge	WB	AM	C	1500	3	3,375				345
				PM	D			4,905				495
3	Mainline on Estrella Dr	Basic	WB	AM	B	Not required	3	3,030				
				PM	D			4,415				
4	West of Estrella Dr	Weave	WB	AM	B	Ls = 3100	4	3,260	2		230	95
				PM	A			4,645			235	70
5	Mainline on Ivanhoe St	Basic	EB	AM	C	Not required	3	4,275				
				PM	C			3,855				
6	On-ramp @ Estrella Dr	Merge	EB	AM	C	1500	3	4,275			435	
				PM	C			3,855			410	
7	Mainline on Estrella Dr	Basic	EB	AM	C	Not required	3	3,840				
				PM	C			3,450				
8	West of Estrella Dr	Weave	EB	AM	A	Ls = 3100	4	4,045	3		35	205
				PM	B			3,730			100	285

Table 4 - Freeway level of service, westbound, 2040, Build

Section ID	Section	Freeway segment type	Freeway direction	Time period	Level of service (LOS)	Segment length (feet)	Data Input (2040 peak hour volumes)					
							Number of lanes	Mainline volume	Weaving lanes	Peak hour volume	On-ramp volume	Off-ramp volume
1	Off-ramp @ Ivanhoe St	Diverge	WB	AM	C	1500	3	3,400				80
				PM	D			4,935				235
2	Mainline @ Ivanhoe St	Basic	WB	AM	C	Not required	3	3,325				
				PM	D			4,725				
3	On-ramp @ Ivanhoe St	Merge	WB	AM	B	1500	3	3,400			75	
				PM	C			4,900			180	
4	Mainline between Ivanhoe & Estrella Dr	Basic	WB	AM	C	Not required	3	3,420				
				PM	D			4,940				
5	Off-ramp @ Estrella Dr	Diverge	WB	AM	C	1500	3	3,420				335
				PM	D			4,940				360
6	Mainline @ Estrella Dr	Basic	WB	AM	C	Not required	3	3,090				
				PM	D			4,585				
7	West of Estrella Dr	Weave	WB	AM	B	Ls = 3100	4	3,290	2		205	95
				PM	A			4,740			160	75

Table 5 - Freeway level of service, eastbound, 2040, Build

Section ID	Section	Freeway segment type	Freeway direction	Time period	Level of service (LOS)	Segment length (feet)	Data Input (2040 peak hour volumes)					
							Number of lanes	Mainline volume	Weaving lanes	Peak hour volume	On- ramp volume	Off-ramp volume
1	On ramp @ Ivanhoe St	Merge	EB	AM	C	1500	3	4,345			165	
				PM	C			3,890			160	
2	Mainline @ Ivanhoe St	Basic	EB	AM	C	Not Required	3	4,140				
				PM	C			3,780				
3	Off ramp @ Ivanhoe St	Diverge	EB	AM	C	1500	3	4,320				180
				PM	C			3,910				120
4	Mainline between Ivanhoe & Estrella Dr	Basic	EB	AM	C	Not Required	3	4,320				
				PM	C			3,910				
5	On ramp @ Estrella Dr	Merge	EB	AM	C	1500	3	4,320			340	
				PM	C			3,910			360	
6	Mainline @ Estrella Dr	Basic	EB	AM	C	Not Required	3	4,015				
				PM	C			3,540				
7	West of Estrella Dr	Weave	EB	AM	A	Ls = 3100	4	4,135	3		40	120
				PM	A			3,760			105	225

3.2 DATA & RESULTS FOR SYNCHRO ANALYSIS

This section presents the turning movement volumes at the ramp intersections and the associated LOS for the No-Build and Build scenarios. The turning movements for the No-Build scenario are presented in Figures 3 and 4 for AM peak hour and PM peak hour, respectively. The turning movements for the Build scenario are presented in Figures 5 and 6 for AM peak hour and PM peak hour, respectively. Detailed Synchro reports are provided in Appendix C.

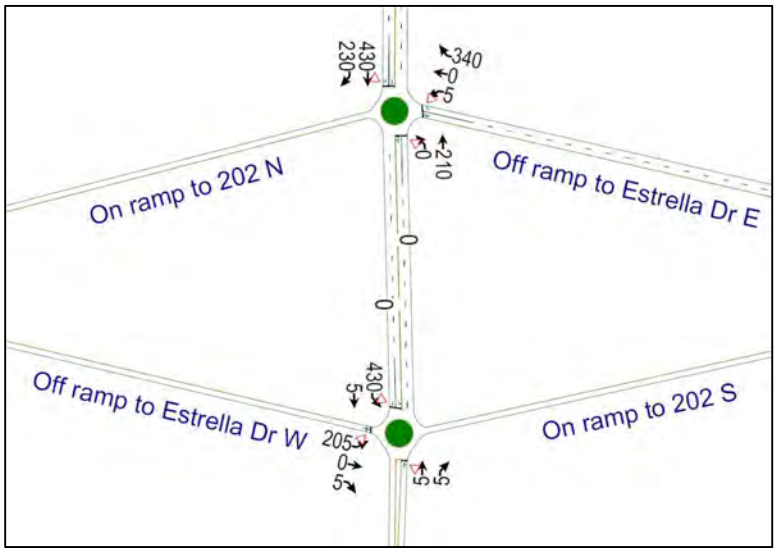


Figure 3 – Turning movements, AM peak hour, No-Build

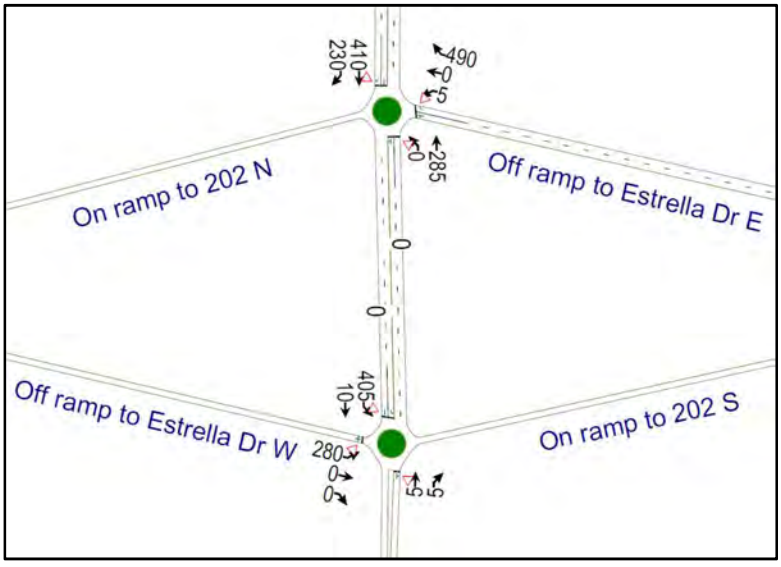


Figure 4 – Turning movements, PM peak hour, No-Build

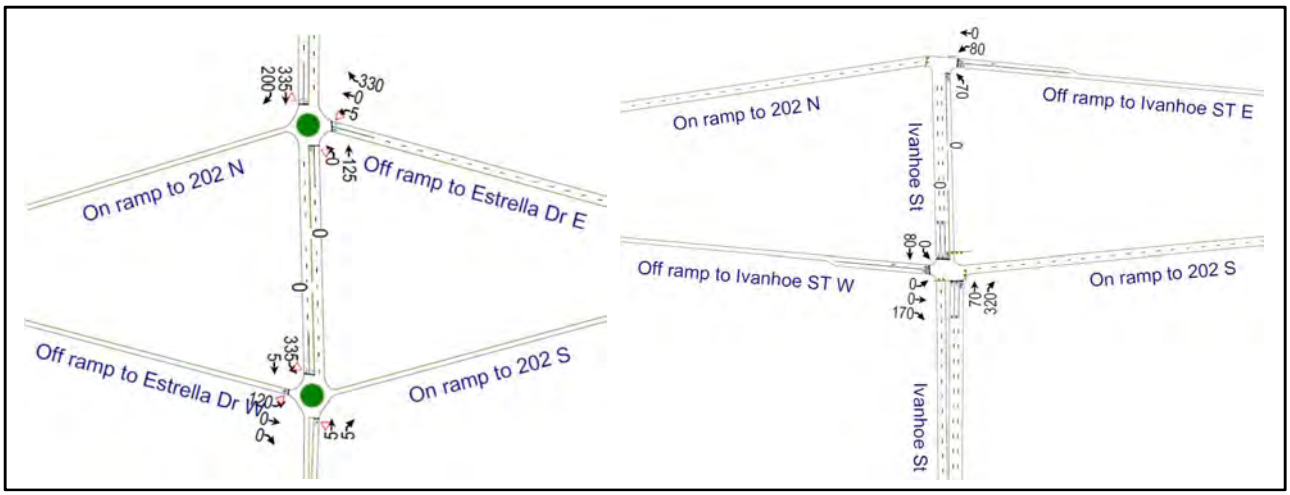


Figure 5 – Turning movements, AM peak hour, Build

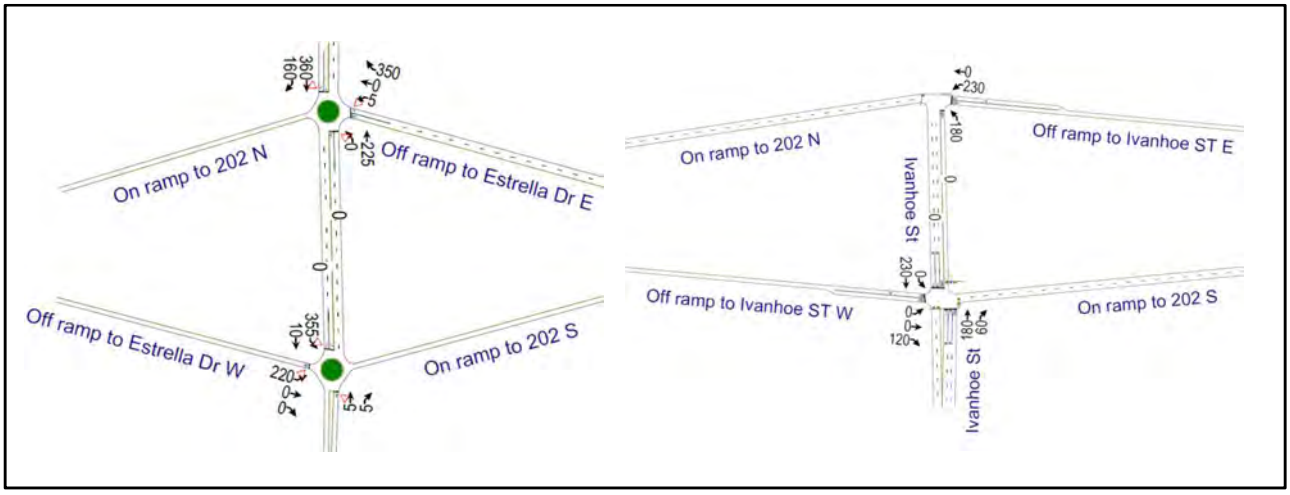


Figure 6 – Turning movements, PM peak hour, Build

The results of the analysis for the No-Build and Build scenario are presented in Tables 6 and 7, respectively.

Table 6 – Intersection level of service, No-Build

Interchange	Intersection	AM peak hour		PM peak hour	
		Delay (seconds)	LOS	Delay (seconds)	LOS
Estrella Dr	East	7	A	10	A
	West	8	A	9	A

Table 7 – Intersection level of service, Build

Interchange	Intersection	AM peak hour		PM peak hour	
		Delay (seconds)	LOS	Delay (seconds)	LOS
Estrella Dr	East	6	A	7	A
	West	6	A	7	A
Ivanhoe St	East	15	B	15	B
	West	8	A	6	A

Notable observations from the intersection analysis include:

1. The level of service of all of the intersections, regardless of scenario, is B or better in 2040.

2. Overall the intersection operations at the Estrella Drive interchange experience less delay with the Build scenario when compared to the No-Build scenario.

4 ADDITIONAL ANALYSIS IN SUPPORT OF REEVALUATION

4.1 TRAFFIC USING IVANHOE TI ON OPENING DAY AND IN 2040

During the public outreach process, members of the public requested information related to the volume of traffic projected to use the Ivanhoe Street TI at opening day (2020) as well as at the design year of 2040. Table 8 presents the total approach volume projected at each intersection during those timeframes. In addition, the projected daily traffic going to and from the Community via Komatke Lane is 7,300 in 2020 and 5,200 in 2040.

Table 8 – Daily intersection approach volume at Ivanhoe TI, 2020 and 2040

Interchange	Intersection	2020	2040
		Vehicles per day	Vehicles per day
Ivanhoe St	East	3,100	3,600
	West	6,200	7,300

4.2 DAILY TRAFFIC AT ESTRELLA TI AND 51ST AVENUE AND ESTRELLA DRIVE INTERSECTION WITH AND WITHOUT THE IVANHOE TI

During the public outreach process, members of the public requested information related to the difference in traffic volumes along Estrella Drive (at the TI as well as at 51st Avenue) for the No-Build and Build scenarios. Table 9 presents the total approach volume projected at each intersection in 2040. Additional details on the projected volumes are provided in Appendix A.

Table 9 – Daily intersection approach volume at Estrella TI and Estrella and 51st Ave intersection, 2040, No-Build and Build scenarios

Interchange	Intersection	No-Build	Build
		Vehicles per day	Vehicles per day
Estrella Dr	East	18,000	12,600
	West	9,000	7,300
Estrella Dr and 51st Ave		19,800	18,200

4.3 LEVEL OF SERVICE AT 51ST AVENUE AND ESTRELLA DRIVE INTERSECTION WITH AND WITHOUT THE IVANHOE TI

During the public outreach process, members of the public requested information related to the difference in level of service at the Estrella Drive and 51st Avenue intersection with and without the Ivanhoe TI. Table 10 presents the level of service in 2040. Additional details on the projected turning movement volumes are provided in Appendix A.

Table 10 – 51st Avenue and Estrella Drive intersection level of service, 2040, Build and No Build scenarios

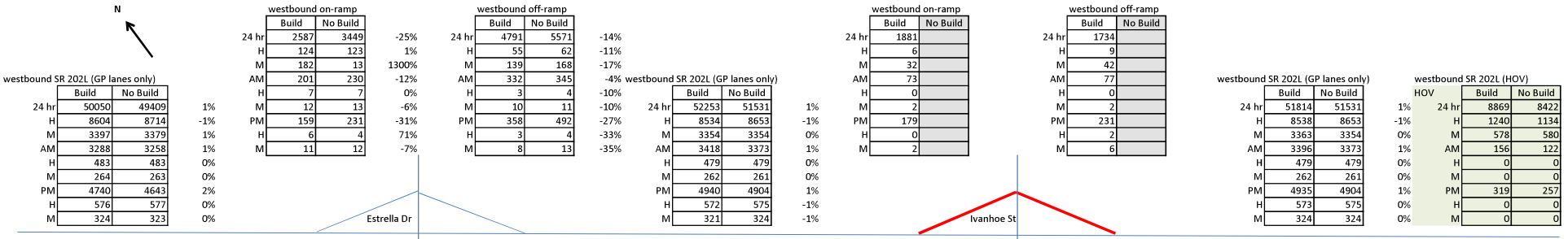
Scenario	AM peak hour		PM peak hour	
	Delay (seconds)	LOS	Delay (seconds)	LOS
Build	11.4	B	8.8	A
No Build	13.3	B	11.3	B

Appendix A. – MAG model traffic projections, Build and No-Build scenario, 2040

2040 MAG Projections - Peak hour and 24-hour
With and Without Ivanhoe Street Traffic Interchange

Peak Hour Conversion Factors	Freeway and Ramp
AM - 3Hr (6am - 9am)	2.72
PM - 4Hr (2pm - 6pm)	3.74

Notes: H = heavy trucks; M = medium trucks; AM = morning; PM = evening; GP = general purpose lanes; HOV = high-occupancy vehicle lane;



westbound SR 202L (GP lanes only)

	Build	No Build	
24 hr	50050	49409	1%
H	8604	8714	-1%
M	3397	3379	1%
AM	3288	3258	1%
H	483	483	0%
M	264	263	0%
PM	4740	4643	2%
H	576	577	0%
M	324	323	0%

westbound on-ramp

	Build	No Build	
24 hr	2587	3449	-25%
H	124	123	1%
M	182	13	1300%
AM	201	230	-12%
H	7	7	0%
M	12	13	-6%
PM	159	231	-31%
H	6	4	71%
M	11	12	-7%

westbound off-ramp

	Build	No Build	
24 hr	4791	5571	-14%
H	55	62	-11%
M	139	168	-17%
AM	332	345	-4%
H	3	4	-10%
M	10	11	-10%
PM	358	492	-27%
H	3	4	-33%
M	8	13	-35%

westbound SR 202L (GP lanes only)

	Build	No Build	
24 hr	52253	51531	1%
H	8534	8653	-1%
M	3354	3354	0%
AM	3418	3373	1%
H	479	479	0%
M	262	261	0%
PM	4940	4904	1%
H	572	575	-1%
M	321	324	-1%

westbound on-ramp

	Build	No Build
24 hr	1881	
H	6	
M	32	
AM	73	
H	0	
M	2	
PM	179	
H	2	
M	2	

westbound off-ramp

	Build	No Build
24 hr	1734	
H	9	
M	42	
AM	77	
H	0	
M	2	
PM	231	
H	2	
M	6	

westbound SR 202L (GP lanes only)

	Build	No Build	
24 hr	51814	51531	1%
H	8538	8653	-1%
M	3363	3354	0%
AM	3396	3373	1%
H	479	479	0%
M	262	261	0%
PM	4935	4904	1%
H	573	575	0%
M	324	324	0%

westbound SR 202L (HOV)

HOV	Build	No Build
24 hr	8869	8422
H	1240	1134
M	578	580
AM	156	122
H	0	0
M	0	0
PM	319	257
H	0	0
M	0	0

eastbound SR 202L (GP lanes only)

	Build	No Build	
24 hr	46866	46117	2%
H	5288	5277	0%
M	3357	3346	0%
AM	4135	4044	2%
H	332	332	0%
M	304	303	0%
PM	3760	3728	1%
H	338	338	0%
M	287	286	0%

eastbound off-ramp

	Build	No Build	
24 hr	2517	3533	-29%
H	122	124	-2%
M	179	196	-9%
AM	119	205	-42%
H	6	7	-11%
M	10	11	-16%
PM	222	282	-21%
H	8	8	-3%
M	14	15	-9%

eastbound on-ramp

	Build	No Build	
24 hr	4691	5417	-13%
H	53	60	-12%
M	135	163	-17%
AM	339	433	-22%
H	1	4	-60%
M	5	11	-58%
PM	357	406	-12%
H	4	4	0%
M	12	12	-4%

eastbound SR 202L (GP lanes only)

	Build	No Build	
24 hr	46270	48001	-4%
H	5181	5213	-1%
M	3225	3314	-3%
AM	4320	4271	1%
H	327	329	-1%
M	297	304	-2%
PM	3864	3853	0%
H	331	333	-1%
M	278	283	-2%

eastbound off-ramp

	Build	No Build
24 hr	1920	
H	6	
M	32	
AM	174	
H	0	
M	2	
PM	116	
H	0	
M	2	

eastbound on-ramp

	Build	No Build
24 hr	1734	
H	9	
M	42	
AM	165	
H	2	
M	8	
PM	147	
H	0	
M	1	

eastbound SR 202L (GP lanes only)

	Build	No Build	
24 hr	47986	48001	0%
H	5170	5213	-1%
M	3275	3314	-1%
AM	4312	4271	1%
H	329	329	0%
M	304	304	0%
PM	3886	3853	1%
H	333	333	0%
M	284	283	0%

eastbound SR 202L (HOV)

HOV	Build	No Build
24 hr	8624	7719
H	646	605
M	612	562
AM	201	159
H	0	0
M	0	0
PM	265	216
H	0	0
M	0	0

SR 202L (both directions+HOV)

	Build	No Build	
24 hr	114409	111667	2%
H	15778	15730	0%
M	7944	7867	1%
AM	7781	7582	3%
H	814	815	0%
M	567	566	0%
PM	9084	8843	3%
H	914	915	0%
M	611	609	0%

SR 202L (both directions+HOV)

	Build	No Build	
24 hr	116016	115673	0%
H	15601	15605	0%
M	7769	7810	-1%
AM	8096	7925	2%
H	806	808	0%
M	559	565	-1%
PM	9388	9229	2%
H	903	908	-1%
M	599	607	-1%

SR 202L (both directions+HOV)

	Build	No Build	
24 hr	117293	115673	1%
H	15594	15605	0%
M	7828	7810	0%
AM	8065	7925	2%
H	808	808	0%
M	566	565	0%
PM	9405	9229	2%
H	906	908	0%
M	609	607	0%

2040 MAG Projections - Peak hour and 24-hour
With and Without Ivanhoe Street Traffic Interchange
Notes: H = heavy trucks; M = medium trucks; AM = morning; PM = evening;

Peak Hour Conversion Factors	Freeway and Ramp
AM - 3Hr (6am - 9am)	2.72
PM - 4Hr (2pm - 6pm)	3.74

N

Estrella Drive

	Build	No Build	Build	No Build
24 hr	2587	3449	4673	5399
H	124	123	53	60
M	182	193	131	160
AM	201	230	335	429
H	7	7	1	4
M	12	13	4	11
PM	159	231	358	407
H	6	6	4	4
M	11	12	11	12

east signal

	24 hr	H	M	AM	H	M	PM	H	M
Build	2749	54	135	330	3	10	40	3	8
No Build	5530	62	164	343	4	11	488	4	13
Build	0	0	0	0	0	0	0	0	0
No Build	0	0	0	0	0	0	0	0	0
Build	42	0	4	2	0	0	5	0	0
No Build	41	0	4	2	0	0	4	0	0

	Build	No Build	Build	No Build
24 hr	0	0	2540	3556
H	0	0	122	124
M	0	0	179	196
AM	0	0	121	207
H	0	0	6	7
M	0	0	10	11
PM	0	0	223	283
H	0	0	8	8
M	0	0	14	15

East intersection; total approach volume

	Build	No Build
24 hr	**12591**	**17975**
H	**353**	**369**
M	**631**	**717**
AM	**989**	**1211**
H	**18**	**21**
M	**36**	**47**
PM	**784**	**1413**
H	**21**	**22**
M	**45**	**52**

West intersection; total approach volume

	Build	No Build
24 hr	**7297**	**9038**
H	**175**	**184**
M	**318**	**363**
AM	**463**	**642**
H	**7**	**10**
M	**15**	**23**
PM	**588**	**696**
H	**12**	**12**
M	**26**	**28**

	Build	No Build	Build	No Build
24 hr	66	65	4649	5375
H	0	0	53	60
M	4	4	131	159
AM	3	3	334	428
H	0	0	1	4
M	0	0	4	11
PM	7	7	355	404
H	0	0	4	4
M	0	0	11	12

	24 hr	H	M	AM	H	M	PM	H	M
Build	2517	122	179	119	6	10	222	8	14
No Build	3533	124	196	205	7	11	282	8	15
Build	0	0	0	0	0	0	0	0	0
No Build	0	0	0	0	0	0	0	0	0
Build	0	0	0	0	0	0	0	0	0
No Build	0	0	0	0	0	0	0	0	0

west signal

	Build	No Build	Build	No Build
24 hr	23	23	42	42
H	0	0	0	0
M	0	0	4	4
AM	3	3	4	4
H	0	0	0	0
M	0	0	0	0
PM	1	1	2	2
H	0	0	0	0
M	0	0	0	0

2040 MAG Projections - Peak hour and 24-hour
With and Without Ivanhoe Street Traffic Interchange
Notes: H = heavy trucks; M = medium trucks; AM = morning; PM = evening;

Peak Hour Conversion Factors	Freeway and Ramp
AM - 3Hr (6am - 9am)	2.72
PM - 4Hr (2pm - 6pm)	3.74

Ivanhoe Street

N

	Build	No Build	Build	No Build
24 hr	0	0	0	0
H	0	0	0	0
M	0	0	0	0
AM	0	0	0	0
H	0	0	0	0
M	0	0	0	0
PM	0	0	0	0
H	0	0	0	0
M	0	0	0	0

	24 hr	H	M	AM	H	M	PM	H	M
Build	0	0	0	0	0	0	0	0	0
No Build	0	0	0	0	0	0	0	0	0
Build	0	0	0	0	0	0	0	0	0
No Build	0	0	0	0	0	0	0	0	0
Build	1734	9	42	77	0	2	231	2	6
No Build	0	0	0	0	0	0	0	0	0

	Build	No Build	Build	No Build
24 hr	1881	0	0	0
H	6	0	0	0
M	32	0	0	0
AM	73	0	0	0
H	0	0	0	0
M	2	0	0	0
PM	179	0	0	0
H	0	0	0	0
M	2	0	0	0

East intersection; total approach volume

	Build	No Build
24 hr	**3615**	**0**
H	**15**	**0**
M	**74**	**0**
AM	**150**	**0**
H	**1**	**0**
M	**4**	**0**
PM	**410**	**0**
H	**2**	**0**
M	**8**	**0**

West intersection; total approach volume

	Build	No Build
24 hr	**7269**	**0**
H	**30**	**0**
M	**148**	**0**
AM	**642**	**0**
H	**3**	**0**
M	**14**	**0**
PM	**582**	**0**
H	**3**	**0**
M	**12**	**0**

	Build	No Build	Build	No Build
24 hr	1734	0	0	0
H	9	0	0	0
M	42	0	0	0
AM	77	0	0	0
H	0	0	0	0
M	2	0	0	0
PM	231	0	0	0
H	2	0	0	0
M	6	0	0	0

	24 hr	H	M	AM	H	M	PM	H	M
Build	0	0	0	0	0	0	0	0	0
No Build	0	0	0	0	0	0	0	0	0
Build	0	0	0	0	0	0	0	0	0
No Build	0	0	0	0	0	0	0	0	0
Build	1920	6	32	174	0	2	116	1	2
No Build	0	0	0	0	0	0	0	0	0

	Build	No Build	Build	No Build
24 hr	1881	0	1734	0
H	6	0	9	0
M	32	0	42	0
AM	73	0	318	0
H	0	0	2	0
M	2	0	8	0
PM	179	0	56	0
H	0	0	0	0
M	2	0	1	0

2040 MAG Projections - Peak hour and 24-hour
With and Without Ivanhoe Street Traffic Interchange
Notes: AM = morning; PM = evening

Peak Hour Conversion Factors	Freeway and Ramp
AM - 3Hr (6am - 9am)	2.72
PM - 4Hr (2pm - 6pm)	3.74

Total approach volume

	Build	No Build
24 hr	2790	3250
AM	180	220
PM	270	250

	Build	No Build
24 hr	2240	2240
AM	180	180
PM	170	200

Intersection

	Build	No Build
24 hr	6090	8110
AM	450	550
PM	580	760

	Build	No Build
24 hr	7110	6210
AM	420	470
PM	240	400

N

Total approach volume

	Build	**No Build**
24 hr	**18230**	**19810**
AM	**1230**	**1420**
PM	**1260**	**1610**

Intersection turning movements

	Build	No Build	Build	No Build	Build	No Build
AM	110	130	50	70	20	20
PM	200	180	50	50	20	20

	AM	PM
Build	200	180
No Build	200	200
Build	100	100
No Build	100	140
Build	150	300
No Build	250	420

Intersection

	AM	PM
Build	20	20
No Build	20	20
Build	100	160
No Build	140	160
Build	60	20
No Build	20	20

	Build	No Build	Build	No Build	Build	No Build
AM	330	390	40	40	50	40
PM	160	300	30	40	50	60

Appendix B. – HCS Analysis Reports

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202 - At Ivanhoe St - WB - No Build		

Geometric Data

Number of Lanes, In	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3375	Heavy Vehicle Adjustment Factor (f_{HV})	0.855
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	1400
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.58
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	69.5
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	20.1
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202 - At Ivanhoe St - WB - No Build		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	4905	Heavy Vehicle Adjustment Factor (f_{HV})	0.855
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	2034
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.85
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	61.9
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	32.9
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	D
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

HCS7 Freeway Diverge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-At Estrella Dr-No Build-WB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	1500	800
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	3375	345
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	17.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.855	0.990
Flow Rate (v_i), pc/h	4199	371
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.58	0.18

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	1773.0	Density in Ramp Influence Area (D_R), pc/mi/ln	21.2
Distance to Upstream Ramp (L_{UP}), ft	3400	Speed Index (D_S)	0.331
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	1386
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	60.7
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.638	Outer Lanes Freeway Speed (S_O), mi/h	75.3
Flow in Lanes 1 and 2 (v_{12}), pc/h	2813	Ramp Junction Speed (S), mi/h	64.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	21.6
Level of Service (LOS)	C		

HCS7 Freeway Diverge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-At Estrella Dr-No Build-WB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	1500	800
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	4905	495
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	17.00	0.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.855	1.000
Flow Rate (v_i), pc/h	6103	527
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.85	0.25

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	1473.9	Density in Ramp Influence Area (D_R), pc/mi/ln	29.5
Distance to Upstream Ramp (L_{UP}), ft	3400	Speed Index (D_S)	0.345
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	2325
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	60.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FO})	0.583	Outer Lanes Freeway Speed (S_O), mi/h	71.6
Flow in Lanes 1 and 2 (v_{12}), pc/h	3778	Ramp Junction Speed (S), mi/h	64.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	31.7
Level of Service (LOS)	D		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202 - At Estrella Dr - WB - No Build		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3030	Heavy Vehicle Adjustment Factor (f_{HV})	0.855
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	1257
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.52
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	70.0
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	18.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202 - At Estrella Dr - WB - No Build		

Geometric Data

Number of Lanes, n	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	4415	Heavy Vehicle Adjustment Factor (f_{HV})	0.855
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	1831
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.76
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	65.4
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	28.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	D
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

HCS7 Freeway Weaving Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-West of Estrella Dr - WB - No Build		

Geometric Data

Number of Lanes (N), ln	4	Segment Type	Freeway
Short Length (L_S), ft	3100	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.80	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	3260	230	0	95
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	17.00	1.00	0.00	1.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.855	0.990	1.000	0.990
Flow Rate (v_i), pc/h	4056	247	0	102

Weaving Flow Rate (v_w), pc/h	349	Freeway Max Capacity (c_{IFL}), pc/h/ln	2400
Non-Weaving Flow Rate (v_{NW}), pc/h	4056	Density-Based Capacity (c_{IWL}), pc/h/ln	2382
Total Flow Rate (v), pc/h	4405	Demand Flow-Based Capacity (c_W), pc/h	30380
Volume Ratio (VR)	0.079	Weaving Segment Capacity (c_W), veh/h	8146
Minimum Lane Change Rate (LC_{MIN}), lc/h	349	Adjusted Weaving Area Capacity, pc/h	9409
Maximum Weaving Length (L_{MAX}), ft	3337	Volume-to-Capacity Ratio (v/c)	0.47

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	1006	Average Weaving Speed (S_W), mi/h	60.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1745	Average Non-Weaving Speed (S_{NW}), mi/h	62.2
Weaving Lane Change Rate (LC_W), lc/h	877	Average Speed (S), mi/h	62.1
Total Lane Change Rate (LC_{All}), lc/h	2622	Density (D), pc/mi/ln	17.7
Weaving Intensity Factor (W)	0.198	Level of Service (LOS)	B

WEAVING

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-West of Estrella Dr - WB - No Build		

Geometric Data

Number of Lanes, In	4	Terrain Type	Level
Segment Length (L), ft	4100	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	0	Heavy Vehicle Adjustment Factor (fHV)	0.855
Peak Hour Factor	0.94	Flow Rate (v_p), pc/h/ln	0
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.00
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	70.0
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	0.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202 - At Ivanhoe St - EB - No Build		

Geometric Data

Number of Lanes, n	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	4275	Heavy Vehicle Adjustment Factor (f_{HV})	0.901
Peak Hour Factor	0.94	Flow Rate (v_p), pc/h/ln	1683
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.70
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	25.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202 - At Ivanhoe St - EB - No Build		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3855	Heavy Vehicle Adjustment Factor (fHV)	0.901
Peak Hour Factor	0.94	Flow Rate (Vp), pc/h/ln	1517
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (cadj), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.63
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (fLW)	0.0	Average Speed (S), mi/h	68.8
Right-Side Lateral Clearance Adj. (fRLC)	0.0	Density (D), pc/mi/ln	22.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Freeway Merge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-At Estrella Dr-NO Build-EB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	4275	435
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	11.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.901	0.990
Flow Rate (v_i), pc/h	5048	467
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.77	0.22

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	25.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.342
Downstream Equilibrium Distance (L_{EQ}), ft	885.7	Flow Outer Lanes (V_{OA}), pc/h/ln	1949
Distance to Downstream Ramp (L_{DOWN}), ft	3400	On-Ramp Influence Area Speed (S_R), mi/h	60.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	0.614	Outer Lanes Freeway Speed (S_O), mi/h	64.8
Flow in Lanes 1 and 2 (V_{12}), pc/h	3099	Ramp Junction Speed (S), mi/h	61.9
Flow Entering Ramp-Infl. Area (V_{R12}), pc/h	3566	Average Density (D), pc/mi/ln	29.7
Level of Service (LOS)	C		

HCS7 Freeway Merge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-At Estrella Dr-No Build-EB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	3855	410
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	11.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.901	0.990
Flow Rate (v_i), pc/h	4552	441
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.69	0.21

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	22.4
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.303
Downstream Equilibrium Distance (L_{EQ}), ft	1231.3	Flow Outer Lanes (v_{OA}), pc/h/ln	1757
Distance to Downstream Ramp (L_{DOWN}), ft	3400	On-Ramp Influence Area Speed (S_R), mi/h	61.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	0.614	Outer Lanes Freeway Speed (S_O), mi/h	65.5
Flow in Lanes 1 and 2 (v_{12}), pc/h	2795	Ramp Junction Speed (S), mi/h	62.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3236	Average Density (D), pc/mi/ln	26.5
Level of Service (LOS)	C		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202 - At Estrella Dr - EB - No Build		

Geometric Data

Number of Lanes, In	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3840	Heavy Vehicle Adjustment Factor (fHV)	0.901
Peak Hour Factor	0.94	Flow Rate (Vp), pc/h/ln	1511
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (cadj), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.63
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (fLW)	0.0	Average Speed (S), mi/h	68.9
Right-Side Lateral Clearance Adj. (fRLC)	0.0	Density (D), pc/mi/ln	21.9
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202 - At Estrella Dr - EB - No Build		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3450	Heavy Vehicle Adjustment Factor (fHV)	0.901
Peak Hour Factor	0.94	Flow Rate (v_p), pc/h/ln	1358
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.57
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (fLW)	0.0	Average Speed (S), mi/h	69.7
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	19.5
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

WEAVING

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-West of Estrella Dr-EB - No Build		

Geometric Data

Number of Lanes, n	4	Terrain Type	Level
Segment Length (L), ft	4100	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	0	Heavy Vehicle Adjustment Factor (fHV)	0.901
Peak Hour Factor	0.94	Flow Rate (v_p), pc/h/ln	0
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.00
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	70.0
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	0.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

WEAVING

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-West of Estrella Dr-EB-No Build		

Geometric Data

Number of Lanes, n	4	Terrain Type	Level
Segment Length (L), ft	4100	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	0	Heavy Vehicle Adjustment Factor (f_{HV})	0.901
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	0
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.00
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	70.0
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	0.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

HCS7 Freeway Diverge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-At Ivanhoe St-Build-WB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	1500	800
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	3400	80
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	17.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.855	0.990
Flow Rate (v_i), pc/h	4230	86
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.59	0.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	498.2	Density in Ramp Influence Area (D_R), pc/mi/ln	21.0
Distance to Upstream Ramp (L_{UP}), ft	2400	Speed Index (D_S)	0.306
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	1450
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	61.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.650	Outer Lanes Freeway Speed (S_O), mi/h	75.0
Flow in Lanes 1 and 2 (v_{12}), pc/h	2780	Ramp Junction Speed (S), mi/h	65.5
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	21.5
Level of Service (LOS)	C		

HCS7 Freeway Diverge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-At Ivanhoe St-Build-WB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	1500	800
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	4935	235
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	17.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.855	0.990
Flow Rate (v_i), pc/h	6140	253
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.85	0.12

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	1308.3	Density in Ramp Influence Area (D_R), pc/mi/ln	29.4
Distance to Upstream Ramp (L_{UP}), ft	2400	Speed Index (D_S)	0.321
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	2384
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	61.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FO})	0.595	Outer Lanes Freeway Speed (S_O), mi/h	71.4
Flow in Lanes 1 and 2 (v_{12}), pc/h	3756	Ramp Junction Speed (S), mi/h	64.7
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	31.6
Level of Service (LOS)	D		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202 - At Ivanhoe St - WB - Build		

Geometric Data

Number of Lanes, In	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3325	Heavy Vehicle Adjustment Factor (f_{HV})	0.855
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	1379
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (cadj), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.57
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	69.6
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	19.8
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202 - At Ivanhoe St - WB - Build		

Geometric Data

Number of Lanes, In	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	4725	Heavy Vehicle Adjustment Factor (f_{HV})	0.855
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	1960
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (cadj), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.82
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	63.3
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	31.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	D
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Freeway Merge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-At Ivanhoe-Build-WB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	3400	75
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	17.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.855	0.990
Flow Rate (v_i), pc/h	4230	81
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.60	0.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	18.2
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.261
Downstream Equilibrium Distance (L_{EQ}), ft	345.6	Flow Outer Lanes (v_{OA}), pc/h/ln	1633
Distance to Downstream Ramp (L_{DOWN}), ft	2400	On-Ramp Influence Area Speed (S_R), mi/h	62.7
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	0.614	Outer Lanes Freeway Speed (S_O), mi/h	65.9
Flow in Lanes 1 and 2 (v_{12}), pc/h	2597	Ramp Junction Speed (S), mi/h	63.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	2678	Average Density (D), pc/mi/ln	22.5
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-At Ivanhoe-Build-WB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	4900	180
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	17.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.855	0.990
Flow Rate (v_i), pc/h	6097	193
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.87	0.09

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	28.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.404
Downstream Equilibrium Distance (L_{EQ}), ft	1015.3	Flow Outer Lanes (v_{OA}), pc/h/ln	2353
Distance to Downstream Ramp (L_{DOWN}), ft	2400	On-Ramp Influence Area Speed (S_R), mi/h	58.7
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	0.614	Outer Lanes Freeway Speed (S_O), mi/h	63.2
Flow in Lanes 1 and 2 (v_{12}), pc/h	3744	Ramp Junction Speed (S), mi/h	60.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3937	Average Density (D), pc/mi/ln	34.8
Level of Service (LOS)	C		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202 - Between Ivanhoe St & Estrella Dr - WB - Build		

Geometric Data

Number of Lanes, n	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3420	Heavy Vehicle Adjustment Factor (f_{HV})	0.855
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	1418
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.59
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	69.4
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	20.4
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202 - Between Ivanhoe St & Estrella Dr - WB - Build		

Geometric Data

Number of Lanes, n	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	4940	Heavy Vehicle Adjustment Factor (fHV)	0.855
Peak Hour Factor	0.94	Flow Rate (Vp), pc/h/ln	2049
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (cadj), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.85
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (fLW)	0.0	Average Speed (S), mi/h	61.7
Right-Side Lateral Clearance Adj. (fRLC)	0.0	Density (D), pc/mi/ln	33.2
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	D
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Freeway Diverge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-At Estrella Dr-Build-WB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	1500	800
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	3420	335
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	17.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.855	0.990
Flow Rate (v_i), pc/h	4255	360
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.59	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	1556.6	Density in Ramp Influence Area (D_R), pc/mi/ln	21.5
Distance to Upstream Ramp (L_{UP}), ft	3400	Speed Index (D_S)	0.330
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	1414
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	60.8
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.637	Outer Lanes Freeway Speed (S_O), mi/h	75.2
Flow in Lanes 1 and 2 (v_{12}), pc/h	2841	Ramp Junction Speed (S), mi/h	64.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	21.9
Level of Service (LOS)	C		

HCS7 Freeway Diverge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-At Estrella Dr-Build-WB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	1500	800
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	4940	360
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	17.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.855	0.990
Flow Rate (v_i), pc/h	6147	387
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.85	0.18

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	939.6	Density in Ramp Influence Area (D_R), pc/mi/ln	29.6
Distance to Upstream Ramp (L_{UP}), ft	3400	Speed Index (D_S)	0.333
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	2367
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	60.7
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.589	Outer Lanes Freeway Speed (S_O), mi/h	71.5
Flow in Lanes 1 and 2 (v_{12}), pc/h	3780	Ramp Junction Speed (S), mi/h	64.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	31.8
Level of Service (LOS)	D		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
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Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202 - At Estrella Dr - WB - Build		

Geometric Data

Number of Lanes, In	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3090	Heavy Vehicle Adjustment Factor (f_{HV})	0.855
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	1282
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.53
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	69.9
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	18.3
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
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Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202 - At Estrella Dr - WB - Build		

Geometric Data

Number of Lanes, n	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	4585	Heavy Vehicle Adjustment Factor (fHV)	0.855
Peak Hour Factor	0.94	Flow Rate (Vp), pc/h/ln	1902
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (cadj), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.79
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (fLW)	0.0	Average Speed (S), mi/h	64.3
Right-Side Lateral Clearance Adj. (fRLC)	0.0	Density (D), pc/mi/ln	29.6
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	D
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Freeway Weaving Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-West of Estrella Dr - WB - Build		

Geometric Data

Number of Lanes (N), ln	4	Segment Type	Freeway
Short Length (L_S), ft	3100	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.80	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	3290	205	0	95
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	17.00	1.00	0.00	1.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.855	0.990	1.000	0.990
Flow Rate (v_i), pc/h	4094	220	0	102

Weaving Flow Rate (v_w), pc/h	322	Freeway Max Capacity (c_{FL}), pc/h/ln	2400
Non-Weaving Flow Rate (v_{NW}), pc/h	4094	Density-Based Capacity (c_{WL}), pc/h/ln	2386
Total Flow Rate (v), pc/h	4416	Demand Flow-Based Capacity (c_W), pc/h	32877
Volume Ratio (VR)	0.073	Weaving Segment Capacity (c_W), veh/h	8160
Minimum Lane Change Rate (LC_{MIN}), lc/h	322	Adjusted Weaving Area Capacity, pc/h	9435
Maximum Weaving Length (L_{MAX}), ft	3280	Volume-to-Capacity Ratio (v/c)	0.47

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	1015	Average Weaving Speed (S_W), mi/h	60.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1753	Average Non-Weaving Speed (S_{NW}), mi/h	62.4
Weaving Lane Change Rate (LC_W), lc/h	850	Average Speed (S), mi/h	62.3
Total Lane Change Rate (LC_{All}), lc/h	2603	Density (D), pc/mi/ln	17.7
Weaving Intensity Factor (W)	0.197	Level of Service (LOS)	B

WEAVING

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-West of Estrella Dr - WB -Build		

Geometric Data

Number of Lanes, n	4	Terrain Type	Level
Segment Length (L), ft	4100	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	0	Heavy Vehicle Adjustment Factor (f_{HV})	0.855
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	0
Total Trucks, %	17.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.00
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	70.0
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	0.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

HCS7 Freeway Merge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-At Ivanhoe-Build-EB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	4345	165
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	11.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.901	0.990
Flow Rate (v_i), pc/h	5130	177
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.74	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	23.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.313
Downstream Equilibrium Distance (L_{EQ}), ft	777.7	Flow Outer Lanes (v_{OA}), pc/h/ln	1980
Distance to Downstream Ramp (L_{DOWN}), ft	2400	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	0.614	Outer Lanes Freeway Speed (S_O), mi/h	64.7
Flow in Lanes 1 and 2 (v_{12}), pc/h	3150	Ramp Junction Speed (S), mi/h	62.5
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3327	Average Density (D), pc/mi/ln	28.3
Level of Service (LOS)	C		

HCS7 Freeway Merge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-At Ivanhoe-Build-EB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	3890	150
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	11.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.901	0.990
Flow Rate (v_i), pc/h	4593	161
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.66	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	20.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.281
Downstream Equilibrium Distance (L_{EQ}), ft	518.4	Flow Outer Lanes (v_{OA}), pc/h/ln	1773
Distance to Downstream Ramp (L_{DOWN}), ft	2400	On-Ramp Influence Area Speed (S_R), mi/h	62.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	0.614	Outer Lanes Freeway Speed (S_O), mi/h	65.4
Flow in Lanes 1 and 2 (v_{12}), pc/h	2820	Ramp Junction Speed (S), mi/h	63.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	2981	Average Density (D), pc/mi/ln	25.0
Level of Service (LOS)	C		

HCS7 Basic Freeway Report

Project Information			
Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202 - At Ivanhoe St - EB - Build		

Geometric Data			
Number of Lanes, n	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors			
Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity			
Demand Volume veh/h	4140	Heavy Vehicle Adjustment Factor (f_{HV})	0.901
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	1629
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.68
Passenger Car Equivalent (ET)	2.000		

Speed and Density			
Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	67.9
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	24.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202 - At Ivanhoe St - EB - Build		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3780	Heavy Vehicle Adjustment Factor (f_{HV})	0.901
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	1488
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.62
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	69.0
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	21.6
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

HCS7 Freeway Diverge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-At Ivanhoe St-Build-EB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	1500	800
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	4320	180
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	11.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.901	0.990
Flow Rate (v_i), pc/h	5101	193
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.71	0.09

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	2103.7	Density in Ramp Influence Area (D_R), pc/mi/ln	25.1
Distance to Upstream Ramp (L_{UP}), ft	2400	Speed Index (D_S)	0.315
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	1845
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.624	Outer Lanes Freeway Speed (S_O), mi/h	73.5
Flow in Lanes 1 and 2 (v_{12}), pc/h	3256	Ramp Junction Speed (S), mi/h	65.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	26.1
Level of Service (LOS)	C		

HCS7 Freeway Diverge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-At Ivanhoe St-Build-EB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	1500	800
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	3910	120
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	11.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.901	0.990
Flow Rate (v_i), pc/h	4617	129
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.64	0.06

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	2310.9	Density in Ramp Influence Area (D_R), pc/mi/ln	22.8
Distance to Upstream Ramp (L_{UP}), ft	2400	Speed Index (D_S)	0.310
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	1620
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	61.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.639	Outer Lanes Freeway Speed (S_O), mi/h	74.4
Flow in Lanes 1 and 2 (v_{12}), pc/h	2997	Ramp Junction Speed (S), mi/h	65.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	23.6
Level of Service (LOS)	C		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202 - Between Ivanhoe St & Estrella Dr-EB-Build		

Geometric Data

Number of Lanes, n	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	4320	Heavy Vehicle Adjustment Factor (fHV)	0.901
Peak Hour Factor	0.94	Flow Rate (Vp), pc/h/ln	1700
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (cadj), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.71
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (fLW)	0.0	Average Speed (S), mi/h	67.1
Right-Side Lateral Clearance Adj. (fRLC)	0.0	Density (D), pc/mi/ln	25.3
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202 - Between Ivanhoe St & Estrella Dr-EB-Build		

Geometric Data

Number of Lanes, n	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3910	Heavy Vehicle Adjustment Factor (f_{HV})	0.901
Peak Hour Factor	0.94	Flow Rate (v_p), pc/h/ln	1539
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.64
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	68.7
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	22.4
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Freeway Merge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-At Estrella Dr-Build-EB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	4320	340
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	11.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.901	0.990
Flow Rate (v_i), pc/h	5101	365
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.76	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	24.5
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.333
Downstream Equilibrium Distance (L_{EQ}), ft	518.4	Flow Outer Lanes (v_{OA}), pc/h/ln	1969
Distance to Downstream Ramp (L_{DOWN}), ft	3400	On-Ramp Influence Area Speed (S_R), mi/h	60.7
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	0.614	Outer Lanes Freeway Speed (S_O), mi/h	64.7
Flow in Lanes 1 and 2 (v_{12}), pc/h	3132	Ramp Junction Speed (S), mi/h	62.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3497	Average Density (D), pc/mi/ln	29.3
Level of Service (LOS)	C		

HCS7 Freeway Merge Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-At Estrella Dr-Build-EB		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	70.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	3910	360
Peak Hour Factor (PHF)	0.94	0.94
Total Trucks, %	11.00	1.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.901	0.990
Flow Rate (v_i), pc/h	4617	387
Capacity (c), pc/h	7200	2100
Volume-to-Capacity Ratio (v/c)	0.70	0.18

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	22.4
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.302
Downstream Equilibrium Distance (L_{EQ}), ft	972.1	Flow Outer Lanes (v_{OA}), pc/h/ln	1782
Distance to Downstream Ramp (L_{DOWN}), ft	3400	On-Ramp Influence Area Speed (S_R), mi/h	61.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	0.614	Outer Lanes Freeway Speed (S_O), mi/h	65.4
Flow in Lanes 1 and 2 (v_{12}), pc/h	2835	Ramp Junction Speed (S), mi/h	62.8
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3222	Average Density (D), pc/mi/ln	26.6
Level of Service (LOS)	C		

HCS7 Basic Freeway Report

Project Information			
Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202 -Build-At Estrella Dr-EB - Build		

Geometric Data			
Number of Lanes, n	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors			
Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity			
Demand Volume veh/h	4015	Heavy Vehicle Adjustment Factor (f_{HV})	0.901
Peak Hour Factor	0.94	Flow Rate (v_p), pc/h/ln	1580
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.66
Passenger Car Equivalent (ET)	2.000		

Speed and Density			
Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	68.3
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	23.1
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/6/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202 -Build-At Estrella Dr-EB-Build		

Geometric Data

Number of Lanes, n	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3540	Heavy Vehicle Adjustment Factor (f_{HV})	0.901
Peak Hour Factor	0.94	Flow Rate (V_p), pc/h/ln	1393
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.58
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	69.6
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	20.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

WEAVING

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	AM
Project Description	Loop 202-West of Estrella Dr-EB-Build		

Geometric Data

Number of Lanes, n	4	Terrain Type	Level
Segment Length (L), ft	4100	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	0	Heavy Vehicle Adjustment Factor (f_{HV})	0.901
Peak Hour Factor	0.94	Flow Rate (v_p), pc/h/ln	0
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.00
Passenger Car Equivalent (ET)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	70.0
Right-Side Lateral Clearance Adj. (f_{RLC})	0.0	Density (D), pc/mi/ln	0.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	70.0		

WEAVING

HCS7 Basic Freeway Report

Project Information

Analyst	GSR	Date	6/8/2018
Agency	HDR	Analysis Year	2040
Jurisdiction	ADOT	Time Period Analyzed	PM
Project Description	Loop 202-West of Estrella Dr-EB-Build		

Geometric Data

Number of Lanes, n	4	Terrain Type	Level
Segment Length (L), ft	4100	Percent Grade, %	-
Measured or Base Free-Flow Speed	Base	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	70.0	Total Ramp Density (TRD), ramps/mi	0.00
Lane Width, ft	12	Free-Flow Speed (FFS), mi/h	70.0
Right-Side Lateral Clearance, ft	10		

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	0	Heavy Vehicle Adjustment Factor (fHV)	0.901
Peak Hour Factor	0.94	Flow Rate (Vp), pc/h/ln	0
Total Trucks, %	11.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (cadj), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.00
Passenger Car Equivalent (Et)	2.000		

Speed and Density

Lane Width Adjustment (fLW)	0.0	Average Speed (S), mi/h	70.0
Right-Side Lateral Clearance Adj. (fRLC)	0.0	Density (D), pc/mi/ln	0.0
Total Ramp Density Adjustment	0.0	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFSadj), mi/h	70.0		

Appendix C. – Synchro Analysis Reports

Intersection	
Intersection Delay, s/veh	7.2
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	0	2	2	2
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	0	375	228	717
Demand Flow Rate, veh/h	0	382	233	731
Vehicles Circulating, veh/h	481	233	0	5
Vehicles Exiting, veh/h	255	0	481	610
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	9.1	5.1	6.9
Approach LOS	-	A	A	A

Lane	Left	Right	Left	Left	Right
Designated Moves	LT	R	LT	LT	R
Assumed Moves	LT	R	LT	LT	R
RT Channelized					
Lane Util	0.013	0.987	1.000	0.651	0.349
Critical Headway, s	5.193	5.193	5.193	5.193	5.193
Entry Flow, veh/h	5	377	233	476	255
Cap Entry Lane, veh/h	895	895	1130	1124	1124
Entry HV Adj Factor	1.000	0.981	0.980	0.980	0.980
Flow Entry, veh/h	5	370	228	467	250
Cap Entry, veh/h	895	878	1108	1102	1102
V/C Ratio	0.006	0.421	0.206	0.423	0.227
Control Delay, s/veh	4.1	9.2	5.1	7.8	5.4
LOS	A	A	A	A	A
95th %tile Queue, veh	0	2	1	2	1

Intersection	
Intersection Delay, s/veh	8.2
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	0	1	2
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	228	0	10	472
Demand Flow Rate, veh/h	232	0	10	481
Vehicles Circulating, veh/h	481	232	703	0
Vehicles Exiting, veh/h	0	481	10	232
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	9.5	0.0	6.7	7.7
Approach LOS	A	-	A	A

Lane	Left	Left	Left	Right
Designated Moves	LTR	TR	L	TR
Assumed Moves	LTR	TR	L	TR
RT Channelized				
Lane Util	1.000	1.000	0.990	0.010
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	232	10	476	5
Cap Entry Lane, veh/h	698	559	1130	1130
Entry HV Adj Factor	0.983	0.990	0.981	0.980
Flow Entry, veh/h	228	10	467	5
Cap Entry, veh/h	686	554	1109	1108
V/C Ratio	0.332	0.018	0.421	0.004
Control Delay, s/veh	9.5	6.7	7.7	3.3
LOS	A	A	A	A
95th %tile Queue, veh	1	0	2	0

Intersection	
Intersection Delay, s/veh	9.8
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	0	2	2	2
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	0	538	310	696
Demand Flow Rate, veh/h	0	549	316	710
Vehicles Circulating, veh/h	460	316	0	5
Vehicles Exiting, veh/h	255	0	460	860
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	15.9	5.9	6.7
Approach LOS	-	C	A	A

Lane	Left	Right	Left	Left	Right
Designated Moves	LT	R	LT	LT	R
Assumed Moves	LT	R	LT	LT	R
RT Channelized					
Lane Util	0.009	0.991	1.000	0.641	0.359
Critical Headway, s	5.193	5.193	5.193	5.193	5.193
Entry Flow, veh/h	5	544	316	455	255
Cap Entry Lane, veh/h	824	824	1130	1124	1124
Entry HV Adj Factor	1.000	0.980	0.980	0.980	0.980
Flow Entry, veh/h	5	533	310	446	250
Cap Entry, veh/h	824	807	1108	1102	1102
V/C Ratio	0.006	0.660	0.280	0.405	0.227
Control Delay, s/veh	4.4	16.0	5.9	7.5	5.4
LOS	A	C	A	A	A
95th %tile Queue, veh	0	5	1	2	1

Intersection	
Intersection Delay, s/veh	8.8
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	0	1	2
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	304	0	10	451
Demand Flow Rate, veh/h	310	0	10	460
Vehicles Circulating, veh/h	460	315	759	0
Vehicles Exiting, veh/h	0	454	11	315
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	11.2	0.0	7.1	7.3
Approach LOS	B	-	A	A

Lane	Left	Left	Left	Right
Designated Moves	LTR	TR	L	TR
Assumed Moves	LTR	TR	L	TR
RT Channelized				
Lane Util	1.000	1.000	0.976	0.024
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	310	10	449	11
Cap Entry Lane, veh/h	713	529	1130	1130
Entry HV Adj Factor	0.981	0.990	0.980	0.980
Flow Entry, veh/h	304	10	440	11
Cap Entry, veh/h	700	524	1107	1108
V/C Ratio	0.435	0.019	0.397	0.010
Control Delay, s/veh	11.2	7.1	7.4	3.3
LOS	B	A	A	A
95th %tile Queue, veh	2	0	2	0

Intersection	
Intersection Delay, s/veh	6.3
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	0	2	2	2
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	0	364	130	581
Demand Flow Rate, veh/h	0	371	133	592
Vehicles Circulating, veh/h	376	133	0	5
Vehicles Exiting, veh/h	221	0	376	499
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	7.7	4.3	6.0
Approach LOS	-	A	A	A

Lane	Left	Right	Left	Left	Right
Designated Moves	LT	R	LT	LT	R
Assumed Moves	LT	R	LT	LT	R
RT Channelized					
Lane Util	0.013	0.987	1.000	0.627	0.373
Critical Headway, s	5.193	5.193	5.193	5.193	5.193
Entry Flow, veh/h	5	366	133	371	221
Cap Entry Lane, veh/h	989	989	1130	1124	1124
Entry HV Adj Factor	1.000	0.981	0.980	0.980	0.982
Flow Entry, veh/h	5	359	130	364	217
Cap Entry, veh/h	989	970	1108	1102	1104
V/C Ratio	0.005	0.370	0.118	0.330	0.197
Control Delay, s/veh	3.7	7.7	4.3	6.5	5.0
LOS	A	A	A	A	A
95th %tile Queue, veh	0	2	0	1	1

Intersection	
Intersection Delay, s/veh	6.4
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	0	1	2
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	130	0	10	364
Demand Flow Rate, veh/h	133	0	10	371
Vehicles Circulating, veh/h	371	138	499	0
Vehicles Exiting, veh/h	0	371	5	138
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	6.5	0.0	5.5	6.4
Approach LOS	A	-	A	A

Lane	Left	Left	Left	Right
Designated Moves	LTR	TR	L	TR
Assumed Moves	LTR	TR	L	TR
RT Channelized				
Lane Util	1.000	1.000	0.987	0.013
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	133	10	366	5
Cap Entry Lane, veh/h	780	686	1130	1130
Entry HV Adj Factor	0.977	0.990	0.981	0.980
Flow Entry, veh/h	130	10	359	5
Cap Entry, veh/h	762	679	1108	1108
V/C Ratio	0.171	0.015	0.324	0.004
Control Delay, s/veh	6.5	5.5	6.4	3.3
LOS	A	A	A	A
95th %tile Queue, veh	1	0	1	0

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	0	0	80	0	70	0
Future Volume (vph)	0	0	80	0	70	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.0	4.0	
Lane Util. Factor			0.95	0.95	1.00	
Frt			1.00	1.00	1.00	
Flt Protected			0.95	0.95	0.95	
Satd. Flow (prot)			1681	1681	1770	
Flt Permitted			0.95	0.95	0.95	
Satd. Flow (perm)			1681	1681	1770	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	87	0	76	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	43	44	76	0
Turn Type			Split	NA	Perm	
Protected Phases			4	4		
Permitted Phases					6	
Actuated Green, G (s)			6.0	6.0	46.0	
Effective Green, g (s)			6.0	6.0	46.0	
Actuated g/C Ratio			0.10	0.10	0.77	
Clearance Time (s)			4.0	4.0	4.0	
Vehicle Extension (s)			3.0	3.0	3.0	
Lane Grp Cap (vph)			168	168	1357	
v/s Ratio Prot			0.03	c0.03		
v/s Ratio Perm					c0.04	
v/c Ratio			0.26	0.26	0.06	
Uniform Delay, d1			24.9	25.0	1.7	
Progression Factor			1.00	1.00	0.97	
Incremental Delay, d2			0.8	0.8	0.1	
Delay (s)			25.7	25.8	1.7	
Level of Service			C	C	A	
Approach Delay (s)	0.0			25.8	1.7	
Approach LOS	A			C	A	

Intersection Summary			
HCM 2000 Control Delay	14.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.08		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	36.7%	ICU Level of Service	A
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	170	0	0	0	0	70	320	0	80	0
Future Volume (vph)	0	0	170	0	0	0	0	70	320	0	80	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0	4.0		4.0	
Lane Util. Factor		0.95	0.95					0.95	1.00		0.95	
Frt		0.85	0.85					1.00	0.85		1.00	
Flt Protected		1.00	1.00					1.00	1.00		1.00	
Satd. Flow (prot)		1504	1504					3539	1583		3539	
Flt Permitted		1.00	1.00					1.00	1.00		1.00	
Satd. Flow (perm)		1504	1504					3539	1583		3539	
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	185	0	0	0	0	76	348	0	87	0
RTOR Reduction (vph)	0	84	83	0	0	0	0	0	81	0	0	0
Lane Group Flow (vph)	0	9	9	0	0	0	0	76	267	0	87	0
Turn Type		NA	Perm					NA	Perm	Perm	NA	
Protected Phases		8						6			2	
Permitted Phases	8		8						6	2		
Actuated Green, G (s)		6.0	6.0					46.0	46.0		46.0	
Effective Green, g (s)		6.0	6.0					46.0	46.0		46.0	
Actuated g/C Ratio		0.10	0.10					0.77	0.77		0.77	
Clearance Time (s)		4.0	4.0					4.0	4.0		4.0	
Vehicle Extension (s)		3.0	3.0					3.0	3.0		3.0	
Lane Grp Cap (vph)		150	150					2713	1213		2713	
v/s Ratio Prot		c0.01						0.02			0.02	
v/s Ratio Perm			0.01						c0.17			
v/c Ratio		0.06	0.06					0.03	0.22		0.03	
Uniform Delay, d1		24.5	24.4					1.7	2.0		1.7	
Progression Factor		1.00	1.00					1.00	1.00		0.10	
Incremental Delay, d2		0.2	0.2					0.0	0.4		0.0	
Delay (s)		24.6	24.6					1.7	2.4		0.2	
Level of Service		C	C					A	A		A	
Approach Delay (s)		24.6			0.0			2.3			0.2	
Approach LOS		C			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.20		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	36.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	7.0
Intersection LOS	A

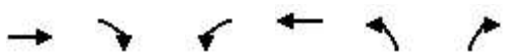
Approach	EB	WB	NB	SB
Entry Lanes	0	2	2	2
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	0	385	239	565
Demand Flow Rate, veh/h	0	393	244	576
Vehicles Circulating, veh/h	404	244	0	5
Vehicles Exiting, veh/h	177	0	404	632
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	9.5	5.2	6.2
Approach LOS	-	A	A	A

Lane	Left	Right	Left	Left	Right
Designated Moves	LT	R	LT	LT	R
Assumed Moves	LT	R	LT	LT	R
RT Channelized					
Lane Util	0.013	0.987	1.000	0.693	0.307
Critical Headway, s	5.193	5.193	5.193	5.193	5.193
Entry Flow, veh/h	5	388	244	399	177
Cap Entry Lane, veh/h	885	885	1130	1124	1124
Entry HV Adj Factor	1.000	0.979	0.980	0.980	0.983
Flow Entry, veh/h	5	380	239	391	174
Cap Entry, veh/h	885	867	1108	1102	1105
V/C Ratio	0.006	0.438	0.216	0.355	0.157
Control Delay, s/veh	4.1	9.5	5.2	6.8	4.7
LOS	A	A	A	A	A
95th %tile Queue, veh	0	2	1	2	1

Intersection	
Intersection Delay, s/veh	7.4
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	0	1	2
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	239	0	10	397
Demand Flow Rate, veh/h	244	0	10	405
Vehicles Circulating, veh/h	405	249	638	0
Vehicles Exiting, veh/h	0	399	11	249
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	8.8	0.0	6.3	6.6
Approach LOS	A	-	A	A

Lane	Left	Left	Left	Right
Designated Moves	LTR	TR	L	TR
Assumed Moves	LTR	TR	L	TR
RT Channelized				
Lane Util	1.000	1.000	0.973	0.027
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	244	10	394	11
Cap Entry Lane, veh/h	754	597	1130	1130
Entry HV Adj Factor	0.980	0.990	0.980	0.980
Flow Entry, veh/h	239	10	386	11
Cap Entry, veh/h	738	591	1107	1108
V/C Ratio	0.324	0.017	0.349	0.010
Control Delay, s/veh	8.8	6.3	6.7	3.3
LOS	A	A	A	A
95th %tile Queue, veh	1	0	2	0



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	0	0	230	0	180	0
Future Volume (vph)	0	0	230	0	180	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.0	4.0	
Lane Util. Factor			0.95	0.95	1.00	
Frt			1.00	1.00	1.00	
Flt Protected			0.95	0.95	0.95	
Satd. Flow (prot)			1681	1681	1770	
Flt Permitted			0.95	0.95	0.95	
Satd. Flow (perm)			1681	1681	1770	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	250	0	196	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	125	125	196	0
Turn Type			Perm	NA	Perm	
Protected Phases				4		
Permitted Phases			4		2	
Actuated Green, G (s)			8.8	8.8	43.2	
Effective Green, g (s)			8.8	8.8	43.2	
Actuated g/C Ratio			0.15	0.15	0.72	
Clearance Time (s)			4.0	4.0	4.0	
Vehicle Extension (s)			3.0	3.0	3.0	
Lane Grp Cap (vph)			246	246	1274	
v/s Ratio Prot						
v/s Ratio Perm			c0.07	0.07	c0.11	
v/c Ratio			0.51	0.51	0.15	
Uniform Delay, d1			23.6	23.6	2.6	
Progression Factor			1.00	1.00	0.86	
Incremental Delay, d2			1.7	1.7	0.3	
Delay (s)			25.3	25.3	2.5	
Level of Service			C	C	A	
Approach Delay (s)	0.0			25.3	2.5	
Approach LOS	A			C	A	

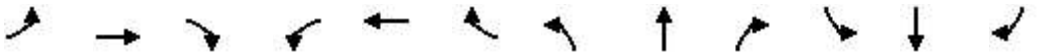
Intersection Summary			
HCM 2000 Control Delay	15.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.21		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	23.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	120	0	0	0	0	180	60	0	230	0
Future Volume (vph)	0	0	120	0	0	0	0	180	60	0	230	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0	4.0		4.0	
Lane Util. Factor		0.95	0.95					0.95	1.00		0.95	
Frt		0.85	0.85					1.00	0.85		1.00	
Flt Protected		1.00	1.00					1.00	1.00		1.00	
Satd. Flow (prot)		1504	1504					3539	1583		3539	
Flt Permitted		1.00	1.00					1.00	1.00		1.00	
Satd. Flow (perm)		1504	1504					3539	1583		3539	
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	130	0	0	0	0	196	65	0	250	0
RTOR Reduction (vph)	0	55	55	0	0	0	0	0	18	0	0	0
Lane Group Flow (vph)	0	10	10	0	0	0	0	196	47	0	250	0
Turn Type		NA	Perm					NA	Perm	Perm	NA	
Protected Phases		8						2			6	
Permitted Phases	8		8						2	6		
Actuated Green, G (s)		8.8	8.8					43.2	43.2		43.2	
Effective Green, g (s)		8.8	8.8					43.2	43.2		43.2	
Actuated g/C Ratio		0.15	0.15					0.72	0.72		0.72	
Clearance Time (s)		4.0	4.0					4.0	4.0		4.0	
Vehicle Extension (s)		3.0	3.0					3.0	3.0		3.0	
Lane Grp Cap (vph)		220	220					2548	1139		2548	
v/s Ratio Prot		c0.01						0.06			c0.07	
v/s Ratio Perm			0.01						0.03			
v/c Ratio		0.04	0.04					0.08	0.04		0.10	
Uniform Delay, d1		22.0	22.0					2.5	2.4		2.5	
Progression Factor		1.00	1.00					1.00	1.00		0.80	
Incremental Delay, d2		0.1	0.1					0.1	0.1		0.1	
Delay (s)		22.1	22.1					2.5	2.5		2.1	
Level of Service		C	C					A	A		A	
Approach Delay (s)		22.1			0.0			2.5			2.1	
Approach LOS		C			A			A			A	

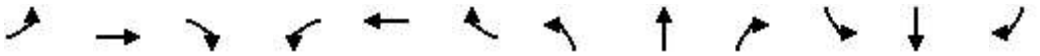
Intersection Summary			
HCM 2000 Control Delay	6.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.09		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	23.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



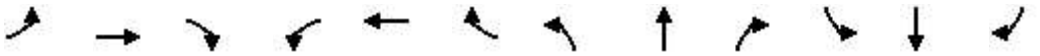
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	200	100	150	60	100	20	330	40	50	20	50	110
Future Volume (vph)	200	100	150	60	100	20	330	40	50	20	50	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.91		1.00	0.97		1.00	0.92		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3221		1770	3450		1770	3244		1770	3173	
Flt Permitted	0.67	1.00		0.58	1.00		0.64	1.00		0.69	1.00	
Satd. Flow (perm)	1246	3221		1088	3450		1196	3244		1287	3173	
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)	217	109	163	65	109	22	359	43	54	22	54	120
RTOR Reduction (vph)	0	105	0	0	14	0	0	29	0	0	64	0
Lane Group Flow (vph)	217	167	0	65	117	0	359	68	0	22	110	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	16.0	16.0		16.0	16.0		21.0	21.0		21.0	21.0	
Effective Green, g (s)	16.0	16.0		16.0	16.0		21.0	21.0		21.0	21.0	
Actuated g/C Ratio	0.36	0.36		0.36	0.36		0.47	0.47		0.47	0.47	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	443	1145		386	1226		558	1513		600	1480	
v/s Ratio Prot		0.05			0.03			0.02			0.03	
v/s Ratio Perm	c0.17			0.06			c0.30			0.02		
v/c Ratio	0.49	0.15		0.17	0.10		0.64	0.05		0.04	0.07	
Uniform Delay, d1	11.3	9.9		9.9	9.7		9.1	6.5		6.5	6.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.8	0.3		0.9	0.2		5.6	0.1		0.1	0.1	
Delay (s)	15.2	10.1		10.9	9.8		14.8	6.6		6.6	6.7	
Level of Service	B	B		B	A		B	A		A	A	
Approach Delay (s)		12.4			10.2			13.0			6.7	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	11.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	45.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



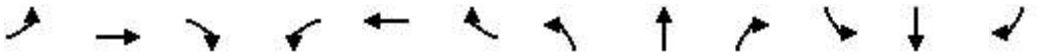
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	180	100	300	20	160	20	160	30	50	20	50	200
Future Volume (vph)	180	100	300	20	160	20	160	30	50	20	50	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.89		1.00	0.98		1.00	0.91		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3141		1770	3480		1770	3210		1770	3114	
Flt Permitted	0.63	1.00		0.50	1.00		0.58	1.00		0.70	1.00	
Satd. Flow (perm)	1171	3141		930	3480		1089	3210		1300	3114	
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)	196	109	326	22	174	22	174	33	54	22	54	217
RTOR Reduction (vph)	0	196	0	0	13	0	0	32	0	0	130	0
Lane Group Flow (vph)	196	239	0	22	183	0	174	55	0	22	141	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	16.0	16.0		16.0	16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)	16.0	16.0		16.0	16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio	0.40	0.40		0.40	0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	468	1256		372	1392		435	1284		520	1245	
v/s Ratio Prot		0.08			0.05			0.02			0.05	
v/s Ratio Perm	c0.17			0.02			c0.16			0.02		
v/c Ratio	0.42	0.19		0.06	0.13		0.40	0.04		0.04	0.11	
Uniform Delay, d1	8.6	7.8		7.4	7.6		8.6	7.3		7.3	7.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.7	0.3		0.3	0.2		2.7	0.1		0.2	0.2	
Delay (s)	11.4	8.1		7.7	7.8		11.3	7.4		7.5	7.7	
Level of Service	B	A		A	A		B	A		A	A	
Approach Delay (s)		9.1			7.8			10.0			7.7	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	45.8%	ICU Level of Service	A
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)	200	100	250	20	140	20	390	40	40	20	70	130
Future Volume (vph)	200	100	250	20	140	20	390	40	40	20	70	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.89		1.00	0.98		1.00	0.93		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3160		1770	3472		1770	3274		1770	3194	
Flt Permitted	0.64	1.00		0.52	1.00		0.62	1.00		0.70	1.00	
Satd. Flow (perm)	1196	3160		964	3472		1147	3274		1301	3194	
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)	217	109	272	22	152	22	424	43	43	22	76	141
RTOR Reduction (vph)	0	185	0	0	15	0	0	21	0	0	68	0
Lane Group Flow (vph)	217	196	0	22	159	0	424	65	0	22	149	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	16.0	16.0		16.0	16.0		26.0	26.0		26.0	26.0	
Effective Green, g (s)	16.0	16.0		16.0	16.0		26.0	26.0		26.0	26.0	
Actuated g/C Ratio	0.32	0.32		0.32	0.32		0.52	0.52		0.52	0.52	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	382	1011		308	1111		596	1702		676	1660	
v/s Ratio Prot		0.06			0.05			0.02			0.05	
v/s Ratio Perm	c0.18			0.02			c0.37			0.02		
v/c Ratio	0.57	0.19		0.07	0.14		0.71	0.04		0.03	0.09	
Uniform Delay, d1	14.1	12.3		11.8	12.1		9.1	5.9		5.9	6.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.0	0.4		0.4	0.3		7.1	0.0		0.1	0.1	
Delay (s)	20.1	12.8		12.3	12.4		16.2	5.9		5.9	6.1	
Level of Service	C	B		B	B		B	A		A	A	
Approach Delay (s)		15.4			12.4			14.5			6.1	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	13.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
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)	200	140	420	20	160	20	300	40	60	20	50	180
Future Volume (vph)	200	140	420	20	160	20	300	40	60	20	50	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.89		1.00	0.98		1.00	0.91		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3141		1770	3480		1770	3220		1770	3123	
Flt Permitted	0.63	1.00		0.36	1.00		0.60	1.00		0.68	1.00	
Satd. Flow (perm)	1171	3141		673	3480		1112	3220		1274	3123	
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)	217	152	457	22	174	22	326	43	65	22	54	196
RTOR Reduction (vph)	0	295	0	0	14	0	0	35	0	0	105	0
Lane Group Flow (vph)	217	314	0	22	182	0	326	73	0	22	145	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	16.0	16.0		16.0	16.0		21.0	21.0		21.0	21.0	
Effective Green, g (s)	16.0	16.0		16.0	16.0		21.0	21.0		21.0	21.0	
Actuated g/C Ratio	0.36	0.36		0.36	0.36		0.47	0.47		0.47	0.47	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	416	1116		239	1237		518	1502		594	1457	
v/s Ratio Prot		0.10			0.05			0.02			0.05	
v/s Ratio Perm	c0.19			0.03			c0.29			0.02		
v/c Ratio	0.52	0.28		0.09	0.15		0.63	0.05		0.04	0.10	
Uniform Delay, d1	11.5	10.4		9.7	9.9		9.1	6.5		6.5	6.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.6	0.6		0.8	0.3		5.7	0.1		0.1	0.1	
Delay (s)	16.1	11.0		10.4	10.1		14.8	6.6		6.6	6.8	
Level of Service	B	B		B	B		B	A		A	A	
Approach Delay (s)		12.3			10.1			12.7			6.8	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	11.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	45.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	57.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			