

# Central District Freeway Frontage Road Traffic Control Study

## FINAL REPORT

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Submitted to:



Submitted by:

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INTERNATIONAL

*Table of Contents*

**EXECUTIVE SUMMARY..... 3**

**CHAPTER 1 INTRODUCTION..... 6**

    NEED AND PURPOSE OF THE STUDY .....6

    STUDY OBJECTIVES .....6

    STUDY AREA .....7

    BACKGROUND AND HISTORY .....10

    STUDY PROCESS .....10

**CHAPTER 2 STAKEHOLDER INVOLVEMENT.....12**

**CHAPTER 3 NATIONWIDE SURVEY OF BEST PRACTICES .....13**

    STATES IDENTIFIED FOR THIS BEST PRACTICES SURVEY .....13

    BEST PRACTICES SURVEY QUESTIONS .....13

    BEST PRACTICE SURVEY FINDINGS.....17

**CHAPTER 4 CURRENT CONDITIONS .....22**

    ROADWAY TYPE .....23

    NUMBER OF LANES.....23

    SPEED LIMITS.....24

    NON-MOTORIZED TRANSPORTATION MOBILITY .....25

*Existing Bicycle Lanes.....25*

*Existing Pedestrian Facilities.....25*

    EXISTING TRAFFIC CONTROL.....26

*Existing Signs along Frontage Roads.....26*

*Existing Pavement Marking along Frontage Road.....27*

    PHYSICAL OBSTRUCTION TO SIGHT DISTANCE.....27

    DISTANCE BETWEEN THE GORE POINT OF EXIT RAMP/FRONTAGE ROAD CONVERGENCE AND ARTERIAL STREET .....30

    EXISTING DRIVEWAYS BETWEEN GORE POINT AND ARTERIAL STREET.....31

    CRASH ANALYSIS .....31

    EXISTING TRAFFIC VOLUMES.....34

**CHAPTER 5 RAMP AND FRONTAGE ROAD TRAFFIC CONTROL GUIDELINES.....35**

    COMPLAINTS.....35

    CRASH ANALYSIS .....35

    SUMMARY AND RESULTS OF THE CRASH ANALYSIS.....41

*Overall Summary.....41*

*STOP Controlled Locations Summary.....41*

*YIELD Controlled Locations Summary.....41*

*NO Traffic Control Locations Summary.....41*

    RECOMMENDED TRAFFIC CONTROL .....42

    SIGN SIZE RECOMMENDATIONS.....45

    PLACEMENT OF SIGNS AND PAVEMENT MARKING RECOMMENDATIONS .....45

**CHAPTER 6 SPOT IMPROVEMENT LOCATIONS, ANALYSIS AND RECOMMENDATIONS .....48**

    ADDITIONAL SUGGESTED RECOMMENDATIONS TO IMPROVE SAFETY.....66

**List of Figures**

Figure 1: Study Area Context Map..... 9  
 Figure 2: Study Process.....11  
 Figure 3: Example of One-Way Frontage Road Best Practices for ARDOT.....18  
 Figure 4: Yield Signs along Frontage Road in Arkansas 712015.....18  
 Figure 5: Sample Data Collection Sheet .....23  
 Figure 6: Crashes by the Year.....33  
 Figure 7: Crashes along Frontage Road adjacent to each Freeway Facility.....33  
 Figure 8: Crashes by Injury Severity .....33  
 Figure 9: Crashes by Collision Manner.....34  
 Figure 10: Crashes by Lighting.....34  
 Figure 11: Flowchart of the Traffic Control Recommendations Along Frontage Roads .....44  
 Figure 12: Sign Placement for One Lane Frontage Road - Distance Between Striped Gore and Physical  
         Gore > than 50 feet .....45  
 Figure 13: Sign Placement for One Lane Frontage Road - Distance Between Striped Gore and Physical  
         Gore < than 50 feet .....46  
 Figure 14: Sign Placement for Two Lane Frontage Road - Distance Between Striped Gore and Physical  
         Gore > than 50 feet .....46  
 Figure 15: Sign Placement for Two Lane Frontage Road - Distance Between Striped Gore and Physical  
         Gore < than 50 feet .....47  
 Figure 16: Recommended Pavement Marking Schematic at I-17 and Grant Street SB Ramp.....62

**List of Tables**

Table 1: Technical Advisory Committee List .....12  
 Table 2: Summary of Survey Responses Received from State Agencies .....15  
 Table 3: Decision Sight Distance.....28  
 Table 4: Ranking of Locations by Various Categories .....38  
 Table 5: Overall Ranking of Locations by Weighted Average .....40

**List of Appendices**

Survey Results and Standards/Best Practices ..... A  
 Frontage Road Locations Data Sheets ..... B  
 Sign Codes and Images ..... C  
 Traffic Volumes ..... D  
 Complaints Log..... E

## EXECUTIVE SUMMARY

The Arizona Department of Transportation (ADOT) maintains and operates several freeway corridors in the Central District with parallel one-way frontage roads. ADOT has received numerous complaints from constituents regarding the use of “Stop” signs at certain locations vs the use of “Yield” signs at other similar locations along the same corridor. Constituents have also expressed frustration with drivers not respecting the existing traffic control (stop or yield). The use of the appropriate control would go a long way in commanding attention and respect to the type of control that is placed in advance of the junction point. Setting guidelines would be beneficial in establishing conformity with the type of control that would be used and or proposed.

There are specific guidelines and standards regarding control of access in the area of freeway ramps and crossroads when frontage roads are present yet there is little guidance on traffic control – specifically the use of yield versus stop-control versus no control on the frontage road approach to the junction point. In response to these concerns and observations, this study was commissioned to establish a set of traffic control guidelines at the exit ramp/frontage road junctions based on traffic volume, lane configuration, sight distance, speeds, distance from the exit ramp/frontage road junction to the cross street, crash history, and/or other factors. The guidelines also considered current practices that are deployed nationwide in similar locations. In order to properly consider the practices of others across the country, a best practice, peer agency survey was conducted with states that have one-way frontage roads incorporated into the freeway system. These states include: Texas, Minnesota, Wisconsin, Arkansas, Oklahoma, Colorado, Louisiana and New Mexico.

These frontage roads offer local circulation/access as well as alternate capacity during mainline incidents. In the ADOT Central District, there are limited or select portions for each mainline freeway facility that possess frontage roads that parallel the mainline freeway.

**Interstate 10** – there are a total of three locations along I-10 where the frontage road converges with the mainline exit ramp included in this study.

**Interstate 17** – there are a total of 48 locations along I-17 where the frontage road converges with the main line exit ramp included in this study.

**State Route 101** – there are a total of 36 locations along SR 101 where the frontage road converges with the main line exit ramp included in this study.

**State Route 202** – there are two locations along SR 202 where the frontage road converges with the main line exit ramp included in this study.

Collectively, this study evaluated approximately 106 miles of frontage roads that contain 89 ramp/frontage road convergence locations in the ADOT Central District.

Major elements that represent the freeway frontage road/ramp conditions including roadway type, number of lanes, speed limits, motorized/non-motorized transportation modes, existing traffic control, distance between gore and arterial street intersection, presence of driveways along the Central District Frontage Roads are documented by conducting field reviews. Crash data and traffic volumes were

obtained from ADOT public records and ADOT Transportation Data Management Systems (TDMS) website respectively.

Crashes within 300 feet upstream and downstream of the physical gore where frontage road merges with the exit ramp and the arterial street intersection were used for the analysis. Engineering judgement was used to determine the crashes that are closer to the arterial street intersection that could have been caused due to the weaving/merging maneuver to be used in the analysis. Segment crash rates were calculated using the number of crashes and traffic volumes obtained from ADOT TDMS.

Crash rate factor (crash rate\*AADT/weave length) was calculated for each study area location. Weave length is defined as the distance between the tip of the striped gore and the start of the solid white lane line approaching the intersection.

Each study area location was ranked based number of crashes (by decreasing number of crashes), crash rate (by decreasing crash rate), weave length (by increasing weave length) and R-factor (by increasing R factor).

Based on the crash analysis, 20 of the top 25 highest crash rate locations had a weave length of less than 300 feet and 23 of the top 25 highest crash rate locations had YIELD signs. In contrast to the top 25 highest crash rates, only 8 of the bottom 25 crash rate locations had a weave length of less than 300 feet and only 12 of the bottom 25 crash rate intersections had YIELD signs. These findings reflect a distinct correlation between the weave length, traffic control and the crash rates.

Further analysis was performed to determine the ranking of each location by comparing each individual ranking criteria, termed as “Weighted Average”, a point system that was created for each criterion, i.e., number of crashes, crash rates, weave length and R-factor.

Based on the crash analysis, it was concluded that the locations with YIELD signs with weave lengths less than 300 feet had the highest ranking. Locations with YIELD signs and weave lengths greater than 1,000 feet ranked the lowest for crash rates.

Utilizing the rankings of the frontage road/exit ramp convergence locations based on the weave length, the majority of the existing data suggests that STOP control is the most effective control for weave lengths of less than 250 feet. The data also suggests that weave lengths greater than 350 feet benefit from the application of a NO Control.

A STOP sign in association with a STOP bar is a strong indication that vehicles must STOP. As drivers are not required to come to complete stop at a YIELD sign, at locations with multiple maneuvers and longer weave distances, a false sense of security is found among drivers on the merging lanes that do not have the YIELD control. Therefore, based on discussions and policy guidance with ADOT, YIELD signs are not recommended as recommended traffic control as part of this project. Ultimately, the crash analysis, MUTCD/AASHTO guidance and policy inputs from ADOT and the TAC were utilized to create a flowchart

illustrating the sequencing of steps/considerations for determining the recommended traffic control for one lane and two-lane frontage roads in the ADOT Central District. Please see **Figure 11** for additional information on how to apply the flowchart to determine the recommended frontage road traffic control.

Based on a review of the crash analysis and complaint log, together with discussions and guidance from ADOT staff, the following top ten locations within the Central District with the highest number of crashes were selected for the spot improvement analysis:

1. SR 101 and Broadway Road; southbound direction,
2. SR 101 and University Drive; northbound direction,
3. SR 101 and Broadway Road; northbound direction,
4. I-17 and Peoria Avenue; southbound direction,
5. SR 101 and 27<sup>th</sup> Avenue; eastbound direction,
6. SR 101 and 67<sup>th</sup> Avenue; westbound direction,
7. SR 101 and Southern Avenue; southbound direction,
8. I-17 and Grant Street; southbound direction,
9. SR 101 and Ray Road; southbound direction, and
10. SR 101 and 35<sup>th</sup> Avenue; eastbound direction.

Traffic control recommendations at each of the spot improvement locations are included in **Chapter 6: Spot Improvement Locations, Analysis and Recommendations**.

## Chapter 1 INTRODUCTION

### Need and Purpose of the Study

The Arizona Department of Transportation (ADOT) maintains and operates several freeway corridors in the Central District with parallel one-way frontage roads. These frontage roads offer local circulation/access as well as alternate capacity during mainline incidents. There are specific guidelines and standards regarding control of access in the area of freeway ramps and crossroads when frontage roads are present yet there is little guidance on traffic control – specifically the use of yield versus stop-control versus no control on the frontage road approach to the junction point. Phoenix has several frontage roads along various freeway segments and there are differences in traffic control due to geometry and traffic volume. Though their numbers are not substantial, there has been an increasing number of driver inquiries and/or complaints received by ADOT. These inquiries and/or complaints reflect a general confusion or frustration with differences or variations in traffic control devices employed at different frontage road/main line ramp convergence locations in the ADOT Central District. Often times these driver inquiries/complaints arise from witnessing other drivers' behaviors in these areas, and as a by-product, the evaluation of the variations in traffic control devices employed at different frontage road/ramp convergence areas that may influence driving behavior at these locations. In response to these concerns and observations, this study was commissioned to establish additional/clarifying policy guidance to effectuate a more consistent application and administration of traffic control measures for these frontage road/main line ramp confluence areas currently and for future conditions.

ADOT has received numerous complaints from constituents regarding the use of “Stop” signs at certain locations vs the use of “Yield” signs at other similar locations along the same corridor. Constituents have also expressed frustration with drivers not respecting the existing traffic control (stop or yield). The use of the appropriate control would go a long way in commanding attention and respect to the type of control that is placed in advance of the junction point. Setting guidelines would go a long way in establishing conformity with the type of control that would be used and or proposed. This project establishes a set of traffic control guidelines based on traffic volume, lane configuration, sight distance, speeds, distance from the exit ramp/frontage road junction to the cross street, crash history, and/or other factors. Today, there are no such guidelines and ADOT reviews and administers traffic control measures on a case by case basis. These guidelines will afford ADOT the enhanced ability to have a more consistent application of traffic control measures for a wide variety of frontage road/main line ramp confluence design conditions. The study also includes detailed recommendations for spot implementation projects for select priority locations in the Central District as to the type of control, traffic signing recommendations (type of sign, location, size etc.), and pavement marking recommendations.

### Study Objectives

The goals and objectives of this study are to establish guidelines on the appropriate type of traffic control to be used at the exit ramp/frontage road junctions. The guidelines shall also consider current practices that are deployed nationwide in similar locations. In order to properly consider the practices of others

across the country, a best practice, peer agency survey was conducted with states that have one-way frontage roads incorporated into the freeway system.

More specifically, the Technical Advisory Committee (TAC) overseeing this project identified and agreed upon the following objectives (in no particular order of importance) for this project:

- 1) To review the current practices that are deployed nationwide in similar locations where one-way frontage roads exist.
- 2) To establish guidelines on the appropriate type of traffic control; traffic signing recommendations (type of sign, location, size etc.), and pavement marking recommendations; to be used at the ramp/frontage road junctions.
- 3) The guidelines should be based on inputs such as: traffic volume, lane configuration, sight distance, speeds, distance from the off ramp/frontage road junction to the cross street, crash history, and/or other factors, as appropriate and as data is available.
- 4) The guidelines will result in a more consistent application of traffic control measures that will be less dependent on subjective review by ADOT staff.
- 5) The guidelines established in this study shall be distributed to the various design build projects that are in progress along various Central District Freeways.
- 6) Evaluate appropriate locations for the possible striping of bike and pedestrian facilities along certain frontage roads for frontage roads maintained by the City of Phoenix.
- 7) Obtain stakeholder and advisory committee input early and throughout the entire study process.

## Study Area

The project study area includes all locations in ADOT's Central District where existing frontage roads along mainline freeways converge with the mainline freeway exit ramps. There are limited or select portions for each mainline freeway facility that possess frontage roads that parallel the mainline freeway. Please see **Figure 1, Study Area Context Map** for additional information. More specifically, the locations identified for this study include:

**Interstate 10 (I-10):** There is a limited use of frontage roads currently along Interstate 10 within the ADOT Central District. There is approximately one mile of frontage road (both sides of the freeway) along I-10 between Washington Street and Sky Harbor Circle. Another one-mile section of frontage road in both directions is located between 99<sup>th</sup> Avenue to 107<sup>th</sup> Avenue in the west Valley. There are a total of three locations along I-10 where the frontage road converges with the mainline exit ramp included in this study.

**Interstate 17 (I-17)** The vast majority of Interstate 17 within the ADOT Central District has frontage roads that parallel both side of the freeway. Approximately 52 miles of frontage roads (both sides of the freeway) exists along I-17 between Dixileta Drive to the north to 16<sup>th</sup> Street to the south. There are a total of 48 locations along I-17 where the frontage road converges with the main line exit ramp included in this study.

**State Route 101 (SR 101)** Frontage roads along SR 101 are located in various locations and increments in the Central District. There are approximately 30 miles of frontage road (both sides of the freeway) along SR 101 at the following locations:

- Between Union Hills and Cave Creek Road,
- Between Scottsdale Road and Hayden Road,
- Between Pima Road and Thunderbird Road, and
- Between SR 202 (Red Mountain Freeway) and SR 202 (Santan Freeway)

In total, there are a total of 36 locations along SR 101 where the frontage road converges with the main line exit ramp included in this study.

**State Route 202 (SR 202)** There are currently just two short segments along SR 202 where frontage roads exist adjacent to the mainline. The first is just two miles of frontage road (both sides of the freeway) along SR 202. This area is located between University Drive and Broadway Road. The second is a very short (approximately ½ mile) segment between 40<sup>th</sup> Street and 44<sup>th</sup> Street. In total, there are two locations along SR 202 where the frontage road converges with the main line exit ramp included in this study.

Collectively, the ADOT Central District currently has (and this study therefore evaluated) a total of approximately 106 miles of frontage roads that contain 89 ramp/frontage road convergence locations.

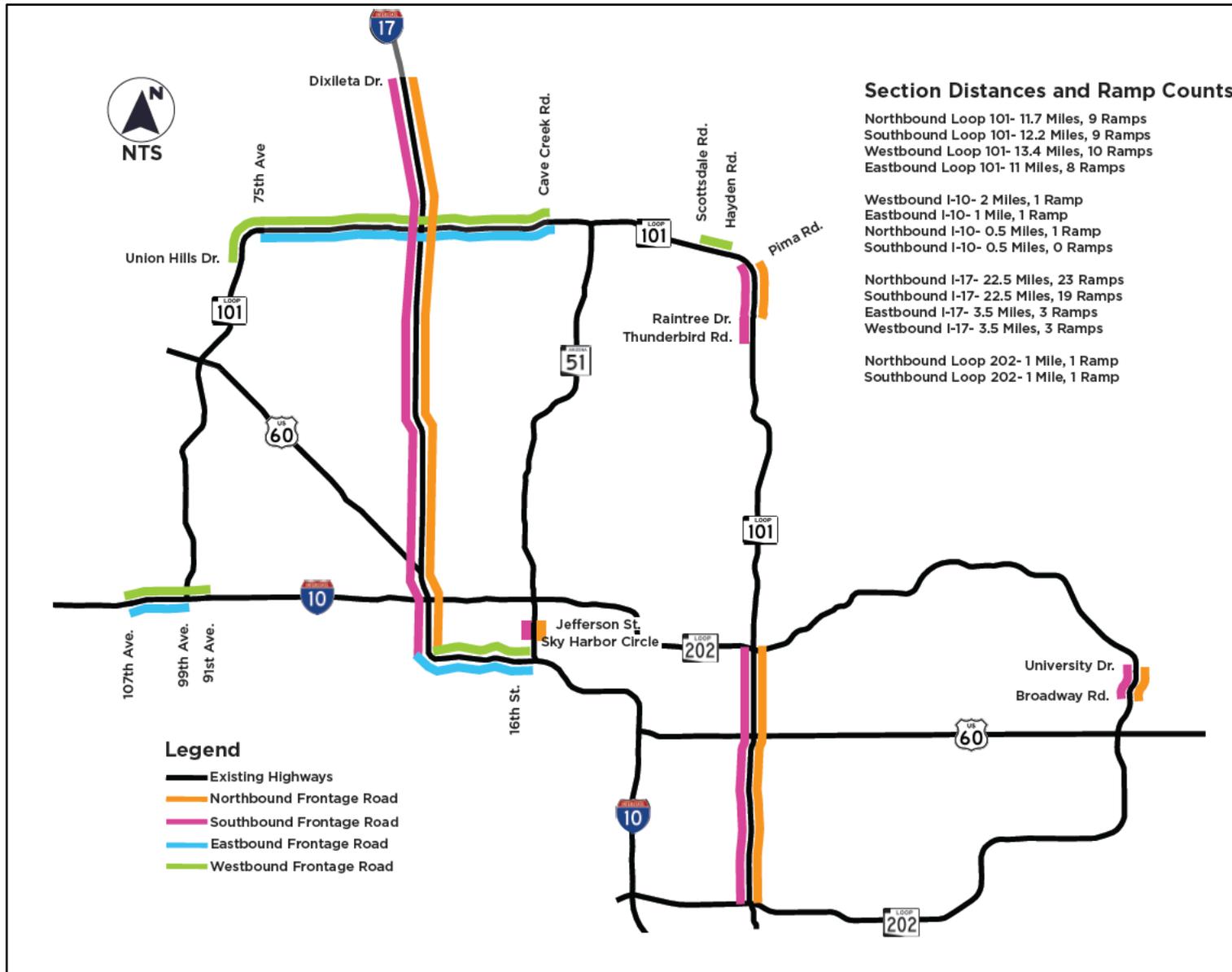


Figure 1: Study Area Context Map

## Background and History

This project represents a first of its kind for ADOT – in developing a traffic control guideline document specifically targeting areas where frontage roads converge with main line exit ramps. ADOT identified the need to conduct this study to achieve the objectives that are described in detail above.

ADOT desired to institute a set of traffic control guidelines to establish added continuity in the review and administration of current and future conditions. Within the ADOT Central District, there are currently (or soon to be) highway improvement projects that will impact the design of the gore at the ramp-frontage road confluence areas. These proposed traffic control design guidelines will help offer new guidance on the appropriate design of these facilities.

In addition to utilizing the traffic control guidelines for informing planned highway expansion projects, this project also developed specific spot improvement recommendations for up to ten (10) existing frontage road/main line ramp convergence locations in the ADOT Central District. These priority spot improvement recommendations were identified and prioritized by the TAC and ADOT staff based on crash data analysis and those locations that receive the most inquiry/complaints to ADOT.

At the initiation of this project, ADOT, the TAC and the Consultant together identified a list of potential states that currently have similar roadway conditions with respect to currently having main line highway facilities in an urban setting that also have frontage roads converging with main line exit ramps. In our initial investigations and group discussions, it was determined that there were only a limited number of states that currently contain similar roadway features and conditions. Please refer to Chapter 3 for an in-depth description of this “Survey of Best Practices”.

As a key municipal stakeholder and TAC member in this process, the City of Phoenix expressed a desire to explore the possibility of incorporating potential bicycle and pedestrian facilities along frontage roads located within the City of Phoenix. The City of Phoenix has been promoting enhanced mobility and connectivity of all travel modes across the City and requested this project provide research on the best practices of other states and provide recommendations on the use and safety of bicycle and pedestrian facilities within these frontage road corridors.

## Study Process

**Figure 2** below depicts the milestone tasks and work products for this project and identifies the major milestones conducted over the course of this study process. The study process began with a scoping meeting with a diverse cross section of ADOT and other agency staff. The scoping meeting focused on setting the direction for the project, identifying, and refining the study area, key project objectives, identification of agency representatives for the TAC and preliminarily identifying state DOT’s to target for the nationwide benchmarking survey. Some of the key takeaways from that scoping meeting include:

1. There is a need to review and evaluate complaints received by ADOT on this issue. Crash data, while useful, is not as imperative to evaluate for the nature of this study.

2. Project deliverables will include the preparation of a set of traffic control guidelines for the Central District and providing specific traffic control countermeasure recommendations for up to 10 spot improvement locations.
3. As a technical study, there is less emphasis on broad public engagement. It was determined that the results of this study would be used to educate and inform stakeholder agencies and the general public on the results/recommendations brought forward from this study.
4. The City of Phoenix expressed a desire to evaluate the potential application of bicycle and pedestrian facilities along existing frontage roads.
5. The nature of this project does not require an environmental overview be conducted.
6. The group discussion preliminarily identified the states of Minnesota, Wisconsin, Texas, Arkansas, Oklahoma, and Louisiana as states that maintain frontage roads adjacent to mainline facilities and therefore to target for the benchmarking survey.

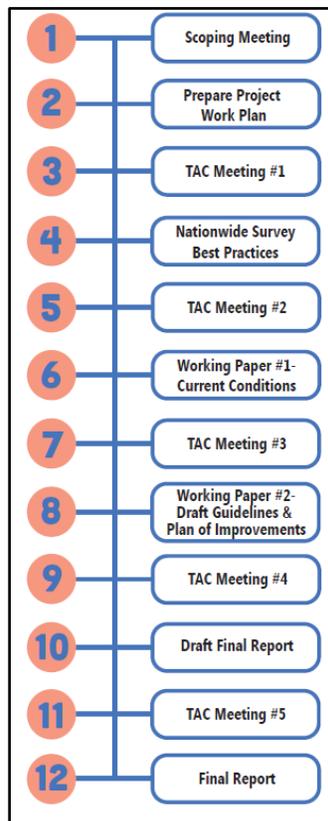


Figure 2: Study Process

## Chapter 2 STAKEHOLDER INVOLVEMENT

As previously noted, TAC members concluded that an extensive public involvement process is not necessary for this study. Rather, due to the technical nature of this study, stakeholders and design professionals are to be informed and educated by ADOT on the results of this study (access control guidelines/manual and suggested spot improvement locations) at the conclusion of the study.

A Technical Advisory Committee (TAC) was established to guide and coordinate the consultant’s efforts throughout the course of the Central District Freeway Frontage Road Traffic Control Study process. TAC input and oversight were instrumental to developing a plan that achieves the desired objectives. The TAC consists of transportation professionals from various agencies including Federal Highway Administration (FHWA), ADOT, Maricopa Association of Governments (MAG), City of Phoenix and various other cities where Central District frontage roads exists. The following agencies and individuals were included in the TAC for the Central District Freeway Frontage Road Traffic Control Study.

Table 1: Technical Advisory Committee List

AGENCY	CONTACT
AZ Dept. of Transportation	Jason Bottjen, Mark Hoffman Multimodal Planning Division, Project Managers
AZ Dept. of Transportation	Tony Abbo, ADOT TSMO
AZ Dept. of Transportation	George Williams, PE, PTOE, PTP
AZ Dept. of Transportation	Scott Brunner, PE
AZ Dept. of Transportation	Vahid Gofar, ADOT TSMO
AZ Dept. of Transportation	Scott Beck, ADOT TSMO
AZ Dept. of Transportation	Cedrick Woodard, ADOT Communications
FHWA	Toni Whitfield
City of Phoenix	Myesha Harris
City of Phoenix	Bruce Littleton
City of Phoenix	Thomas Remes
MAG	Bob Hazlett
MAG	Quinn Castro
City of Glendale	Debbie Albert
City of Chandler	Dana Alvidrez
City of Tempe	Julian Dresang, Catherine Hollow

## Chapter 3 NATIONWIDE SURVEY OF BEST PRACTICES

This Nationwide Survey and Best Practices section was prepared to document the survey findings and adopted regulations, policies and/or best practices for Frontage Road traffic control in various states. To obtain the information from various states, an e-mail survey with a series of questions was developed and electronically distributed to states that have one-way frontage roads incorporated into the freeway system. Follow up telephone calls with agency representatives were also used to garner additional information to supplement the electronic surveys.

### States Identified for this Best Practices Survey

Guidance from the TAC and consultant research together identified states that possess the existence of one-way frontage roads adjacent to the main line freeway (many states do not). The following states were identified as State DOT's that were selected to be surveyed for this project:

1. Texas,
2. Minnesota,
3. Wisconsin,
4. Arkansas,
5. Oklahoma,
6. Colorado,
7. Louisiana, and
8. New Mexico.

### Best Practices Survey Questions

The TAC assisted the consultant in identifying the most relevant/beneficial information to seek in preparation of the survey questions. Based on that input and discussion, ten questions were developed, and the survey was electronically distributed to the states listed above. The survey questions used include:

1. Do you currently have one-way frontage roads along and/or adjacent to state, county, or local highways within your City/State?
2. If answered YES for question 1, do you have adopted standards/policies and/or best practices for traffic control where frontage roads merge with exit ramp?
3. If answered YES for question 2, what is the basis for the recommended traffic control?
  - a. Volume,
  - b. Sight Distance,
  - c. Speed,
  - d. Crashes,
  - e. Number of Lanes,
  - f. All of the above, or
  - g. Other (Specify)
4. Do you currently have any traffic calming elements/policies specific to locations where the frontage road merges with the exit ramp?
5. Do you currently have any pavement marking recommendations/policies specific to locations where the frontage road merges with the exit ramp?

6. What is the posted speed limit on the EXIT ramp that merge onto or with the frontage roads?
7. What is the posted speed limit on frontage road that have ramps merging into them?
8. If there are more than one lane on frontage road, do they merge the lanes in advance of the gore point?
9. Are there bike lanes on frontage road? If yes, what kind of traffic control do you use for the bike lanes?
10. If there are driveways in the vicinity of the frontage road merging with the exit ramp, what type of traffic control is used for the driveways? E.g.: One-way, right-turn only, wrong way, do not enter, no left-turns etc.

**Table 2** depicts the summary of responses obtained from the survey questions that were sent to various agencies. **Appendix A** includes the detailed listing of responses to the surveys that were received from the state agencies. Survey responses were not received from Wisconsin and Colorado.

Table 2: Summary of Survey Responses Received from State Agencies

Question No.	Summary of Survey Responses Received from State Agencies			
	Texas	Minnesota	Arkansas	Oklahoma
1	Yes, TxDOT has a very large inventory of continuous one way frontage roads that run adjacent to many interstate, US, and some state highways. They are located in primarily urban areas as well as in some rural areas.	Yes, example include I-94 through Saint Paul between Rice Street and Snelling Avenue	Yes, along Interstate routes	Yes
2	We do have a few manuals that are considered best practices, while the TMUTCD and our traffic engineering standard sheets are considered 'standards'. Figure 7-20 in our Sign Crew Field Book shows an example where we cut off a frontage road lane to give full access to exiting traffic. Figures 6-4 and 6-5 in the Freeway Signing Handbook show a few configurations also. In one of the configurations, a lane is added for the exiting ramp. Figures 5-1 and 5-2 in the Sign Guidelines and Applications Manual also show similar treatments. We make use of 'Do Not Cross Double White Line' signs to try to restrict merge movements where the exit ramp meets with the frontage road. We also deny access to adjacent property owners as described in Chapter 3, Section 6 of the Roadway Design Manual. Note that the Roadway Design Manual is managed out of a separate division within TxDOT.	Not specific to Frontage Roads	Yes	No
3	To be clear, the drawings in our traffic engineering manuals are mainly providing guidance on how to sign/strip various lane configurations for an exit ramp. They are not making recommendations on when to reduce a lane on the frontage road, use a deceleration lane, etc. The Roadway Design Manual gives recommendations in Table 3-16 of distance required between the exit ramp and any side streets/driveways, with a recommended 250' distance. The decision on lane movements/access is done by designer with engineering judgment.	N/A	All of the above	N/A
4	No, most frontage roads in Texas operate at higher speeds (50 mph or higher) except in highly urban areas where there are multiple side streets and intersection spacing is closer together.	Not specific to Frontage Roads	No	No
5	As mentioned previously, we often use a double white stripe for a distance of at least 80' to deter merging movements. Note that in many urban areas, the exit ramp essentially becomes a frontage road auxiliary lane where it will ultimately become an entrance ramp downstream. In these case, we usually stripe the lane with a dotted line instead of a broken white line and include 'Left Lane Must Enter Ramp' signs. We may also use left turn arrow and ONLY markings within the lane as further guidance. This treatment is similar to what is shown on our Freeway Pavement Markings (FPM) standards. Those standards are for mainlanes, but the striping on the frontage roads is the same.	No. Use typical MUTCD practices for striping.	Yes, directional arrows on pavement	No
6	We do not post separate regulatory speed limits on the exit ramp itself, but will post advisory speed limits if ramp geometrics necessitate it. We then install downstream speed limit signs on the frontage road to inform exiting traffic.	Varies by location and ramp design	Typically 40-45 MPH	45 mph or less (varies)
7	They are entirely based on the 85th percentile speed zone study, not based on the fact that an exit ramp is present. We have a separate manual, Procedures for Establishing Speed Zones, that defines this process.	Typically 30 mph. Statutory limits for local roads that meet the definition of Urban District is 30 mph. Urban district is defined in Minnesota Statute 169.14 as "the territory contiguous to and including any city street or town road that is built up with structures devoted to business, industry, or dwelling houses situated at intervals of less than 100 feet for a distance of a quarter of a mile or more." Depending on the amount and type of development, and driveway access, this could be higher say 35 to 40 mph in some locations.	45-55 MPH	45 mph or less (varies)
8	Yes, if we are giving the exit ramp one of the lanes on the frontage road. But in many cases, the exiting ramp will form a new lane on the frontage road that often becomes an auxiliary lane as described above. In rare instances, we do not create a new lane for the exit ramp and we install Yield signs and To Ramp plaques with yield triangle markings on the frontage road to give access to exiting traffic.	It would depend on the traffic analysis	Yes	Most of the frontage roads keep their lanes, and the exit lane continues to become a left-turn lane and/or U-turn
9	This would be a rare occurrence due to the fact most frontage roads are high speed and due to difficulties at intersections with turning movements.	Not sure if we have bike lanes on the MN examples, but if we did, we would use typical bike lane designs as the bike lanes would be on the right side of the frontage road.	No	Not aware of bike lanes on frontage roads
10	The typical treatment is a One-Way sign across from the driveway between the frontage road and mainlanes. Per memo issued in 2013, TxDOT should only be installing these when there is alternate access to the property from another street.	Driveways are not allowed between the cross street intersection and the gore area. Driveways are not restricted on the frontage road beyond the gore area where access is physical separated from the ramp. See Section 6-4 of the MnDOT Road Design Manual.	R6-2R One-Ways, Do Not Enter, Wrong Way, Red delineators along ramp, etc.	We use traffic control listed in your example: One-way, right-turn only, wrong way, do not enter, no left-turns etc

Table 2: Summary of Survey Responses Received from State Agencies (Continued)

Question No.	Summary of Answers to the Survey Question from various State Agency			
	Louisiana	New Mexico	Wisconsin	Colorado
1	Yes	Yes		
2	No. Traffic Control would be managed on a case by case basis with the objective to ensure that there is no back up on the ramp or other impact to the free flow speed on the Interstate. Our intent would be to either add a free flow lane on the frontage road, or an accelerations lane. If that is not possible, than we would have to control the traffic on the frontage road with either a stop control, signal control, or Yield. The traffic analysis would dictate the appropriate strategy.	No, each location is addressed individually		
3	The basis would be to not impact interstate free flow speed.	N/A		
4	No.	No Policies		
5	The MUTCD. We do have Pavement Marking Standards, but they are not specific to a frontage Road. The Frontage Road is like any other road and the Pavement Markings are as required. Any special pavement markings at the merge point (I.E. Shark Teeth For Yield Condition) would be added on case by case basis and those markings would follow MUTCD standards.	No		
6	We post an advisory speed on every exit ramp that is dependent on the ramp geometry.	Varies		
7	Normally designed for 45 mph for Urban and 50 mph for rural but also dependent on traffic analysis and roadway geometry.	Varies, but typically at 45 MPH		
8	That is an appropriate strategy but the Access Management Policy requires an added lane for the exit ramp volume so merging frontage traffic to one lane may not be required.	Not necessarily		
9	Complete Street Policy requires that all projects be evaluated for complete street elements. The appropriate facility is dependent on the local bike and Ped Plan. In the absence of a plan, a minimum facility on a new frontage road would be a 4 ft. shoulder. On a rehab project, restriping the roadway to create space for complete street elements may be considered.	I don't recall of any bike lanes at this time		
10	One-way frontage roads would require a right in- right out driveway. The spacing requirements are outlined in our Control Access Policy.	There could be driveways but State Access manual sets the parameters for the distance to the merge or intersections		

## Best Practice Survey Findings

As mentioned in the *Purpose of Nation-Wide Survey of Best Practices* section, the adopted regulations, policies and/or best practices for frontage road traffic control in various states was researched and obtained through the survey questionnaire. The following document the standards and/or best practices of these states for the one-way frontage road traffic control.

### Arkansas Department of Transportation (ARDOT)

A summary of the traffic control regulations and/or policies utilized by ARDOT in locations where the frontage road converges with the exit ramps includes the following:

- Frontage road traffic always yields to the ramp traffic.
- Traffic control standards are based on traffic volume, sight distance, speed, crashes, and number of lanes.
- The two-lane, one-way frontage road is narrowed to one-lane using merge lane signs in advance of the gore point where the frontage road converges with the exit ramp.
- The exit-ramp is given a designated lane for a brief distance before the frontage road becomes two-lanes again.
- Yield (R1-2) and advance yield (W3-2) signs are placed along frontage road in advance of the gore point.
- Yield bar pavement markings are placed in conjunction with the Yield (R1-2) signs.
- Directional arrow pavement markings are placed on frontage road and exit ramps where they merge.
- One-Way (R6-2R) and a corresponding Do Not Enter (R5-1) signs are placed at every drive or intersection intersecting with the frontage road.
- The Do Not Enter (R5-1) signs are gated at the exit ramp transitions and Wrong Way (R5-1A) signs are installed in some situations.
- Bike lanes do not exist on frontage roads in Arkansas.

**Figure 3** and **Figure 4** depict examples of traffic control along frontage roads in the State of Arkansas.



Figure 3: Example of One-Way Frontage Road Best Practices for ARDOT

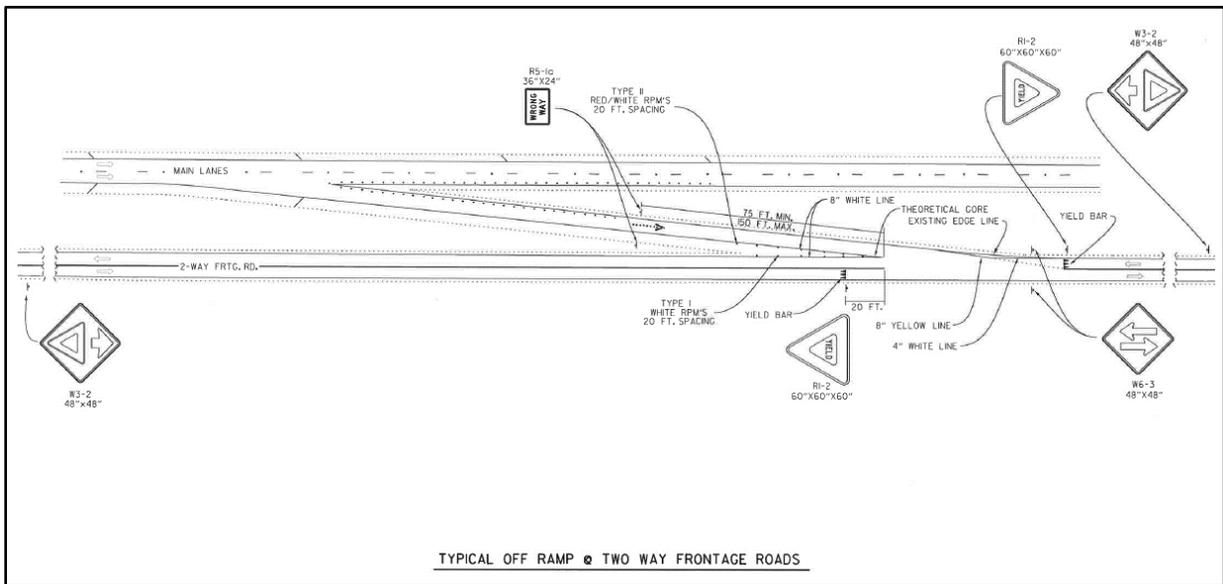


Figure 4: Yield Signs along Frontage Road in Arkansas 712015

### **Minnesota Department of Transportation (MnDOT)**

A summary of the traffic control regulations and/or policies utilized by MnDOT in locations where the frontage road converges with the exit ramps includes the following:

- Minnesota does have one-way and two-way frontage roads that merge and diverge.
- MnDOT does not have adopted standards and/or best practices for traffic control and/or traffic calming specific to frontage roads.
- MnDOT does not have adopted standards and/or best practices for pavement marking specific to frontage roads but follow the Manual of Uniform Traffic Control Devices (MUTCD) standards.
- The need (or not) to merge the lanes on the frontage road in advance of the gore point, where the frontage road merges with the exit ramp depends upon a traffic analysis.
- It is not known/unclear if there are existing bike lanes along the frontage roads. However, if the bike lanes are installed, they shall follow the typical bike lane designs that would place the bike lanes on the right side of the frontage road.
- Driveways are not allowed on frontage roads between the cross-street intersection and the gore area. Driveways on frontage roads beyond the gore are located where access is physically separated from the exit ramp. Frontage Road design and driveway locations on frontage roads beyond the gore area follow the MnDOT Road Design Manual.

### **New Mexico Department of Transportation (NMDOT)**

A summary of the traffic control regulations and/or policies utilized by NMDOT in locations where the frontage road converges with the exit ramps includes the following:

- New Mexico does not have adopted standards, regulations, policies and/or best practices for traffic control and/or traffic calming specific to frontage roads. Rather, each location is treated individually on a case-by-case basis.
- NMDOT does not have adopted standards, regulations, policies and/or best practices for pavement marking and/or traffic calming specific to frontage roads.
- It is not a necessity to merge the lanes on the frontage road in advance of the gore point.
- It is not known if there are existing bike lanes along the frontage roads.
- Driveways could be present along frontage roads, however, the parameters for the distance to the merge or intersections is based on the State Access Management Manual.

### **Oklahoma Department of Transportation (ODOT)**

A summary of the traffic control regulations and/or policies utilized by ODOT in locations where the frontage road converges with the exit ramps includes the following:

- ODOT does not have adopted standards, regulations, policies and/or best practices for traffic control, pavement marking and/or traffic calming specific to frontage roads.
- Most of the frontage roads in Oklahoma maintain the continuation of their lanes and the exit lane extends/continues to become a left-turn lane and/or U-turn lane.
- It is not known if there are existing bike lanes along the frontage roads.

- Traffic control at driveways on frontage roads will be one of a combination of one-way, right-turn only, wrong way, do not enter, no left-turns etc. signs. Evaluated on a case-by-case basis.

### **Texas Department of Transportation (TxDOT)**

A summary of the traffic control regulations and/or policies utilized by TxDOT in locations where the frontage road converges with the exit ramps includes the following:

- Texas State law states that frontage road traffic must yield to ramp traffic.
- Typically, two Yield signs are placed, one on each side of the frontage road, along with the Yield bar pavement marking on the roadway.
- In some situations, “Yield to Ramp Traffic” plaque is placed under the Yield sign.
- In some situations, solid double white line pavement marking of at least 80 feet is placed between the frontage road and exit ramp along with “Do No Cross Double White Line” sign. “Do Not Cross Double White Line” signs are installed to try to restrict merge movements where the exit ramp meets with the frontage road.
- In some situations, a dotted line (not broken white) is marked so that ramp traffic can have its own lane leading to the arterial street.
- In almost all situations, either a new lane is created on frontage road or merge one of the lanes on frontage road to make way for the ramp traffic or provide a significant deceleration lane distance to merge into the frontage road lanes. “Left Lane Ends” sign and “Lane Ends Merge Right” signs are placed along frontage road when one of the lanes on frontage road is merged before approaching the gore.
- On very rare occasions, Texas does not provide any lane or merging area for the exit ramp and instead install “Yield to Ramp” signs/plaques with yield triangles pavement marking on the frontage road. However, TxDOT staff are generally under the opinion that these types of designs are often confusing to the traveling public.
- In many urban areas, the exit ramp essentially becomes a frontage road auxiliary lane where it ultimately transitions to an entrance ramp downstream. In these instances, Texas usually stripes the lane with a dotted line instead of a broken white line and include “Left Lane Must Enter Ramp” signs. Texas is also required to use left turn arrow and ONLY markings within the lane as further guidance.
- Bike lanes on frontage roads are rarely installed due to higher speeds on frontage roads.
- Access to the adjacent properties along frontage roads is restricted from the arterial street intersection to the gore point where frontage road merges with the exit ramp.
- Texas typically places a “One-Way” sign across from the driveway between the frontage road and main lanes. TxDOT should only be installing these when there is alternate access to the property from another street.

### **Louisiana Department of Transportation and Development (LaDOTD)**

A summary of the traffic control regulations and/or policies utilized by LaDOTD in locations where the frontage road converges with the exit ramps includes the following:

- Louisiana does not have adopted standards, regulations, policies and/or best practices for traffic control and/or traffic calming specific to frontage roads. Traffic Control is managed on a case by case basis with the objective of ensuring that there is no traffic back up on the ramp or other impact to the free flow speed on the Interstate.
- Louisiana intends to either add a free flow lane on the frontage road, or an acceleration lane. Where a free flow lane or an acceleration lane cannot be installed, traffic on the frontage road will be controlled with either a stop control, signal control, or Yield. The traffic analysis specific to a given location determines the appropriate approach/strategy.
- Generally speaking, the basis and overall intent for the recommended traffic control strategy would be to not impact the interstate free flow speed.
- Louisiana does not have adopted standards, regulations, policies and/or best practices for pavement marking specific to frontage roads. A frontage road is treated as any other typical roadway with respect to pavement marking. Any special pavement markings at the merge point like shark teeth for Yield condition would be added on case by case basis and those markings would follow MUTCD standards.
- The appropriate strategy in Louisiana is to merge the frontage road lanes (assuming more than one lane) before the gore point, however, the Access Management Policy requires an added lane for the exit ramp volume, so merging frontage traffic to one lane may not be required.
- The Louisiana Complete Street Policy requires that all projects be evaluated for complete street elements. The appropriate facility is dependent on the local municipality's bicycle and pedestrian plan. In the absence of such a plan, a minimum bicycle facility on a new frontage road would typically consist of a 4-foot shoulder. On a rehabilitation project, restriping the roadway to create space for complete street elements may be considered.
- One-way frontage roads would require a right-in/right-out driveway. The spacing requirements are outlined in LaDOTD Control Access Policy.

Traffic control standards for various states that were surveyed as part of the project are included in **Appendix A**.

## Chapter 4 CURRENT CONDITIONS

The major elements that represent the freeway frontage road/ramp condition of the existing transportation system along the Central District Frontage Roads are documented in this section and summarized by the status/condition of each element. Major elements include;

- 1) roadway type,
- 2) number of lanes,
- 3) speed limits,
- 4) motorized/non-motorized transportation modes,
- 5) existing frontage road traffic control; signage, markings, or other traffic control devices,
- 6) Distance between the gore point of the exit ramp/frontage road and the arterial street Physical Obstruction to Sight Distance,
- 7) Existing driveways between the gore point of the exit ramp/frontage road and the arterial street, and
- 8) crash history and traffic count information (obtained from ADOT Traffic Data Management System website) on frontage roads.

Y2K Engineering through contract with Michael Baker International (and to fulfill the DBE requirement for this project) conducted the field review and collected the existing data for the Central District Freeway Frontage Road Traffic Control study.

Individual, detailed data collection sheets for each and every location where the frontage road converges with the exit ramp in the Central District are included in **Appendix B. Figure 5** below represents a sample of one such data collection sheet for reference. Existing features of the various elements along the frontage roads within the study area are summarized below.

Location: I-17 & McDowell NB					
<b>EXISTING INVENTORY</b>					
LOCATION: I-17 & McDowell NB					
LINK: <a href="https://earth.google.com/web/@33.46404126,-112.10768362,326.0776815a,395.4104684d,35u,0h,0t">https://earth.google.com/web/@33.46404126,-112.10768362,326.0776815a,395.4104684d,35u,0h,0t</a>					
ARTERIAL/FREEWAY INTERCHANGE TYPE: <b>Diamond</b>					
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft):		330	
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):		800	
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?		No	
Sidewalk Along Frontage?	NO				
Bicycle Lane Along Frontage?	NO				
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO				
<b>DISTANCES (NEAREST 10 FEET)</b>					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White Lane Stripe Approaching the	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	30	120	280	350	330
<b>Lanes</b>					
Lanes on Frontage Road Approach:	2				
Number of Lanes on Ramp at Merge:	1				
Lanes on Frontage Road Departure:	3				
<b>Advance Warning Signs</b>		<b>Traffic Control Signs</b>		<b>Overhead Signs</b>	
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)	
		W4-3	Left	Lane Configuration	
<b>TOTAL # of Warning Signs:</b>		<b>of Traffic Control Signs:</b>			
0		1			
<b>Pavement Markings at Frontage/Ramp</b>					
Stop Bar for Frontage:	NO				
Yield Ahead:	NO				
Stop Ahead:	NO				
Wrong-way Arrows with RPMs (M-12):	NO				
Yield Lines:	NO				



Figure 5: Sample Data Collection Sheet

## Roadway Type

### Frontage Road

Based on the ADOT Function Road Type, a frontage road is a local street or road located on the side of, and usually parallel to, a limited-access highway that allows access to residences and businesses from a controlled intersection of the arterial highway.

Based on discussions with ADOT staff, all the frontage roads located in the Central District are owned by ADOT but maintained by the cities in which the frontage road exists. ADOT maintains the portion of each frontage road from gore point to gore point.

### Arterial Streets

Frontage Roads intersect with arterial streets at locations where the exit ramps of the freeways intersect with arterial streets. Arterial Streets in general are owned and maintained by the cities in which the arterial streets exist. The intersection of the arterial street with the exit ramps/frontage road is maintained by ADOT.

### Number of Lanes

Frontage roads in the Central District are primarily one-lane frontage roads. Number of lanes on frontage roads along various freeway within the Central District are described below.

**SR 101** primarily consists of two-lane frontage roads along the freeway within the Central District with the exception of the following locations, where two-lane frontage roads are merged into one-lane before approaching the converging point of the exit ramp:

- Approaching Scottsdale Road, 51<sup>st</sup> Avenue, 59<sup>th</sup> Avenue, 67<sup>th</sup> Avenue, 75<sup>th</sup> Avenue and 78<sup>th</sup> Avenue – all westbound direction,
- Pima Road, Guadalupe Road and Baseline Road – northbound direction, and
- Chandler Boulevard, Ray Road, Warner Road, Elliot Road and Southern Road – southbound direction.

**I-17** primarily consists of one-lane frontage roads along the freeway within the Central District with the exception of the following locations, which has two-lane frontage roads approaching the converging point of the exit ramp at the following roadways:

- McDowell Road, Bell Road and Grant Street – northbound and southbound directions, and
- Union Hills Road, Utopia Road, Adams Street, Jefferson Street and Buckeye Road – northbound direction.

**I-10** has one-lane frontage roads between Washington Street and Sky Harbor Circle in the northbound and southbound directions and two-lane frontage roads between 99<sup>th</sup> Avenue to 107<sup>th</sup> Avenue in the eastbound and westbound directions.

**SR 202** has a two-lane frontage road from University Avenue to Broadway Road in both the northbound and southbound direction.

## Speed Limits

Posted speed limits along the frontage roads through the study area vary between 35 miles-per-hour (mph) to 50 mph. Speed limits along the various frontage road segments are described below:

### SR 101

Posted speed limits along the frontage roads adjacent to SR 101 are 45 mph with the exception of the following locations:

- Eastbound direction approaching 27<sup>th</sup> Avenue and 35<sup>th</sup> Avenue – 40 mph, and
- Westbound direction approaching 19<sup>th</sup> Avenue – 40 mph.

### I-17

Posted speed limits along the frontage roads adjacent to I-17 vary between 35 mph and 50 mph, as more specifically described below:

- Between McDowell Road and Peoria Road in both directions – 40 mph,
- Between Peoria Road and Jomax Road – 45 mph with the exception of the following:
  - Between Bell Road and Greenway Road – 50 mph,
  - Southbound direction approaching Happy Valley Road – 35 mph.

- Northbound direction approaching Dixileta Drive – 35 mph.
- Between Adams Road and Jefferson Road in both directions – 35 mph, and
- Between Grant Street and 16<sup>th</sup> Street – 35 mph.

### **I-10**

Posted speed limits along frontage roads adjacent to I-10 include:

- Northbound direction approaching Jefferson Street – 40 mph,
- Eastbound direction approaching 99<sup>th</sup> Avenue – 40 mph, and
- Westbound direction approaching 99<sup>th</sup> Avenue – 45 mph.

### **SR 202**

Posted speed limits along the frontage roads adjacent to SR 202 are 45 mph throughout the SR 202 study corridor.

## **Non-Motorized Transportation Mobility**

### Existing Bicycle Lanes

There are no existing bicycle lanes on any frontage roads in the Central District with the exception of select areas along the SR 101 corridor. Bicycle lanes exist along the SR 101 at the following locations:

- Westbound direction approaching Scottsdale Road,
- Southbound direction approaching Chandler Boulevard,
- Northbound and southbound directions approaching Ray Road,
- Southbound direction approaching Warner Road, and
- Northbound and southbound direction approaching Elliot Road.

There are several locations along frontage roads adjacent to SR 101 that have a wider striped shoulder, but bike lane signs or pavement markings are not installed.

### Existing Pedestrian Facilities

Sidewalks along Central District frontage roads exist along frontage roads adjacent to I-17 and SR 101 at the following locations:

- I-17 and Indian School Road – southbound direction,
- I-17 and Camelback Road – northbound and southbound directions,
- I-17 and Bethany Home Road – northbound and southbound directions,
- I-17 and Northern Avenue – northbound direction,
- I-17 and Dunlap Avenue – northbound and southbound directions,
- SR 101 and 67<sup>th</sup> Avenue – eastbound and westbound directions,
- SR 101 and 27<sup>th</sup> Avenue – westbound direction,
- SR 101 and 7<sup>th</sup> Avenue – westbound direction,
- SR 101 and 7<sup>th</sup> Street – eastbound direction,
- SR 101 and Scottsdale Road – westbound direction,

- SR 101 and Durango Street at I-17 Curve – southbound direction,
- SR 101 between Baseline Road and Chandler Boulevard – both directions,
- SR 101 between Broadway Road and Southern Road – both directions, and
- SR 101 and Northern Avenue – northbound direction.

## Existing Traffic Control

Traffic control devices are defined as all signs, signals, markings, and other devices used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, pedestrian facility, bikeway, or private road open to public travel by authority of a public agency or official having jurisdiction, or, in the case of a private road, by authority of the private owner or private official having jurisdiction.

The following describes the existing signs and pavement markings along the various frontage roads and along the exit ramps where the frontage road converge with the exit ramp within the study area.

### Existing Signs along Frontage Roads

Traffic control signs along the frontage roads where the frontage road converges with the exit ramps within the study area consist of three types: Stop Signs (R1-1), Yield Signs (R1-2) or no signs.

Yield signs were predominantly used through the study area with a few exceptions where there are “STOP” signs or no signs at all as discussed in this section. “To Ramp Traffic” (R1-2rp) plaques are installed below the Yield Signs at all the locations with the exception of I-17 and Cactus Road in the southbound direction, I-17 and Happy Valley Road in the northbound direction, SR 202 and Broadway Road in the southbound direction and I-10 and 99<sup>th</sup> Avenue in the eastbound direction. “Yield Ahead” (W3-2) advance warning signs exist in advance (at varying distances) of each of the existing “Yield” signs at the following locations:

- I-17 and Peoria Avenue – northbound direction,
- I-17 and Thunderbird Road – southbound direction,
- I-17 and Greenway Road – northbound direction,
- I-17 and Union Hills Drive – northbound direction,
- I-17 and Happy Valley Road – northbound direction,
- I-17 and Grant Street – southbound direction,
- SR 101 and 67<sup>th</sup> Avenue – westbound direction,
- SR 101 and 59<sup>th</sup> Avenue – eastbound and westbound directions,
- SR 101 and 27<sup>th</sup> Avenue – eastbound direction,
- SR 101 and Pima Road – northbound direction,
- SR 101 and Chandler Boulevard – southbound direction, and
- SR 101 and Elliot Road – northbound and southbound directions.

Stop signs exist at the following locations along the frontage roads:

- I-17 and Jefferson Street – southbound direction,
- I-17 and Durango Street – southbound direction,
- I-17 and 19<sup>th</sup> Avenue – westbound direction,
- I-17 and 7<sup>th</sup> Avenue – eastbound and westbound directions,
- I-17 and 7<sup>th</sup> Street – eastbound and westbound directions,
- I-17 and 16<sup>th</sup> Street – eastbound direction, and
- I-10 and Jefferson Street – northbound direction.

“Stop Ahead” (W3-1) advance warning signs exist in advance of each of the existing “Stop” signs along the frontage road.

There are no existing regulatory traffic control signs along the frontage roads at the following locations within the study area:

- I-17 and Glendale Avenue – northbound and southbound directions,
- I-17 and Northern Avenue – northbound and southbound directions,
- I-17 and Dunlap Avenue – northbound direction,
- SR 101 and 78<sup>th</sup> Avenue – westbound direction,
- SR 202 and University Avenue – northbound direction, and
- I-10 and 99<sup>th</sup> Avenue – westbound direction.

Sign codes and images of the signs located along the frontage roads within the study area are included in **Appendix C**.

### Existing Pavement Marking along Frontage Road

Solid white stop bar pavement markings exist at all the locations where there are existing stop signs along the frontage roads within the study area. Yield line marking exist at only approximately half of the locations where “Yield” signs exist along the frontage roads. Wrong Way arrows with raised pavement markers (RPM’s) exist at approximately half of the exit ramps within the study area. Detailed pavement markings at each study location within the study area are included within the individual, detailed data collection sheets for each and every location where the frontage road converges with the exit ramp in the Central District and are included in **Appendix B**.

### Physical Obstruction to Sight Distance

A driver’s ability to see ahead is of the utmost importance in the safe and efficient operation of a vehicle. Sight distance is the length of the roadway ahead that is visible to the driver. For safety on roadways, designers should provide sight distance of sufficient length that drivers can control the operation of their vehicles to avoid striking an unexpected object in the travel lane.

Based on the *Geometric Design of Highways and Streets*, stopping sight distance is the distance needed to allow a vehicle traveling at a design speed to stop before reaching a stationary object in its path. Stopping sight distances are usually sufficient to allow reasonably competent and alert drivers to come to

a hurried stop under ordinary circumstances. However, these distances are often inadequate when drivers must make complex or instantaneous decisions, when information is difficult to perceive, or when unexpected or unnatural maneuvers are required. Limiting sight distances to those needed for stopping may preclude drivers from performing evasive maneuvers, which often involves less risk and are otherwise preferable to stopping. Even with an appropriate complement of standard traffic control devices in accordance with the MUTCD, stopping sight distances may not provide sufficient visibility for drivers to corroborate advance warning and to perform the appropriate maneuvers. At location that could benefit from longer sight distance to safely perform the weaving maneuver, decision sight distance provides the greater visibility that drivers need.

Decision sight distance is the distance needed for a driver to detect an unexpected or otherwise difficult-to-perceive information source or condition in a roadway environment that may be visually cluttered, recognize the condition or its potential threat, select an appropriate speed and path and complete the maneuver safely and efficiently.

Due to the complexity of the maneuvering traffic from frontage roads and/or on exit ramps into the appropriate lane before approaching the intersection, decision sight distance was considered for this project while evaluating the presence of any physical obstruction within the sight distance. Decision sight distance for various design speed limits for an urban roadway are shown in **Table 3**.

*Table 3: Decision Sight Distance*

Design Speed (mph)	Decision Sight Distance (ft)	
	Avoidance Maneuver	
	B	E
35	490	620
35	590	720
40	690	825
45	800	930
50	910	1030
55	1030	1135
60	1150	1280
65	1275	1365
70	1410	1445
75	1545	1545
80	1685	1650

*Source: AASHTO Green Book 2011, Table 3-3  
Avoidance Maneuver B: Stop on Urban Road  
Avoidance Maneuver E: Speed/Path/Direction Change on Urban Road*

The driver of a vehicle approaching or departing an intersection should have an unobstructed view of the intersection, including any traffic control devices, and sight distances along the intersection roadway to permit the driver to anticipate and avoid potential conflicts. During the field reviews to document the existing conditions completed by Y2K Engineering, any existing physical obstructions blocking the traffic control signs within the sight distance limitations were documented. For the purposes of this study, the

posted speed limit along the frontage roads is also considered as the design speed to calculate the sight distances. Existing physical obstructions along the frontage roads within the study area include the following:

- I-17 and Bethany Home Road in the southbound direction – the existing added lane sign (W4-3) is being obstructed by a bush,
- I-17 and Peoria Avenue in the northbound direction – the existing “Yield Ahead” sign (W3-2) is being obstructed by a tree,
- I-17 and Cactus Road in the northbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by a wall,
- I-17 and Cactus Road in the southbound direction – the existing “Yield” sign (R1-2) is being obstructed by a wall,
- I-17 and Thunderbird Road in the northbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by a wall and the existing curve advisory speed limit sign (W1-2a) is being blocked by the existing added lane sign (W4-3),
- I-17 and Greenway Road in the northbound direction – the existing “Yield Ahead” sign (W3-2) is being obstructed by “School” sign (S1-1) and the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being blocked by a tree,
- I-17 and Union Hills Drive in the northbound direction – the existing “Yield Ahead” sign (W3-2) is being obstructed by a power pole,
- I-17 and Utopia Road in the northbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by an advertisement sign,
- I-17 and Deer Valley Road in the northbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by the curve,
- I-17 and Deer Valley Road in the southbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by the curve and a wall,
- I-17 and Happy Valley Road in the northbound direction – the existing “Yield Ahead” sign (W3-2) is being obstructed by a light pole,
- I-17 and Happy Valley Road in the southbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by curve,
- I-17 and 7<sup>th</sup> Avenue in the eastbound direction – the existing “Stop” sign (R1-1) and the existing “Stop Ahead” sign (W3-1) are being obstructed by a pole,
- SR 101 and 35<sup>th</sup> Avenue in the eastbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by bushes,
- SR 101 and 19<sup>th</sup> Avenue in the westbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) located on the left side of the frontage road are being obstructed a tree,
- SR 101 and 7<sup>th</sup> Avenue in the eastbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by a tree,
- SR 101 and 7<sup>th</sup> Street in the eastbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by a tree,

- SR 101 and Elliot Road in the northbound direction – the existing “Yield” sign (R1-2), “To Ramp Traffic” sign (R1-2rp) and the existing “Yield Ahead” sign (W3-2) are being obstructed by trees,
- SR 101 and Guadalupe Road in the northbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by trees,
- SR 101 and Baseline Road in the northbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by trees, and
- SR 101 and Southern Avenue in the southbound direction – the existing “Yield” sign (R1-2) and the “To Ramp Traffic” sign (R1-2rp) are being obstructed by trees.

### Distance Between the Gore Point of Exit Ramp/Frontage Road Convergence and Arterial Street

The distance between the gore point where the frontage road converges with the exit ramp and the arterial street intersection varies widely throughout the study area. The distances range from 90 feet at I-17 and Adams Road in the northbound direction to 3,810 feet at I-10 and 99<sup>th</sup> Avenue in the eastbound direction.

The lowest posted speed limits along the frontage roads within the study area is 35 mph. As mentioned in the *Physical Obstruction to Sight Distance* section of this report, the posted speed limit along the frontage roads is also considered as the design speed to calculate the sight distances. For a speed limit of 35 mph, the decision sight distance required for a STOP condition is 590 feet. All locations where the distance between the gore point and the frontage road converge with the exit ramp and the arterial street intersection is less than 600 feet are listed below.

- I-17 and Deer Valley Road in the northbound direction – 490 feet,
- I-17 and Dixileta Drive in the northbound direction – 560 feet,
- I-17 and Adams Road in the northbound direction – 90 feet,
- I-17 and Jefferson Street in the southbound direction – 330 feet,
- I-17 and Grant Street in the southbound direction – 360 feet,
- I-17 and 19<sup>th</sup> Avenue in the westbound direction – 470 feet,
- I-17 and 7<sup>th</sup> Avenue in the eastbound and westbound directions – 210 feet and 280 feet respectively,
- I-17 and 7<sup>th</sup> Street in the eastbound and westbound directions – 280 feet and 440 feet respectively,
- I-10 and Jefferson Street in the northbound direction – 350 feet,
- SR 101 and 78<sup>th</sup> Avenue in the westbound direction – 330 feet,
- SR 101 and Ray Road in the northbound direction – 460 feet,
- SR 101 and Warner Road in the southbound direction – 420 feet,
- SR 101 and Elliot Road in the southbound direction – 430 feet,
- SR 101 and Southern Avenue in the southbound direction – 470 feet,
- SR 101 and University Avenue in the northbound direction – 580 feet, and

- SR 202 and Broadway Road in the southbound direction – 580 feet.

Distances between the gore point where the frontage road converges with the exit ramp and the arterial street intersection for each location within the study area are included within the individual, detailed data collection sheets are included in **Appendix B**.

### Existing Driveways between Gore Point and Arterial Street

Traffic entering and/or exiting driveways located between the gore point and the arterial street intersection are expected to experience complicated lane changing maneuvers. The following list depicts the presence of driveways between the gore point where frontage road converges with the exit ramp and the arterial street intersection within the study area:

- I-17 and McDowell Road in the southbound direction,
- I-17 and Thomas Road in the southbound direction
- I-17 and Indian School Road in the northbound and southbound directions,
- I-17 and Camelback Road in the southbound direction,
- I-17 and Bethany Home Road in the northbound and southbound directions,
- I-17 and Glendale Road in the northbound and southbound directions,
- I-17 and Northern Avenue in the northbound and southbound directions,
- I-17 and Dunlap Avenue in the northbound and southbound directions,
- I-17 and Greenway Road in the northbound direction,
- I-17 and Deer Valley Road in the southbound direction,
- I-17 and Jefferson Street in the southbound direction,
- I-17 and Grant Street in the northbound and southbound directions,
- I-17 and Buckeye Road in the northbound direction,
- I-17 and 19<sup>th</sup> Avenue in the westbound direction,
- I-17 and 7<sup>th</sup> Avenue in the westbound direction,
- SR 101 and 67<sup>th</sup> Avenue in the eastbound and westbound directions,
- SR 101 and 59<sup>th</sup> Avenue in the eastbound direction,
- SR 101 and 7<sup>th</sup> Avenue in the westbound direction,
- SR 101 and Frank Lloyd Wright Boulevard in the northbound direction,
- SR 101 and Raintree Drive in the southbound direction,
- SR 101 and Broadway Road in the southbound direction,
- SR 101 and Guadalupe Road in the southbound direction, and
- SR 101 and Southern Avenue in the southbound direction.

### Crash Analysis

As mentioned in **Chapter 1: Study Process**, crash data, while useful, was not initially considered by the TAC to be as imperative to consider due to the complaint-driven nature of this study. However, this project ultimately established a set of traffic control guidelines based on traffic volume, lane configuration, sight distance, speeds, distance from the exit ramp/frontage road junction to the cross

street, crash history, and/or other factors. As the discussion with the TAC evolved, it was determined that the crash data analysis would be conducted within the study area to identify trends, patterns, predominant crash types, and high crash locations. The purpose of the crash summary is to discover safety hazard locations caused due to existing traffic control along the frontage road ramps where they converge with the exit ramps. Crash data for the five-year period from January 1, 2012 to December 31, 2016 was obtained from the Arizona Department of Transportation Traffic Records Section.

Crashes that occurred within 300 feet upstream and downstream of the frontage ramp where the frontage road ramp converges with the exit ramp were considered for this analysis. The following sections provide a brief description of the crashes within the study area:

- A total of 523 crashes occurred within the study area during the five-year analysis period,
- Of the total recorded 523 crashes, 97 of those crashes occurred in the year 2012, 103 in the year 2013, 85 in the year 2014, 110 in the year 2015 and 128 in the year 2016.
- 7 of the reported crashes occurred along the frontage roads adjacent to I-10, 294 along the frontage roads adjacent to I-17, 217 along the frontage roads adjacent to SR 101 and 5 along the frontage roads adjacent to SR 202.
- 309 of the total crashes were rear end collisions, 98 occurred due to sideswipe in the same direction and 78 were single vehicle collisions. The remainder of 38 crashes occurred due to various other collision manners.
- 384 of the crashes occurred during the daylight conditions and 11 occurred during the dark lighted conditions. The remainder of the 28 crashes occurred during not lighted, dawn or dusk conditions.
- There were three fatalities reported in the analysis period within the study area. The three reported fatalities occurred at the following locations:
  - I-17 and Jomax Road in the southbound direction,
  - I-17 and Bell Road in the northbound direction, and
  - I-17 and Happy Valley Road in the northbound direction,
- 137 of 523 crashes within the study area resulted in an injury. The remainder of the 383 crashes were no injury/property damage only collisions.

**Figure 6** through **Figure 10** illustrate the various crash data findings within the study area.

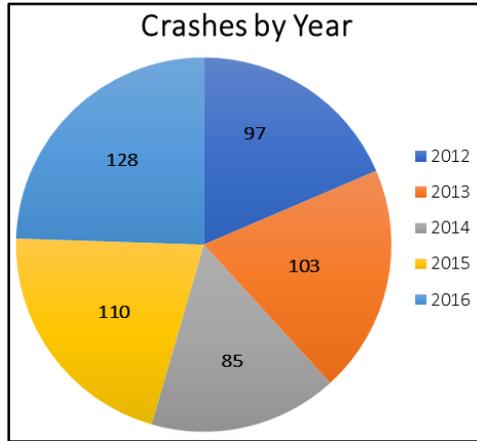


Figure 6: Crashes by the Year

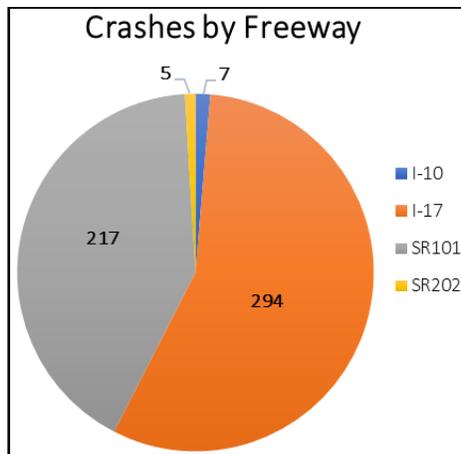


Figure 7: Crashes along Frontage Road adjacent to each Freeway Facility

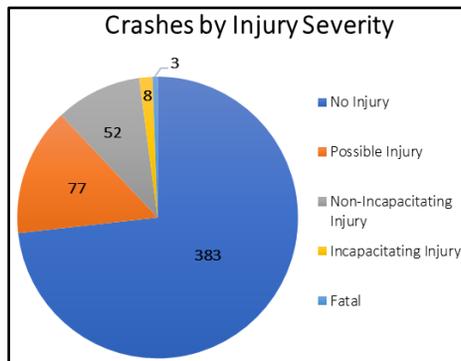


Figure 8: Crashes by Injury Severity

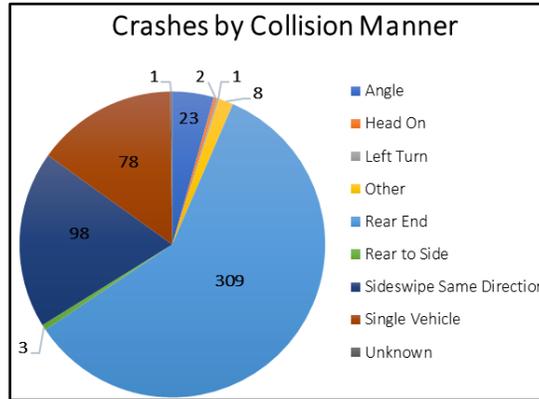


Figure 9: Crashes by Collision Manner

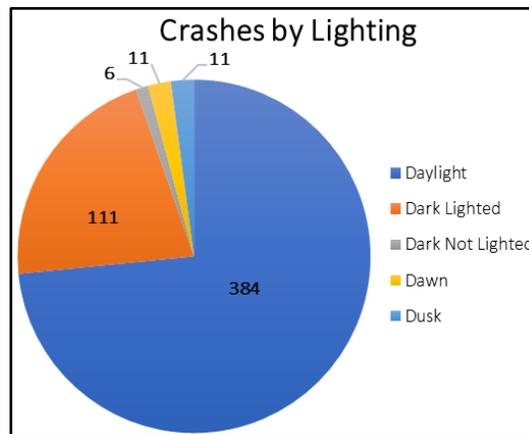


Figure 10: Crashes by Lighting

### Existing Traffic Volumes

Historical average daily traffic volume information at various locations within the study area for the year 2017 were obtained from the ADOT Transportation Data Management System (TDMS) website. Traffic volume information along the frontage roads within the study area is included in **Appendix D**.

## CHAPTER 5 RAMP AND FRONTAGE ROAD TRAFFIC CONTROL GUIDELINES

Chapter 5 presents traffic control design guideline recommendations along ADOT's Freeway frontage roads in the Central District. After extensive inventory and analysis of the existing ramp and frontage road conditions, crash analysis, coordination, and deliberation with the TAC and various ADOT staff members, the recommended traffic control guidelines are presented below. It is worth noting that an enhanced level of collaboration occurred with a separate ADOT study team on a somewhat similar and ongoing study in the ADOT Southcentral District. This study team was commissioned to partner with the other study team to examine and ensure consistency between the recommendations of two studies in their respective application of methodologies, assumptions, and findings. The findings and recommendations presented below represent the culmination of these various efforts.

### Complaints

As described in the *Need and Purpose of the Study* section of this report, ADOT had received numerous complaints from constituents regarding the use of "Stop" signs at certain locations where the frontage road merged with the exit ramp vs the use of "Yield" signs at other similar locations along the same corridor and complaints that the drivers on the frontage road were not yielding to the drivers exiting the Freeway. These inquiries and/or complaints reflect a general confusion or frustration with differences or variations in traffic control devices employed at different frontage road/mainline ramp convergence locations in the ADOT Central District. Often times these driver inquiries/complaints arise from witnessing other drivers' behaviors in these areas, and as a by-product, the evaluation of the variations in traffic control devices employed at different frontage road/ramp convergence areas that may influence driving behavior at these locations.

A complaint log for the entire study area for the years 2016 to 2018 was obtained from ADOT. A summary of the complaints is included in the **Appendix E** section of this report.

There were eight (8) specific complaints regarding the traffic control signs where frontage road merges with the exit ramp from the years 2016 to 2018. The type of complaints included:

- "Yield to Ramp Traffic" signs are currently lacking, request sign installation,
- "YIELD" signs are placed too far prior to the merge point,
- Drivers on the frontage road often do not yield to the exit ramp traffic etc.

It is our understanding based on conversations with ADOT that there are likely additional complaints than what were initially provided for this study.

### Crash Analysis

As mentioned above, a detailed crash analysis was performed at various locations within the study area to determine patterns/similarities in crashes relating to the traffic control signs. Crash analysis was conducted to include locations with the following major elements that represent the freeway frontage road/ramp condition of the existing transportation system along the Central District Frontage Roads:

1. One lane and two-lane frontage roads,
2. STOP sign and YIELD sign locations,
3. YIELD sign locations with and without YIELD pavement marking,
4. Weave lengths less than 300 feet and greater than 300 feet,
5. Weave lengths greater than 1,000 feet, and
6. Locations with driveways existing between the physical gore where frontage road merges with exit ramp and the solid intersection striping.

The parameters that were used for the crash analysis are described below:

Crash Data: crash data for the five-year period from January 1, 2012 to December 31, 2016 was obtained from the Arizona Department of Transportation (ADOT) Traffic Records Section was used for the analysis. Crashes that occurred between 300 feet upstream of the physical gore where frontage road merges with the exit ramp and the arterial street intersection are used for the analysis. Engineering judgement was used to determine the crashes that are closer to the arterial street intersection that could have been caused due to the weaving/merging maneuver to be used in the analysis.

Segment Crash Rate: segment crash rate is calculated using the following formula:

$$\text{Segment Crash Rate} = \frac{\text{Number of Crashes in the } n \text{ Year Period} * 1,000,000}{\text{AADT} * \text{segment length} * 365 * \text{number of years}}$$

Average annual daily traffic volume (AADT) for the study locations was obtained from the ADOT Transportation Data Management System (TDMS) website. A combined AADT on the exit ramp and on the frontage road approaching the merge point was used for the analysis.

Segment length is the length between the tip of the striped gore to the stop bar at the intersection.

Weave Length: weave length is the distance between the tip of the striped gore and the start of the solid white lane line approaching the intersection.

Crash Rate (R) Factor: crash rate (R) factor is calculated using the following formula:

$$R = \frac{\text{Segment Crash Rate} * \text{AADT}}{\text{Weave Length}}$$

Ranking of Locations: after calculating the crash rates and R factors at various study locations, the locations were ranked by various factors, i.e., number of crashes (by decreasing number of crashes), crash rate (by decreasing crash rate), weave length (by increasing weave length) and R-factor (by increasing R factor). Ranking of the study locations by various factors is shown in **Table 4**.

Based on the crash analysis shown in **Table 4**, 20 of the top 25 highest crash rate locations have a weave length of less than 300 feet and 23 of the top 25 highest crash rate locations have YIELD signs. In contrast to the top 25 highest crash rates, only 8 of the bottom 25 crash rate locations have a weave length of less than 300 feet and only 12 of the bottom 25 crash rate intersections have YIELD signs. This summary shows a distinct correlation between the weave length, traffic control and the crash rates.

Weighted Average: A further analysis was performed to determine the ranking of each location by comparing each individual ranking criteria, termed as “Weighted Average”. A point system was created for each ranking criterion, i.e., number of crashes, crash rates, weave length and R-factor. A total of eight points were allotted to each criterion, one for number of crashes, three for crash rate and two each for weave length and R-Factor. Weighted Average for each location is calculated as follows:

$$\text{Weighted Average} = \frac{(\# \text{ of crashes} * C) + (\text{Crash Rate} * CR) + (\text{Weave Length} * WL) + (\text{R Factor} * R)}{\text{Total Number of Points}}$$

Where,

C = Points allotted to number of crashes, 1,

CR = Points allotted to crash rate, 3,

WL = Points allotted to weave length, 2,

R = Points allotted to R-Factor, 2, and

Total Number of Points = 8.

**Table 5** shows the summary of the overall ranking of all study area locations by weighted average.

Table 4: Ranking of Locations by Various Categories

Ranking by # of Crashes								Ranking by Rate							
Ranking	Location	Direction	Existing Control	Crashes	Rate	Weave length	R Factor	Ranking	Location	Direction	Existing Control	Crashes	Rate	Weave length	R Factor
1	L101 & Broadway	SB	YIELD	47	11.32052	290	936.5583	1	L101 & Broadway	SB	YIELD	47	11.32052	290	936.5583
2	SR 101 and University Drive	NB	YIELD	20	9.346296	110	1696.863	2	SR 101 and University Drive	NB	YIELD	20	9.346296	110	1696.863
2	L101 & Broadway	NB	YIELD	20	5.387247	130	803.653	3	I-17 & Grant	SB	YIELD	9	8.48777	70	1487.906
4	I-17 and Peoria Road	SB	YIELD	14	2.39736	860	44.01664	4	L101 & Southern Ave	SB	YIELD	11	5.657264	300	235.7382
5	L101 & 27th	EB	YIELD	13	4.758321	330	253.2725	5	L101 & Broadway	NB	YIELD	20	5.387247	130	803.653
6	L101 & 67th Ave	WB	YIELD	11	3.859078	240	270.6178	6	L101 & 67th	EB	YIELD	7	4.984925	150	321.4612
6	L101 & Southern Ave	SB	YIELD	11	5.657264	300	235.7382	7	L101 & 27th	EB	YIELD	13	4.758	330	253.27
8	I-17 & Grant	SB	YIELD	9	8.48777	70	1487.906	8	L101 & 67th Ave	WB	YIELD	11	3.859078	240	270.6178
8	L101 & Ray Rd	SB	YIELD	9	2.753485	280	189.7839	9	L101 & Elliot	NB	YIELD	6	3.643927	230	184.0817
10	L101 & 35th	EB	YIELD	7	3.18002	330	125.2446	10	L101 & 51st	EB	YIELD	5	3.267	330	84.30
10	L101 & 67th	EB	YIELD	7	4.984925	150	321.4612	11	L101 & 35th	EB	YIELD	7	3.18002	330	125.2446
10	L101 & Guadalupe	SB	YIELD	7	2.761784	220	191.7808	12	L101 & Guadalupe	SB	YIELD	7	2.761784	220	191.7808
13	I-17 and Durango Street	SB	STOP	6	1.184016	380	61.97079	13	L101 & Ray Rd	SB	YIELD	9	2.753	280	189.78
13	L101 & Elliot	NB	YIELD	6	3.643927	230	184.0817	14	L101 & 59th Ave	WB	YIELD	5	2.664239	190	173.0353
15	L101 & 51st	EB	YIELD	5	3.26703	330	84.29926	15	I-17 and Peoria Road	SB	YIELD	14	2.39736	860	44.01664
15	L101 & 59th Ave	WB	YIELD	5	2.664239	190	173.0353	16	L101 & Warner	NB	YIELD	4	2.35707	250	107.6521
17	I-17 & Thomas Rd	NB	None	4	0.49203	1,270	5.841209	17	L101 & 59th	EB	YIELD	4	2.219	180	146.12
17	I-17 and Camelback Road	SB	None	4	0.765782	470	40.36485	18	L101 & Ray Rd	NB	YIELD	4	2.088902	250	105.2055
17	L101 & 59th	EB	YIELD	4	2.218589	180	146.1187	19	L101 & Elliot Rd	SB	YIELD	4	2.00146	110	276.8565
17	L101 & Elliot Rd	SB	YIELD	4	2.00146	110	276.8565	20	SR 101 and Warner	SB	YIELD	4	1.740403	140	201.6133
17	L101 & Ray Rd	NB	YIELD	4	2.088902	250	105.2055	21	I-10 & Jefferson	NB	STOP	2	1.667176	80	249.4095
17	L101 & Warner	NB	YIELD	4	2.35707	250	107.6521	22	I-17 & Pinnacle Peak Rd	NB	YIELD	3	1.462211	210	89.8494
17	SR 101 and Warner	SB	YIELD	4	1.740403	140	201.6133	23	I-17 and Jefferson	SB	STOP	1	1.336254	70	258.317
24	I-17 & Pinnacle Peak Rd	NB	YIELD	3	1.462211	210	89.8494	24	L101 & 7th St	EB	YIELD	3	1.201381	380	40.7869
24	I-17 and Indian School Road	SB	None	3	0.940	340	47.274	25	I-17 and Durango Street	SB	STOP	6	1.184016	380	61.97079
24	L101 & 7th St	EB	YIELD	3	1.201381	380	40.7869	26	I-17 and Indian School Road	SB	None	3	0.94011	340	47.2737
24	L101 & Ranitree Dr	SB	YIELD	3	0.175937	2,000	1.972603	27	I-17 and 19th Avenue	WB	STOP	2	0.911	250	57.86
28	I-10 & Jefferson	NB	STOP	2	1.667176	80	249.4095	28	I-17 and Camelback Road	SB	None	4	0.765782	470	40.36485
28	I-17 & Thunderbird	SB	YIELD	2	0.557473	230	52.41215	29	I-17 & 7th St	NB	STOP	1	0.62991	100	93.32744
28	I-17 and 19th Avenue	WB	STOP	2	0.91054	250	57.86301	30	I-17 & Thunderbird	SB	YIELD	2	0.557473	230	52.41215
28	L101 & Frank Lloyd Wright	SB	YIELD	2	0.366274	650	10.11591	31	L101 & 19th Ave	WB	YIELD	1	0.550014	350	16.20813
32	I-17 & 7th St	NB	STOP	1	0.62991	100	93.32744	32	L101 & 7th Ave	EB	YIELD	1	0.506111	300	17.85895
32	I-17 & Cactus	SB	YIELD	1	0.403459	290	16.90912	33	I-17 & Thomas Rd	NB	None	4	0.492	1,270	5.84
32	I-17 & Dunlap Rd	SB	YIELD	1	0.154	1120	2.018	34	I-17 & Cactus	SB	YIELD	1	0.403459	290	16.90912
32	I-17 & Greenway Road	NB	YIELD	1	0.256021	410	8.501765	35	L101 & Frank Lloyd Wright	SB	YIELD	2	0.366274	650	10.11591
32	I-17 & Northern Avenue	NB	None	1	0.296915	570	6.953018	36	I-17 and Glendale Avenue	SB	None	1	0.360841	490	9.840649
32	I-17 and Glendale Avenue	SB	None	1	0.360841	490	9.840649	37	I-17 & Northern Avenue	NB	None	1	0.297	570	6.953
32	I-17 and Jefferson	SB	STOP	1	1.336254	70	258.317	38	I-17 & Greenway Road	NB	YIELD	1	0.256021	410	8.501765
32	L101 & 19th Ave	WB	YIELD	1	0.550014	350	16.20813	39	L101 & Ranitree Dr	SB	YIELD	3	0.175937	2,000	1.972603
32	L101 & 7th Ave	EB	YIELD	1	0.506111	300	17.85895	40	I-17 & Dunlap Rd	SB	YIELD	1	0.154475	1120	2.018102
41	I-10 & 99th Ave	EB	YIELD	0	0	3,230	0	41	I-10 & 99th Ave	EB	YIELD	0	0	3,230	0
41	I-10 and 99th Avenue	WB	None	0	0	160	0	41	I-10 and 99th Avenue	WB	None	0	0	160	0
41	I-17 & 16th St	EB	STOP	0	0	180	0	41	I-17 & 16th St	EB	STOP	0	0	180	0
41	I-17 & 7th Ave	EB	STOP	0	0	20	0	41	I-17 & 7th Ave	EB	STOP	0	0	20	0
41	I-17 & 7th Ave	WB	STOP	0	0	50	0	41	I-17 & 7th Ave	WB	STOP	0	0	50	0
41	I-17 & 7th St	SB	STOP	0	0	100	0	41	I-17 & 7th St	SB	STOP	0	0	100	0
41	I-17 & Buckeye Road	NB	None	0	0	720	0	41	I-17 & Buckeye Road	NB	None	0	0	720	0
41	I-17 & Deer Valley Rd	NB	YIELD	0	0	230	0	41	I-17 & Deer Valley Rd	NB	YIELD	0	0	230	0
41	I-17 & Deer Valley Rd	SB	YIELD	0	0	320	0	41	I-17 & Deer Valley Rd	SB	YIELD	0	0	320	0
41	I-17 & Dunlap Rd	NB	None	0	0	680	0	41	I-17 & Dunlap Rd	NB	None	0	0	680	0
41	I-17 & Grant Road	NB	YIELD	0	0	150	0	41	I-17 & Grant Road	NB	YIELD	0	0	150	0
41	I-17 & Northern Avenue	SB	None	0	0	910	0	41	I-17 & Northern Avenue	SB	None	0	0	910	0
41	I-17 & Union Hills	NB	YIELD	0	0	350	0	41	I-17 & Union Hills	NB	YIELD	0	0	350	0
41	I-17 & Utopia	NB	YIELD	0	0	430	0	41	I-17 & Utopia	NB	YIELD	0	0	430	0
41	I-17 and Bethany Home Road	NB	None	0	0	550	0	41	I-17 and Bethany Home Road	NB	None	0	0	550	0
41	I-17 and Bethany Home Road	SB	None	0	0	410	0	41	I-17 and Bethany Home Road	SB	None	0	0	410	0
41	I-17 and Glendale Avenue	NB	None	0	0	450	0	41	I-17 and Glendale Avenue	NB	None	0	0	450	0
41	I-17 and Indian School Road	NB	None	0	0	340	0	41	I-17 and Indian School Road	NB	None	0	0	340	0
41	I-17 and McDowell Road	SB	None	0	0	670	0	41	I-17 and McDowell Road	SB	None	0	0	670	0
41	I-17 and Thomas Rd	SB	YIELD	0	0	430	0	41	I-17 and Thomas Rd	SB	YIELD	0	0	430	0
41	L101 & 27th Ave	WB	YIELD	0	0	1,240	0	41	L101 & 27th Ave	WB	YIELD	0	0	1,240	0
41	L101 & 7th Ave	WB	YIELD	0	0	380	0	41	L101 & 7th Ave	WB	YIELD	0	0	380	0
41	L101 & Frank Lloyd Wright	NB	YIELD	0	0	2,420	0	41	L101 & Frank Lloyd Wright	NB	YIELD	0	0	2,420	0
41	L202 & Broadway Rd	SB	YIELD	0	0	190	0	41	L202 & Broadway Rd	SB	YIELD	0	0	190	0
41	SR 101 and 7th Street	WB	YIELD	0	0	470	0	41	SR 101 and 7th Street	WB	YIELD	0	0	470	0

Table 4: Ranking of Locations by Various Categories (Continued)

Ranking by Weave Length							
Ranking	Location	Direction	Existing Control	Crashes	Rate	Weave length	R Factor
1	I-17 & 7th Ave	EB	STOP	0	0	20	0
2	I-17 & 7th Ave	WB	STOP	0	0	50	0
3	I-17 & Grant	SB	YIELD	9	8.48777	70	1487.906
3	I-17 and Jefferson	SB	STOP	1	1.336254	70	258.317
5	I-10 & Jefferson	NB	STOP	2	1.667176	80	249.4095
6	I-17 & 7th St	NB	STOP	1	0.62991	100	93.32744
6	I-17 & 7th St	SB	STOP	0	0	100	0
8	SR 101 and University Drive	NB	YIELD	20	9.346296	110	1696.863
8	L101 & Elliot Rd	SB	YIELD	4	2.00146	110	276.8565
10	L101 & Broadway	NB	YIELD	20	5.387247	130	803.653
11	SR 101 and Warner	SB	YIELD	4	1.740403	140	201.6133
12	L101 & 67th	EB	YIELD	7	4.984925	150	321.4612
12	I-17 & Grant Road	NB	YIELD	0	0	150	0
14	I-10 and 99th Avenue	WB	None	0	0	160	0
15	L101 & 59th	EB	YIELD	4	2.218589	180	146.1187
15	I-17 & 16th St	EB	STOP	0	0	180	0
17	L101 & 59th Ave	WB	YIELD	5	2.664239	190	173.0353
17	L202 & Broadway Rd	SB	YIELD	0	0	190	0
19	I-17 & Pinnacle Peak Rd	NB	YIELD	3	1.462211	210	89.8494
20	L101 & Guadalupe	SB	YIELD	7	2.762	220	191.78
21	L101 & Elliot	NB	YIELD	6	3.643927	230	184.0817
21	I-17 & Thunderbird	SB	YIELD	2	0.557473	230	52.41215
21	I-17 & Deer Valley Rd	NB	YIELD	0	0	230	0
24	L101 & 67th Ave	WB	YIELD	11	3.859078	240	270.6178
25	L101 & Ray Rd	NB	YIELD	4	2.088902	250	105.2055
25	L101 & Warner	NB	YIELD	4	2.35707	250	107.6521
25	I-17 and 19th Avenue	WB	STOP	2	0.91054	250	57.86301
28	L101 & Ray Rd	SB	YIELD	9	2.753485	280	189.7839
29	L101 & Broadway	SB	YIELD	47	11.32052	290	936.5583
29	I-17 & Cactus	SB	YIELD	1	0.403459	290	16.90912
31	L101 & Southern Ave	SB	YIELD	11	5.657264	300	235.7382
31	L101 & 7th Ave	EB	YIELD	1	0.506	300	17.86
33	I-17 & Deer Valley Rd	SB	YIELD	0	0	320	0
34	L101 & 27th	EB	YIELD	13	4.758321	330	253.2725
34	L101 & 35th	EB	YIELD	7	3.18002	330	125.2446
34	L101 & 51st	EB	YIELD	5	3.26703	330	84.29926
37	I-17 and Indian School Road	SB	None	3	0.94011	340	47.2737
37	I-17 and Indian School Road	NB	None	0	0	340	0
39	L101 & 19th Ave	WB	YIELD	1	0.550014	350	16.20813
39	I-17 & Union Hills	NB	YIELD	0	0	350	0
41	I-17 and Durango Street	SB	STOP	6	1.184016	380	61.97079
41	L101 & 7th St	EB	YIELD	3	1.201381	380	40.7869
41	L101 & 7th Ave	WB	YIELD	0	0	380	0
44	I-17 & Greenway Road	NB	YIELD	1	0.256021	410	8.501765
44	I-17 and Bethany Home Road	SB	None	0	0	410	0
46	I-17 & Utopia	NB	YIELD	0	0	430	0
46	I-17 and Thomas Rd	SB	YIELD	0	0	430	0
48	I-17 and Glendale Avenue	NB	None	0	0	450	0
49	I-17 and Camelback Road	SB	None	4	0.765782	470	40.36485
49	SR 101 and 7th Street	WB	YIELD	0	0	470	0
51	I-17 and Glendale Avenue	SB	None	1	0.360841	490	9.840649
52	I-17 and Bethany Home Road	NB	None	0	0	550	0
53	I-17 & Northern Avenue	NB	None	1	0.297	570	6.95
54	L101 & Frank Lloyd Wright	SB	YIELD	2	0.366274	650	10.11591
55	I-17 and McDowell Road	SB	None	0	0	670	0
56	I-17 & Dunlap Rd	NB	None	0	0	680	0
57	I-17 & Buckeye Road	NB	None	0	0	720	0
58	I-17 and Peoria Road	SB	YIELD	14	2.39736	860	44.01664
59	I-17 & Northern Avenue	SB	None	0	0	910	0
60	I-17 & Dunlap Rd	SB	YIELD	1	0.154475	1,120	2.018102
61	L101 & 27th Ave	WB	YIELD	0	0	1,240	0
62	I-17 & Thomas Rd	NB	None	4	0.49203	1,270	5.841209
63	L101 & Ranitree Dr	SB	YIELD	3	0.175937	2,000	1.972603
64	L101 & Frank Lloyd Wright	NB	YIELD	0	0	2,420	0
65	I-10 & 99th Ave	EB	YIELD	0	0	3,230	0

Ranking by R-Factor							
Ranking	Location	Direction	Existing Control	Crashes	Rate	Weave length	R Factor
1	SR 101 and University Drive	NB	YIELD	20	9.346296	110	1696.863
2	I-17 & Grant	SB	YIELD	9	8.48777	70	1487.906
3	L101 & Broadway	SB	YIELD	47	11.32052	290	936.5583
4	L101 & Broadway	NB	YIELD	20	5.387247	130	803.653
5	L101 & 67th	EB	YIELD	7	4.984925	150	321.4612
6	L101 & Elliot Rd	SB	YIELD	4	2.00146	110	276.8565
7	L101 & 67th Ave	WB	YIELD	11	3.859078	240	270.6178
8	I-17 and Jefferson	SB	STOP	1	1.336254	70	258.317
9	L101 & 27th	EB	YIELD	13	4.758321	330	253.2725
10	I-10 & Jefferson	NB	STOP	2	1.667176	80	249.4095
11	L101 & Southern Ave	SB	YIELD	11	5.657264	300	235.7382
12	SR 101 and Warner	SB	YIELD	4	1.740403	140	201.6133
13	L101 & Guadalupe	SB	YIELD	7	2.761784	220	191.7808
14	L101 & Ray Rd	SB	YIELD	9	2.753	280	189.78
15	L101 & Elliot	NB	YIELD	6	3.643927	230	184.0817
16	L101 & 59th Ave	WB	YIELD	5	2.664239	190	173.0353
17	L101 & 59th	EB	YIELD	4	2.218589	180	146.1187
18	L101 & 35th	EB	YIELD	7	3.18002	330	125.2446
19	L101 & Warner	NB	YIELD	4	2.357	250	107.65
20	L101 & Ray Rd	NB	YIELD	4	2.089	250	105.21
21	I-17 & 7th St	NB	STOP	1	0.62991	100	93.32744
22	I-17 & Pinnacle Peak Rd	NB	YIELD	3	1.462211	210	89.8494
23	L101 & 51st	EB	YIELD	5	3.26703	330	84.29926
24	I-17 and Durango Street	SB	STOP	6	1.184016	380	61.97079
25	I-17 and 19th Avenue	WB	STOP	2	0.91054	250	57.86301
26	I-17 & Thunderbird	SB	YIELD	2	0.557473	230	52.41215
27	I-17 and Indian School Road	SB	None	3	0.940	340	47.27
28	I-17 and Peoria Road	SB	YIELD	14	2.39736	860	44.01664
29	L101 & 7th St	EB	YIELD	3	1.201381	380	40.7869
30	I-17 and Camelback Road	SB	None	4	0.765782	470	40.36485
31	L101 & 7th Ave	EB	YIELD	1	0.506111	300	17.85895
32	I-17 & Cactus	SB	YIELD	1	0.403459	290	16.90912
33	L101 & 19th Ave	WB	YIELD	1	0.550	350	16.21
34	L101 & Frank Lloyd Wright	SB	YIELD	2	0.366274	650	10.11591
35	I-17 and Glendale Avenue	SB	None	1	0.360841	490	9.840649
36	I-17 & Greenway Road	NB	YIELD	1	0.256021	410	8.501765
37	I-17 & Northern Avenue	NB	None	1	0.296915	570	6.95
38	I-17 & Thomas Rd	NB	None	4	0.492	1,270	5.84
39	I-17 & Dunlap Rd	SB	YIELD	1	0.154475	1,120	2.018102
40	L101 & Ranitree Dr	SB	YIELD	3	0.175937	2,000	1.972603
41	I-10 & 99th Ave	EB	YIELD	0	0	3,230	0
41	I-10 and 99th Avenue	WB	None	0	0	160	0
41	I-17 & 16th St	EB	STOP	0	0	180	0
41	I-17 & 7th Ave	EB	STOP	0	0	20	0
41	I-17 & 7th Ave	WB	STOP	0	0	50	0
41	I-17 & 7th St	SB	STOP	0	0	100	0
41	I-17 & Buckeye Road	NB	None	0	0	720	0
41	I-17 & Deer Valley Rd	NB	YIELD	0	0	230	0
41	I-17 & Deer Valley Rd	SB	YIELD	0	0	320	0
41	I-17 & Dunlap Rd	NB	None	0	0	680	0
41	I-17 & Grant Road	NB	YIELD	0	0	150	0
41	I-17 & Northern Avenue	SB	None	0	0	910	0
41	I-17 & Union Hills	NB	YIELD	0	0	350	0
41	I-17 & Utopia	NB	YIELD	0	0	430	0
41	I-17 and Bethany Home Road	NB	None	0	0	550	0
41	I-17 and Bethany Home Road	SB	None	0	0	410	0
41	I-17 and Glendale Avenue	NB	None	0	0	450	0
41	I-17 and Indian School Road	NB	None	0	0	340	0
41	I-17 and McDowell Road	SB	None	0	0	670	0
41	I-17 and Thomas Rd	SB	YIELD	0	0	430	0
41	L101 & 27th Ave	WB	YIELD	0	0	1,240	0
41	L101 & 7th Ave	WB	YIELD	0	0	380	0
41	L101 & Frank Lloyd Wright	NB	YIELD	0	0	2,420	0
41	L202 & Broadway Rd	SB	YIELD	0	0	190	0
41	SR 101 and 7th Street	WB	YIELD	0	0	470	0

Table 5: Overall Ranking of Locations by Weighted Average

Overall Ranking by Weighted Average								
Ranking	Location	Direction	Existing Control	Crashes	Rate	Weave length	R Factor	Wt Avg Rank
1	SR 101 and University Drive	NB	YIELD	2	2	8	1	3.3
2	I-17 & Grant	SB	YIELD	8	3	3	2	3.4
3	L101 & Broadway	NB	YIELD	2	5	10	4	5.6
4	L101 & 67th	EB	YIELD	10	6	12	5	7.8
5	L101 & Broadway	SB	YIELD	1	1	29	3	8.5
6	L101 & 67th Ave	WB	YIELD	6	8	24	7	11.5
7	L101 & Southern Ave	SB	YIELD	6	4	31	11	12.8
7	L101 & Elliot Rd	SB	YIELD	17	19	8	6	12.8
9	L101 & 27th	EB	YIELD	5	7	34	9	14.0
9	L101 & Guadalupe	SB	YIELD	10	12	20	13	14.0
9	L101 & Elliot	NB	YIELD	13	9	21	15	14.0
12	I-10 & Jefferson	NB	STOP	28	21	5	10	15.1
13	L101 & 59th Ave	WB	YIELD	15	14	17	16	15.4
13	SR 101 and Warner	SB	YIELD	17	20	11	12	15.4
13	I-17 and Jefferson	SB	STOP	32	23	3	8	15.4
16	L101 & Ray Rd	SB	YIELD	8	13	28	14	16.4
17	L101 & 59th	EB	YIELD	17	17	15	17	16.5
18	L101 & 35th	EB	YIELD	10	11	34	18	18.4
19	L101 & Warner	NB	YIELD	17	16	25	19	19.1
20	L101 & 51st	EB	YIELD	15	10	34	23	19.9
21	L101 & Ray Rd	NB	YIELD	17	18	25	20	20.1
22	I-17 & Pinnacle Peak Rd	NB	YIELD	24	22	19	22	21.5
23	I-17 & 7th St	NB	STOP	32	29	6	21	21.6
24	I-17 and 19th Avenue	WB	STOP	28	27	25	25	26.1
25	I-17 & Thunderbird	SB	YIELD	28	30	21	26	26.5
26	I-17 and Durango Street	SB	STOP	13	25	41	24	27.3
27	I-17 and Peoria Road	SB	YIELD	4	15	58	28	27.6
28	I-17 and Indian School Road	SB	None	24	26	37	27	28.8
29	L101 & 7th St	EB	YIELD	24	24	41	29	29.5
30	I-17 & 7th Ave	EB	STOP	41	41	1	41	31.0
31	I-17 & 7th Ave	WB	STOP	41	41	2	41	31.3
32	L101 & 7th Ave	EB	YIELD	32	32	31	31	31.5
33	I-17 & Cactus	SB	YIELD	32	34	29	32	32.0
34	I-17 & 7th St	SB	STOP	41	41	6	41	32.3
35	I-17 and Camelback Road	SB	None	17	28	49	30	32.4
36	L101 & 19th Ave	WB	YIELD	32	31	39	33	33.6
37	I-17 & Grant Road	NB	YIELD	41	41	12	41	33.8
38	I-10 and 99th Avenue	WB	None	41	41	14	41	34.3
39	I-17 & 16th St	EB	STOP	41	41	15	41	34.5
40	L202 & Broadway Rd	SB	YIELD	41	41	17	41	35.0
41	I-17 & Deer Valley Rd	NB	YIELD	41	41	21	41	36.0
42	I-17 & Greenway Road	NB	YIELD	32	38	44	36	38.3
43	L101 & Frank Lloyd Wright	SB	YIELD	28	35	54	34	38.6
44	I-17 and Glendale Avenue	SB	None	32	36	51	35	39.0
44	I-17 & Deer Valley Rd	SB	YIELD	41	41	33	41	39.0
46	I-17 & Thomas Rd	NB	None	17	33	62	38	39.5
47	I-17 and Indian School Road	NB	None	41	41	37	41	40.0
48	I-17 & Northern Avenue	NB	None	32	37	53	37	40.4
49	I-17 & Union Hills	NB	YIELD	41	41	39	41	40.5
50	L101 & 7th Ave	WB	YIELD	41	41	41	41	41.0
51	I-17 and Bethany Home Road	SB	None	41	41	44	41	41.8
52	I-17 & Utopia	NB	YIELD	41	41	46	41	42.3
52	I-17 and Thomas Rd	SB	YIELD	41	41	46	41	42.3
54	I-17 and Glendale Avenue	NB	None	41	41	48	41	42.8
55	SR 101 and 7th Street	WB	YIELD	41	41	49	41	43.0
56	L101 & Ranitree Dr	SB	YIELD	24	39	63	40	43.4
57	I-17 & Dunlap Rd	SB	YIELD	32	40	60	39	43.8
57	I-17 and Bethany Home Road	NB	None	41	41	52	41	43.8
59	I-17 and McDowell Road	SB	None	41	41	55	41	44.5
60	I-17 & Dunlap Rd	NB	None	41	41	56	41	44.8
61	I-17 & Buckeye Road	NB	None	41	41	57	41	45.0
62	I-17 & Northern Avenue	SB	None	41	41	59	41	45.5
63	L101 & 27th Ave	WB	YIELD	41	41	61	41	46.0
64	L101 & Frank Lloyd Wright	NB	YIELD	41	41	64	41	46.8
65	I-10 & 99th Ave	EB	YIELD	41	41	65	41	47.0

## Summary and Results of the Crash Analysis

Shown below is a brief summary of the crash analysis included in **Table 4** and **Table 5**.

### Overall Summary

- A total of 65 locations were included in the analysis,
- Nine of the 65 locations were STOP controlled, 42 were YIELD controlled and 14 have no traffic control signs,
- The average weave length of all the locations analyzed was 462 feet,
- Average weave length of the top 10 locations based on weighted average was 202 feet,
- Average weave length of the bottom 10 locations based on weighted average was 1,273 feet,
- 75<sup>th</sup> percentile crash rate was 2.377215,
- Average weave length above the 75<sup>th</sup> percentile crash rate was 272 feet,
- 20 of the top 25 locations based on the crash rate had weave lengths less than 300 feet,
- 23 of the top 25 locations based on the crash rate were YIELD controlled,
- Eight of the bottom 25 locations based on the crash rate had weave lengths less than 300 feet,
- 12 of the bottom 25 locations based on the crash rate were YIELD controlled,
- 22 of the top 25 locations based on the weighted average had weave lengths less than 300 feet,
- 21 of the top 25 locations based on the weighted average were YIELD controlled,
- 14 of the bottom 25 locations based on the weighted average were YIELD controlled, and
- Two of the bottom 25 locations based on the weighted average had weave lengths less than 300 feet.

### STOP Controlled Locations Summary

- Average weave length of the STOP controlled locations was 137 feet,
- 75<sup>th</sup> percentile crash rate at the STOP controlled locations was 1.26, and
- Average weave length above the 75<sup>th</sup> percentile crash rate at the STOP controlled locations was 75 feet.

### YIELD Controlled Locations Summary

- Average weave length of the YIELD controlled locations was 494 feet,
- Average weave length of the top 10 YIELD controlled locations by weighted average was 192 feet,
- Average weave length of the bottom 10 YIELD controlled locations by weighted average was 1,207 feet,
- 75<sup>th</sup> percentile crash rate of the YIELD controlled locations was 3.361254, and
- Average weave length above the 75<sup>th</sup> percentile crash rate at the YIELD controlled locations was 214 feet.

### NO Traffic Control Locations Summary

- Average weave length of the locations with NO traffic control was 574 feet,
- 75<sup>th</sup> percentile crash rate of the NO traffic control locations was 0.393638, and
- Average weave length above the 75<sup>th</sup> percentile crash rate at the NO traffic control locations was 693 feet.

Based on the crash analysis and the summary described above, it was concluded that the locations with YIELD signs and weave lengths less than 300 feet had the highest ranking. Locations with YIELD signs and weave lengths greater than 1,000 feet ranked the lowest for crash rates.

According to the Manual on Uniform Traffic Control Devices (MUTCD) Table 2C-4 and the American Association of State Highway and Transportation Officials (AASHTO) Policy on Geometric Design, vehicle drivers need approximately 4.5 seconds of time for making vehicle maneuvers in addition to the perception-reaction time to adjust speed and lane changes in heavy traffic, which would include performing weaving maneuvers. Assuming the typical frontage road posted speed limit of 45 mph, this 4.5 second time demand results in a distance of 300 feet required for a driver in an ideal setting free from any side friction to perform a weave maneuver. Assuming the perception-reaction time occurs before approaching the striped gore, an additional 300 feet is needed from the tip of the striped gore to the solid white intersection striping for a driver to be able to perform the weaving maneuver.

Using the ranking of the intersections based on the weave length, as shown in **Table 4**, the majority of the existing data suggests that STOP control is the efficient control for weave lengths of less than 250 feet. The data also suggests that weave lengths with greater than 350 feet benefit with the application of a NO Control.

A STOP sign in association with a STOP bar is a strong indication that vehicles must STOP. As drivers are not required to come to complete stop at a YIELD sign, at locations with multiple maneuvers and longer weave distances, a false sense of security is expected among drivers on the merging lanes that do not have the YIELD control. Therefore, based on discussions and guidance with ADOT, YIELD signs are not recommended as recommended traffic control as part of this project.

Existing crash data analysis as shown in **Table 4** suggests that STOP control is an efficient control for weave lengths of less than 250 feet. However, with and through additional consultation and guidance from ADOT, STOP signs for weave distances of less than 250 are suggested, but not required. There is also the option of recommending NO Control at weave lengths shorter than 250 feet weave lengths while also considering other recommendations like shortening of the gore, advisory warning signs and advisory speeds. Therefore, per ADOT's guidance, the STOP sign recommendations in this project are notated as "should" be installed (suggestion only) instead of "shall" be installed (mandatory).

These important factors and assumptions discussed above, together with the crash analysis findings, are important in informing the recommended traffic control.

## Recommended Traffic Control

Based on the conclusions from the crash analysis, the MUTCD/AASHTO suggestions and discussions with ADOT, the below standards/guidelines are recommended for the frontage road traffic control. **Figure 11** is a flowchart illustrating the below described sequencing of steps/considerations in determining the recommended traffic control for one lane and two-lane frontage roads.

1. If STOP (R1-1) signs are recommended on a two lane frontage road, then, STOP signs should be installed on both sides of the frontage road in which case the sign located in the gore area on the left side of the frontage road will be visible to the exit ramp traffic causing confusion. In situations where a STOP sign is required on a two-lane frontage road, the STOP sign within the gore area between frontage road and exit ramp shall be shielded from the exit ramp traffic.
2. If the weaving distance (distance between tip of striped gore to the beginning of the solid white lane line stripe at the arterial street intersection) is less than 250 feet, consider restriping to shorten the striped gore, where physically possible, to provide a weaving distance of 250 feet or more.
3. For single lane frontage roads with a weaving distance of less than 250 feet, and after confirmation of STEP 2, one STOP sign should be installed on the right side of frontage road.
4. For two lane frontage roads with a weaving distance of less than 250 feet, and after confirmation of STEP 2, a traffic volume analysis shall be completed to determine if the two frontage road lanes should be merged into one frontage road lane based on the following criteria:
  - Number of lanes and traffic volumes upstream and downstream of the striped gore where frontage road merges with the exit ramp,
  - Signal timing at the arterial street intersection to determine if any existing traffic volume backups can/cannot be mitigated by adjusting the signal timing,
  - Crashes associated with weaving vehicles between the physical gore and arterial street intersection to ensure number of crashes at the study location are not increasing by eliminating one lane,
  - Presence of driveways between the physical gore and the arterial street intersection ensure that there are no driveway conflicts,
  - To ensure that sight visibility is adequate and not compromised by eliminating one lane, etc.
  - Merge lanes should only be recommended to create exclusive lanes where the ramp and frontage roads have their own receiving lanes at the intersection. Lane traps should be avoided if merging lanes is recommended.

If all of the above criteria are met, then install a stop sign on the right side of the frontage road.

5. If the weaving distance for a two-lane frontage road cannot be increased/expanded to 250 feet per STEP 2, and if the traffic analysis determines that the two-lane frontage road cannot be merged into one lane, then a two STOP signs should be installed, one on each side of the frontage road. The STOP sign located on the left side of the frontage road within the gore area between the frontage road and exit ramp shall be shielded from the exit ramp traffic.
6. If the weaving distance is between 250 feet and 350 feet for either a one lane or two-lane frontage roads, no sign should be recommended with an option of installing a STOP sign based on discretion of the Regional Traffic Engineer.
7. If the weaving distance is greater than 350 feet for either one lane or two-lane frontage roads, no traffic control sign is recommended.

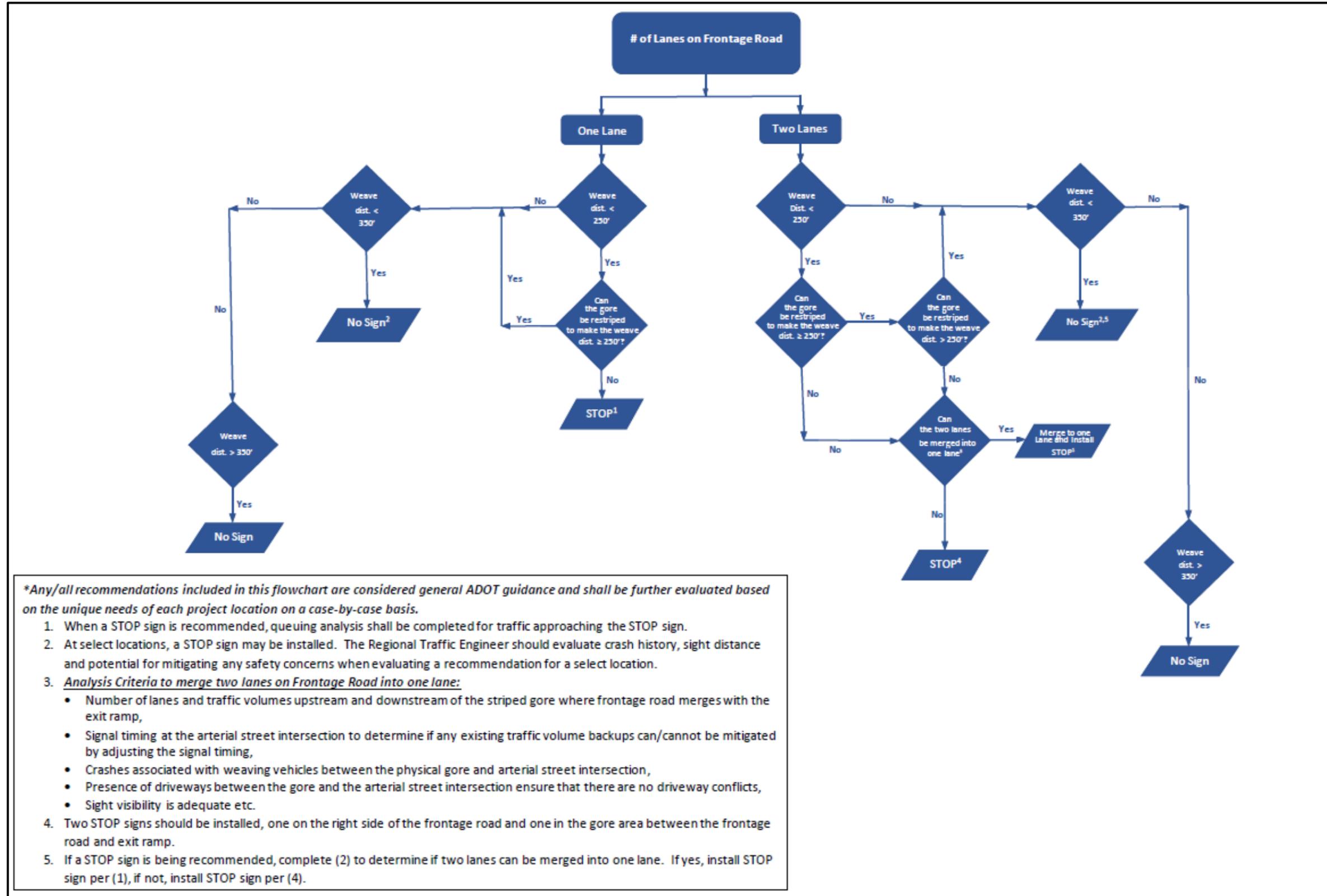


Figure 11: Flowchart of the Traffic Control Recommendations Along Frontage Roads

## Sign Size Recommendations

Recommended sign sizes along the frontage roads where they merge with the exit ramps within the Central District are as follows:

1. STOP (R1-1) signs shall be 36" x 36" (per MUTCD Section 2B.03).
2. STOP AHEAD (W3-1) signs shall be 36" x 36" (per MUTCD Section 2B.03).
3. Larger signs may be considered to bring attention to sign if deemed necessary by the Regional Traffic Engineer (RTE).

## Placement of Signs and Pavement Marking Recommendations

Locations of the sign placements along the frontage roads where they merge with the exit ramps within the Central District are as follows:

1. For single lane frontage roads with no sight visibility constraints (such as landscaping, noise reduction walls, vertical geometry of the ramp and frontage road etc.) between the frontage road and exit ramp, and the distance between striped gore and physical gore is greater than 50 feet a STOP sign (as recommended per the *Recommended Traffic Control* section) should be placed 50 feet from the tip of the striped gore on the right-hand side of the approach as shown in **Figure 12**.

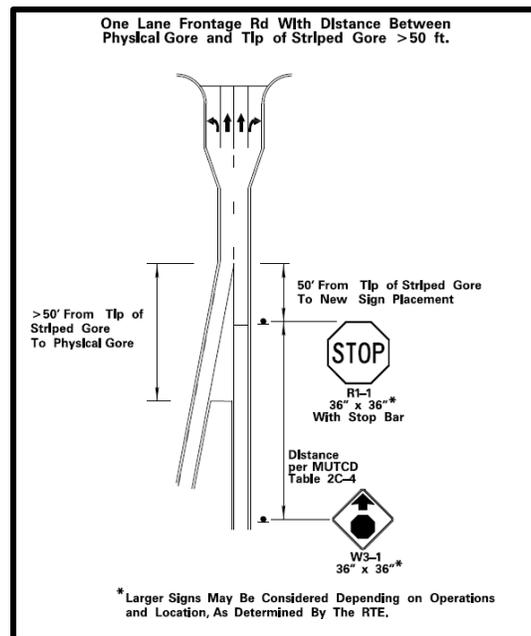


Figure 12: Sign Placement for One Lane Frontage Road - Distance Between Striped Gore and Physical Gore > than 50 feet

2. For single lane frontage roads with no sight visibility constraints between the frontage road and exit ramp, and if the distance between physical gore and striped gore is less than 50 feet, a STOP sign (as recommended per the *Recommended Traffic Control* section) should be placed at the physical gore on the right-hand side of the approach shown in **Figure 13**.

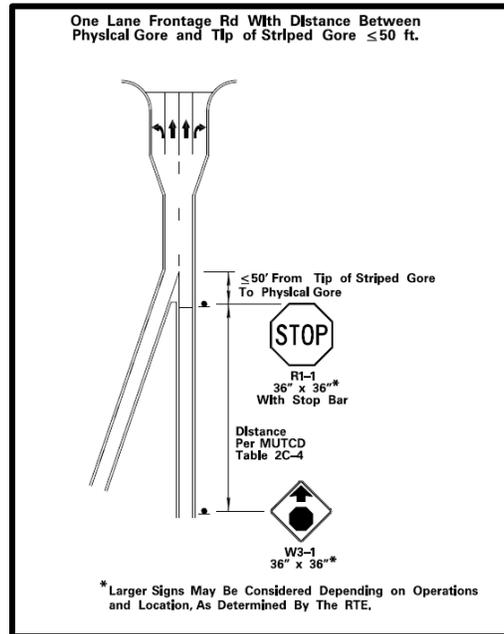


Figure 13: Sign Placement for One Lane Frontage Road - Distance Between Striped Gore and Physical Gore < than 50 feet

- For two-lane frontage roads with no sight visibility constraints between the frontage road and exit ramp, and the distance between striped gore and physical gore is greater than 50 feet, a STOP sign should be placed at 50 feet from the tip of striped gore on the both sides of the frontage road approach as shown in **Figure 14**. The STOP sign placed on the left-hand side of the frontage road shall be angled towards the frontage road and shielded from the exit ramp traffic.

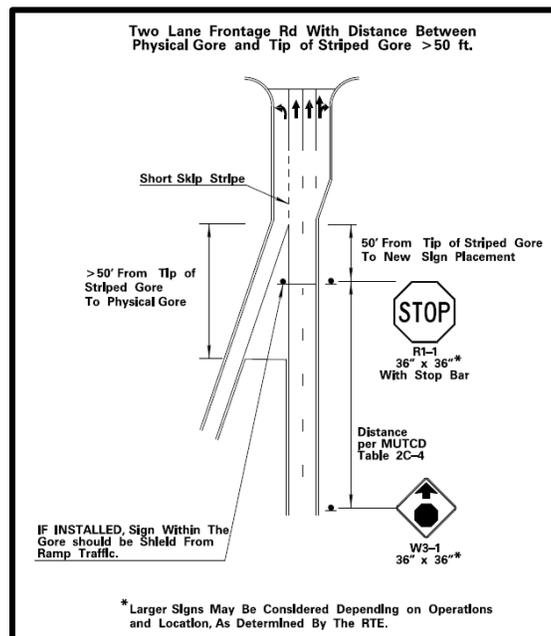


Figure 14: Sign Placement for Two Lane Frontage Road - Distance Between Striped Gore and Physical Gore > than 50 feet

- For two-lane frontage roads with no sight visibility constraints between the frontage road and exit ramp, and the distance between the striped gore and physical gore is less than 50 feet, a STOP

sign should be placed at the physical gore on the both sides of the approach as shown in **Figure 15**. The STOP sign placed on the left-hand side of the frontage road shall be angled towards the frontage road and shielded from the exit ramp traffic.

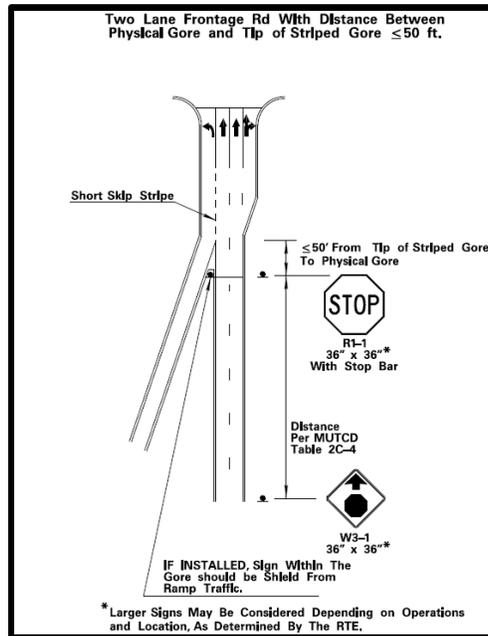


Figure 15: Sign Placement for Two Lane Frontage Road - Distance Between Striped Gore and Physical Gore < than 50 feet

5. If there are sight visibility constraints between the frontage road and exit ramp, the STOP sign (as recommended per the **Recommended Traffic Control** section) should be placed at 10 feet from the tip of the striped gore for both one lane and two-lane frontage roads, assuming that there are no additional sight visibility restrictions at this location.
6. "Stop Ahead" signs should be installed in accordance with MUTCD Table 2C-4: Placement of Advance Warning Signs.
7. At locations where lane traps exist and lane changes are expected due lane traps, short skip stripe shall be installed. The beginning of skip stripe shall be in accordance to the lane drop taper length. In cases where full lane drop taper length cannot be accommodated, short skip lane stripe shall begin at the tip of the striped gore. Skip lane stripe line type shall be determined by the RTE based on anticipated lane changes.
8. In addition to the short skip stripe, lane use arrows should be installed where lane traps occur.
9. Where lane traps exist and a through lane from the frontage road and/or exit ramp is converted to an exclusive turn lane at the intersection, Thru Traffic Merge Left/Right (W9-101) sign is recommended to be installed.

Lane geometry of the frontage road, exit ramp and the intersection shown in **Figure 12** through **Figure 15** are general schematics only and not a representation of the existing conditions.

## CHAPTER 6 SPOT IMPROVEMENT LOCATIONS, ANALYSIS AND RECOMMENDATIONS

Chapter 6 presents analysis and traffic control recommendations for ten priority spot improvement locations along ADOT's Central District freeway frontage roads where the frontage road merges with the exit ramp. Based on a review of the crash analysis and complaint log, together with discussions and guidance from ADOT staff, the top ten locations within the Central District with the highest number of crashes were selected for the spot improvement analysis.

The following locations were vetted with ADOT staff and selected for conceptual design spot improvement recommendations along ADOT's Freeway frontage roads in the Central District:

1. SR 101 and Broadway Road; southbound direction
2. SR 101 and University Drive; northbound direction
3. SR 101 and Broadway Road; northbound direction
4. I-17 and Peoria Avenue; southbound direction
5. SR 101 and 27<sup>th</sup> Avenue; eastbound direction
6. SR 101 and 67<sup>th</sup> Avenue; westbound direction
7. SR 101 and Southern Avenue; southbound direction
8. I-17 and Grant Street; southbound direction
9. SR 101 and Ray Road; southbound direction
10. SR 101 and 35<sup>th</sup> Avenue; eastbound direction

The following section details the existing conditions, analysis, and recommendations for each of the ten spot improvement locations.

## SR 101 and Broadway Road; southbound direction

### Existing Conditions

- Two lanes exist on the frontage road and one lane on the exit ramp. There is one exclusive left-turn lane, one shared thru/left-turn lane, one shared thru/right-turn lane and one exclusive right turn lane at the Broadway Road intersection. The two frontage road lanes are directly aligned with the downstream shared thru/left and the shared thru/right turn lanes at the intersection. The exit ramp lane aligns with the downstream exclusive left-turn lane at the intersection.
- There is an existing YIELD sign and Yield Shark Teeth pavement marking approximately 60 feet from the location where vehicle maneuvers are permitted between the frontage road and exit ramp. A supplemental “To Ramp” plaque exists under the Yield sign. There is no advance Yield Ahead traffic sign.
- The existing weave length is 290 feet. Distance from the physical gore to the striped gore is 300 feet.
- There are two existing driveways within the weave length, one where the intersection striping begins, and a second within the weaving area between the exit ramp and frontage road is permitted.
- A total of 46 crashes were reported at this location between 2012 and 2016. 32 of the 46 crashes are rear end crashes, two are rear-to-side, two are angled crashes, nine side swipe crashes in the same direction and one crash noted as “other”.
- Four sideswipe crashes, one rear-to-side crash and one angled crash were reported within the weave length area. Two sideswipe crashes were reported at the Village Antigua Apartment driveway, traffic existing from this driveway could be the contributing factor for these crashes.
- 34 of the 46 crashes are no injury crashes, six possible injury, five non-incapacitating injury and one incapacitating injury crashes.
- 18 of the 46 crashes reported were during dark lighted conditions and the remaining 28 during daylight.
- The year 2019 ADT is 10,764 on the frontage road and 14,381 ADT on the exit ramp.
- Drainage grates exist on the roadway between the physical gore and the end of the solid striped gore where the vehicle weaving maneuver is permitted.

### Analysis and Recommendations

- Based on application of the flowchart shown in **Figure 11**, for a two-lane frontage road, if the weave length is between 250’ and 350’, then, no traffic control sign is needed with an option of installing a STOP sign.
- Based on the ADOT roadway functional classification maps, frontage roads are classified as minor collector roadways. According to the MCDOT Roadway Design Manual Table 2.1, the capacity of a two-lane undivided urban minor collector is 9,200 average daily traffic (ADT) for a desired level-of-service (LOS) B. Therefore, a one lane minor collector can accommodate 4,600 ADT with a desired LOS B. The existing 10,764 vehicles will result in unacceptable levels-of-service at this location. Therefore, the existing two-lane frontage road is not recommended to be merged to one lane.
- Based on discussions with ADOT, no traffic control sign is recommended at this location.

- It is recommended that the existing YIELD sign assembly be removed from its current location. The existing shark teeth marking is recommended to be obliterated per ADOT obliteration procedures.
- It is recommended that the location be monitored for safety for 3 – 6 months after the existing YIELD sign is removed. If the recommended No Control results in more crashes compared to the crash data that was analyzed as part of this project, a STOP sign shall be installed while considering other measures to reduce the undue delays.
- 12" white chevron markings may be recommended to be installed within the striped gore with the approval of the ADOT Regional Traffic Engineer. Bollards may be recommended along the exit ramp solid white striped gore to restrict the lane changes within the striped gore with the approval of the ADOT Regional Traffic Engineer. Type and specifications of the bollards shall be determined by the ADOT Regional Traffic Engineer.
- ADOT should evaluate the ramp to determine the costs and potential benefits of installing an additional exit ramp lane at this location.

## SR 101 and University Drive northbound direction

### Existing Conditions

- Two lanes exist on the frontage road and one lane on the exit ramp. There is one exclusive left-turn lane, one shared thru/left-turn lane, one shared thru/right-turn lane and one exclusive right turn lane at the University Drive intersection. The two frontage road lanes are directly aligned with the downstream shared thru/left and the shared thru/right turn lanes at the intersection. The exit ramp lane aligns with the downstream exclusive left-turn lane at the intersection.
- There is an existing YIELD sign and Yield Shark Teeth pavement marking approximately 265 feet from the tip of the striped gore. A supplemental “To Ramp” plaque exists under the Yield sign. There is no advance Yield Ahead traffic sign.
- The existing weave length is 110 feet. Distance from the physical gore to the tip of the striped gore is 290 feet.
- There is one existing driveway within the weave length leading to Hawthorn Suites.
- A total of 20 crashes were reported at this location between 2012 and 2016. Ten of the 20 crashes are rear end crashes, one is an angled crash and nine side swipe crashes in the same direction.
- Eighteen of the 20 crashes are no injury crashes, one possible injury and one non-incapacitating injury crashes.
- Thirteen of the 20 crashes reported are during day light, six during dark lighted conditions one during dark no lighted conditions.
- The 2019 ADT is 5,297 on the frontage road and 15,634 ADT on the exit ramp.

### Analysis and Recommendations

- Since the weave length is 110 feet and the striped gore is 290 feet, restriping the gore to increase the weave length to 250 feet is not physically possible without major infrastructure modifications. Based on the application of the flowchart shown in **Figure 11**, for a two-lane frontage road, if the gore cannot be restriped to increase the weave distance to 250 feet or greater, then, a traffic volume analysis shall be completed to determine if the two lanes can be merged into one lane and install a STOP sign.
- Based on the ADOT roadway functional classification maps, frontage roads are classified as minor collector roadways. According to the MCDOT Roadway Design Manual Table 2.1, the capacity of a two-lane undivided urban minor collector is 9,200 average daily traffic (ADT) for a desired level-of-service (LOS) B. Therefore, a one lane minor collector can accommodate 4,600 ADT with a desired LOS B. The existing 5,297 vehicles will result in slightly poorer LOS than LOS B, however, the acceptable LOS per the ADOT Traffic Engineering Guidelines and Procedures (TGP) is LOS C. Therefore, the one lane frontage road is expected to accommodate the existing 5,297 ADT with an acceptable LOS. However, based on discussions with ADOT, it is not recommended to reduce the existing lanes on frontage road.
- It is recommended that the existing YIELD sign assembly be removed from its current location and two new 36”x36” STOP (R1-1) signs and stop bar be installed at 50 feet from the tip of the striped gore as shown in **Figure 12**.

- A new 36"x36" advance Stop Ahead (W3-1) warning sign is recommended to be installed along the frontage road 175 feet from the STOP sign as shown in **Figure 12**, per MUTCD Table 2C-4 advance warning sign placement.
- 12" white chevron markings may be recommended to be installed within the striped gore with the approval of the ADOT Regional Traffic Engineer. Bollards may be recommended along the exit ramp solid white striped gore to restrict the lane changes within the striped gore with the approval of the ADOT Regional Traffic Engineer. Type and specifications of the bollards shall be determined by the ADOT Regional Traffic Engineer.
- ADOT should evaluate the ramp to determine the costs and potential benefits of installing an additional exit ramp lane at this location.

## SR 101 and Broadway Road northbound direction

### Existing Conditions

- Two lanes exist on the frontage road and one lane on the exit ramp. There is one exclusive left-turn lane, one shared thru/left-turn lane, one shared thru/right-turn lane and one exclusive right turn lane at the Broadway Road intersection. The two frontage road lanes are directly aligned with the downstream shared thru/left and the shared thru/right turn lanes at the intersection. The exit ramp lane aligns with the downstream exclusive left-turn lane at the intersection.
- There is an existing YIELD sign and Yield Shark Teeth pavement marking approximately 45 feet from the tip of the striped gore. A supplemental “To Ramp” plaque exists under the Yield sign. There is no advance Yield Ahead traffic sign.
- The existing weave length is 130 feet. Distance from the physical gore to the tip of the striped gore is 280 feet.
- There one private driveway existing within the weave length.
- A total of 20 crashes were reported at this location between 2012 and 2016. Twelve of the 20 crashes are rear end crashes, two are angled crashes, five side swipe crashes in the same direction and one single vehicle crash.
- Eighteen of the 20 crashes are no injury crashes and two non-incapacitating injury crashes.
- Seventeen of the 20 crashes reported are during day light, one during dawn and two during dark lighted conditions.
- The year 2019 ADT is 7,072 on frontage road and 13,252 ADT on the exit ramp.

### Analysis and Recommendations

- Since the weave length is 130 feet and the striped gore is 280 feet, restriping the gore to increase the weave length to 250 feet is physically not possible. Based on the application of the flowchart shown in **Figure 11**, for a two-lane frontage road, if the gore cannot be restriped to increase the weave distance to 250 feet or greater, then, a traffic volume analysis shall be completed to determine if the two lanes can be merged into one lane and install a STOP sign.
- Based on the ADOT roadway functional classification maps, frontage roads are classified as minor collector roadways. According to the MCDOT Roadway Design Manual Table 2.1, the capacity of a two-lane undivided urban minor collector is 9,200 for a desired level-of-service (LOS) B. Therefore, a one lane minor collector can accommodate 4,600 ADT for a desired LOS B. The existing 7,072 ADT at this location are significantly higher than the one lane minor collector threshold of 4,600 ADT. Therefore, a one lane frontage road is not expected to be adequate to accommodate the existing traffic volumes at this location.
- It is recommended that the existing YIELD sign assembly be removed and two new STOP 36”x36” signs and stop bar be installed 50 feet from the tip of the striped gore as shown in **Figure 14**.
- A new 36”x36” advance STOP Ahead (W3-1) warning sign is recommended to be installed along the frontage road 175 feet from the YISTOPELD sign as shown in **Figure 14**, per MUTCD Table 2C-4 advance warning sign placement.
- Bollards may be recommended along the exit ramp solid white striped gore with the approval of the ADOT Regional Traffic Engineer to restrict the lane changes within the striped gore. Type and specifications of the bollards shall be determined by the ADOT Regional Traffic Engineer.

- ADOT should evaluate the ramp to determine the costs and potential benefits of installing an additional exit ramp lane at this location.

### I-17 and Peoria Avenue; southbound direction

#### Existing Conditions

- One lane exists on the frontage road and one lane on the exit ramp. There is one exclusive left-turn lane, one shared thru/left-turn lane, one shared thru/right-turn lane and one exclusive right turn lane at the Peoria Avenue intersection.
- There is an existing YIELD sign approximately 260 feet from the tip of the striped gore. A supplemental “To Ramp” plaque exists under the Yield sign. There is no advance Yield Ahead traffic sign.
- The existing weave length is 860 feet. Distance from the end of the noise wall to the striped gore is 650 feet.
- There are no existing driveways within the weave length.
- A total of 14 crashes were reported at this location between 2012 and 2016. Twelve of the 14 crashes are rear end, one side swipe crash in the same direction and one single vehicle crash.
- Eleven of the 14 crashes are no injury crashes and three are possible injury crashes.
- Twelve of the 14 crashes reported during day light and the remaining two are reported during dark lighted conditions.
- All 14 reported crashes are within the striped gore, approximately between 90 feet and 120 feet of the noise wall.
- The year 2019 ADT is 3,025 on frontage road and 12,242 ADT on the exit ramp.

#### Analysis and Recommendations

- Based on application of the flowchart shown in **Figure 11**, for one lane or two-lane frontage roads, if the weave length is greater than 350 feet, then, no traffic control is needed. Therefore, no traffic control is recommended at this location.
- The existing Yield sign assembly is recommended to be removed from its current location.
- It is recommended that the location be monitored for safety for 3 – 6 months after the existing YIELD sign is removed. If the recommended No Control results in more crashes compared to the crash data that was analyzed as part of this project, a STOP sign shall be installed while considering other measures to reduce the undue delays that are expected to be caused by the shopping center driveways.
- 12” white chevron markings may be recommended to be installed within the striped gore with the approval of the ADOT Regional Traffic Engineer. Bollards may be recommended along the exit ramp solid white striped gore to restrict the lane changes within the striped gore with the approval of the ADOT Regional Traffic Engineer. Type and specifications of the bollards shall be determined by the ADOT Regional Traffic Engineer.
- The frontage road lane is aligned with the exclusive right-turn lane at the intersection resulting in right-turn lane traps. Using a 40-mph speed limit and a lane width of 12 feet, a lane change taper of 480 feet is required per MUTCD. Therefore, a 480-foot short skip stripe is recommended to be installed from the exclusive right-turn lane stripe. Exclusive lane use arrows are recommended to be installed for all lanes where the short skip stripe begins.
- Thru Traffic Merge Left (W9-101L) sign is recommended to be installed on the right side of the roadway at the beginning of the short skip stripe.

## SR 101 and 27<sup>th</sup> Avenue eastbound direction

### Existing Conditions

- Two lanes exist on the frontage road and one lane on the exit ramp. There is one exclusive left-turn lane, one shared thru/left-turn lane, one shared thru/right-turn lane and one exclusive right turn lane at the 27<sup>th</sup> Avenue intersection. The two frontage road lanes are directly aligned with the downstream shared thru/left and the shared thru/right turn lanes at the intersection. The exit ramp lane leads to the exclusive left-turn lane at the intersection.
- There are two existing YIELD signs approximately 360 feet from the tip of the striped gore, one on the right side of the frontage road and one on the left side within the gore. A supplemental “To Ramp” plaque exists under the Yield sign.
- Two advance Yield Ahead signs exist approximately 360 feet from the YIELD sign, one on the right side of the frontage road and one on the left side.
- The existing weave length is 330 feet. Distance from the physical gore to the tip of the striped gore is 250 feet.
- There are no existing driveways within the weave length.
- A total of 13 crashes were reported at this location between 2012 and 2016. Seven of the 13 crashes are rear end crashes, five are side swipe crashes in the same direction and one single vehicle crash.
- Six of the 13 crashes are no injury crashes, six are possible injury crashes and one non-incapacitating injury crash.
- Eleven of the 13 crashes reported are during day light, one during dusk and one during dark lighted conditions.
- The year 2019 ADT is 11,033 on frontage road and 7,376 ADT on the exit ramp.

### Analysis and Recommendations

- Based on application of the flowchart shown in **Figure 11**, for a two-lane frontage road, if the weave length is between 250 feet and 350 feet, no traffic control sign is recommended with an option of installing a STOP sign.
- Based on the number, type, and severity of crashes and relatively low traffic volume on exit ramp, No Control is recommended at this location
- It is recommended that the existing YIELD sign assembly and the existing advance Yield Ahead signs be removed from their current locations.
- It is recommended that this location be monitored for safety for 3 – 6 months after the existing YIELD sign is removed. If the recommended No Control results in more crashes compared to the crash data that was analyzed as part of this project, a STOP sign shall be installed while considering other measures to reduce the undue delays that are expected to be caused by the shopping center driveways.
- Bollards may be recommended along the exit ramp solid white striped gore with the approval of the ADOT Regional Traffic Engineer to restrict the lane changes within the striped gore. Type and specifications of the bollards shall be determined by the ADOT Regional Traffic Engineer.
- ADOT should evaluate the ramp to determine the costs and potential benefits of installing an additional exit ramp lane at this location.

## SR 101 and 67<sup>th</sup> Avenue westbound direction

### Existing Conditions

- One lane exists on the frontage road and one lane on the exit ramp. There is one exclusive left-turn lane, one shared thru/left-turn lane, one shared thru/right-turn lane and one exclusive right turn lane at the 67<sup>th</sup> Avenue intersection. The frontage road lane aligns with the downstream shared thru/right turn lane and the right-turn lane at the intersection. The lane from the exit ramp aligns with the downstream exclusive left-turn lane and the shared thru/left at the intersection.
- There is existing YIELD sign and Yield Shark Teeth pavement marking approximately 130 feet from the tip of the striped gore. A supplemental “To Ramp” plaque exists under the Yield sign.
- An advance Yield Ahead sign exist approximately 740 feet from the YIELD sign.
- Bollards exist along the exit ramps solid white striped gore.
- The existing weave length is 240 feet. Distance from the physical gore to the tip of the striped gore is 240 feet.
- There one existing driveways (driveway leading to the Safeway parking lot) within the weave length. There is an existing driveway (Safeway Driveway) between the physical gore and the striped gore, approximately 140 feet from the tip of the striped gore leading to shopping center.
- A total of 11 crashes were reported at this location between 2012 and 2016. Five of the 11 crashes are rear end crashes, three are side swipe crashes in the same direction, two angled crashes and one unknown crash. There was one reported sideswipe crash in the same direction within the weave length.
- Ten of the 11 crashes are no injury crashes and one possible injury crash.
- Six of the 11 crashes reported were during day light, one during dusk, three during dark lighted conditions and one during dark not lighted conditions.
- The year 2019 ADT is 4,631 on frontage road and 13,242 ADT on the exit ramp.

### Analysis and Recommendations

- Restriping the gore at this location will result in steeper taper along the exit ramp. Therefore, restriping the gore is not recommended to increase the weave length. Based on application of the flowchart shown in **Figure 11**, for a one-lane frontage road, if the weave length is less than 250 feet and if the striped gore cannot be restriped to increase the weave length to 250 feet, then, a STOP sign shall be recommended. However, the expected backups on the frontage road due to installation of the STOP sign at this location are expected to cause undue delays and operational and safety issues at the shopping center driveway location approximately 140 feet from the tip of the striped gore.
- Based on discussions with Stanley Consultants who are working on the *SR 101L, 75<sup>th</sup> Avenue to I-17 General Purpose Lanes* project, two exit ramp lanes and two frontage road lanes are being recommended at this location. The existing striped gore is being pulled back by 60 feet thereby increasing the weave length to 300 feet. Existing YIELD signs are recommended to be removed. It is Michael Baker’s understanding that these recommendations are preliminary recommendations only and are subject to change when the project design is finalized.

- Since there is no reported major crash history caused due to the weaving between vehicles from the frontage road and exit ramp and to avoid undue delays and operational and safety issues at the shopping center driveway, the recommended No Control is appropriate at this location.
- It is recommended that the existing YIELD sign assembly and the advance YIELD AHEAD sign be removed from their current locations.
- It is recommended that the location be monitored for safety for 3 – 6 months after the existing YIELD sign is removed. If the recommended No Control results in more crashes compared to the crash data that was analyzed as part of this project, a STOP sign shall be installed while considering other measures to reduce the undue delays that are expected to be caused by the shopping center driveways.

## SR 101 and Southern Avenue; southbound direction

### Existing Conditions

- One lane exists on the frontage road and one lane on the exit ramp. There is one exclusive left-turn lane, one shared thru/left-turn lane, one shared thru/right-turn lane and one exclusive right turn lane at the Southern Avenue intersection. The frontage road lane aligns with the downstream shared thru/right turn lane and the right-turn lane at the intersection. The exit ramp lane aligns with the downstream exclusive left-turn lane and the shared thru/left at the intersection.
- There is an existing YIELD sign and Yield Shark Teeth pavement marking approximately 30 feet from the tip of the striped gore. A supplemental “To Ramp” plaque exists under the Yield sign.
- The existing weave length is 300 feet. Distance from the physical gore to the tip of the striped gore is 180 feet.
- There are three existing driveways, one driveway to the Redemption Church and two driveways to the T-Mobile store, within the weave length.
- A total of 11 crashes were reported at this location between 2012 and 2016. Eight of the 11 crashes are rear end, two are side swipe crashes in the same direction and one angled crash.
- Eight of the 11 crashes are no injury crashes, one is possible injury crash and two are non-incapacitating injury crashes.
- Five of the 11 crashes reported were during day light, one during dawn, one during dusk and four during dark lighted conditions.
- The year 2019 ADT is 5,556 on frontage road and 7,546 ADT on the exit ramp.

### Analysis and Recommendations

- Based on application of the flowchart shown in **Figure 11**, for a one lane frontage road, if the weave length is between 250 feet and 350 feet, no traffic control sign is recommended with an option of installing a STOP sign.
- Due to the relatively lower traffic volumes on the frontage road and exit ramp, and no reported major crash history caused due to the weaving between vehicles from the frontage road and exit ramp and to avoid undue delays and operational and safety issues at the shopping center driveway, No Control is recommended at this current location.
- It is recommended that the existing YIELD sign assembly be removed from its current location.
- It is recommended that the location be monitored for safety for 3 – 6 months after the existing YIELD sign is removed. If the recommended No Control results in more crashes compared to the crash data that was analyzed as part of this project, a STOP sign shall be installed while considering other measures to reduce the undue delays that are expected to be caused by the shopping center driveways.
- Bollards may be recommended along the exit ramp solid white striped gore with the approval of the ADOT Regional Traffic Engineer to restrict the lane changes within the striped gore. Type and specifications of the bollards shall be determined by the ADOT Regional Traffic Engineer.
- ADOT should evaluate the ramp to determine the costs and potential benefits of installing an additional exit ramp lane at this location.

### I-17 and Grant Street Southbound direction

Please see **Figure 16** for further illustration of the recommendations described below.

#### Existing Conditions

- Two lanes exist on the frontage road and one lane on the exit ramp. There is one exclusive left-turn lane, one shared thru/left-turn lane and one thru lane at the Grant Street intersection. The two frontage road lanes are directly aligned with the downstream shared thru/left and the thru lanes at the intersection. The exit ramp lane aligns with the downstream exclusive left-turn lane at the intersection.
- There is an existing YIELD sign and Yield Shark Teeth pavement marking approximately 125 feet from end of the bollards where weaving is permitted. A supplemental “To Ramp” plaque exists under the Yield sign.
- Advance Yield Ahead warning sign exists approximately 300 feet from the existing YIELD sign.
- The existing weave length is 70 feet. Distance from the physical gore to the end of the bollards where weaving is permitted is 30 feet.
- There are no existing driveways within the weave length. Lincoln Drive exists at the physical gore. Bollards and no right-turn signs exist to restrict right-turns from the exit ramp to Lincoln Drive.
- A total of nine crashes were reported at this location between 2012 and 2016. Four of the 9 crashes are rear end crashes, two are angled crashes and three side swipe crashes in the same direction.
- Seven of the nine crashes are no injury crashes, one possible injury and one non-incapacitating injury crash.
- All the crashes reported were during day light.
- The year 2019 ADT is 2,310 on frontage road and 7,664 ADT on the exit ramp.

#### Analysis and Recommendations

- Since the weave length is 70 feet and the distance where weaving is permitted is 30 feet, restriping the gore to increase the weave length to 250 feet is physically not a possible. Based on application of the flowchart shown in **Figure 11**, for a two-lane frontage road, if the gore cannot be restriped to increase the weave distance to 250 feet or greater, then, a traffic volume analysis shall be completed to determine if the two lanes can be merged into one lane and install a STOP sign.
- Based on the ADOT roadway functional classification maps, frontage roads are classified as minor collector roadways. According to the MCDOT Roadway Design Manual Table 2.1, the capacity of a two-lane undivided urban minor collector is 9,200 ADT for a desired level-of-service (LOS) B. Therefore, a one lane minor collector can accommodate 4,600 ADT for a desired LOS B. A one lane frontage road can accommodate the existing 2,330 vehicles with a desired LOS B.
- Therefore, it is recommended that the two-lane frontage road at this located be merged to one lane before approaching the physical gore. **Figure 16** shows a schematic of the recommended pavement marking.
- Due to the presence of the driveways within 50 feet of the end of bollards where weaving is permitted, a STOP control is recommended at this location.

- It is recommended that the existing YIELD sign assembly and the advance YIELD AHEAD sign be removed from their current locations.
- It is recommended that a new 36"x36" STOP (R1-1) sign and a stop bar be installed at 100 feet from the end of bollards where weaving is permitted.
- A new 36"x36" advance Stop Ahead (W3-1) warning sign is recommended to be installed along the frontage road 125 feet from the STOP sign as shown in **Figure 13**, per MUTCD Table 2C-4 advance warning sign placement.
- 12" white chevron markings may be recommended to be installed within the striped gore with the approval of the ADOT Regional Traffic Engineer.
- ADOT should evaluate the ramp to determine the costs and potential benefits of installing an additional exit ramp lane at this location.

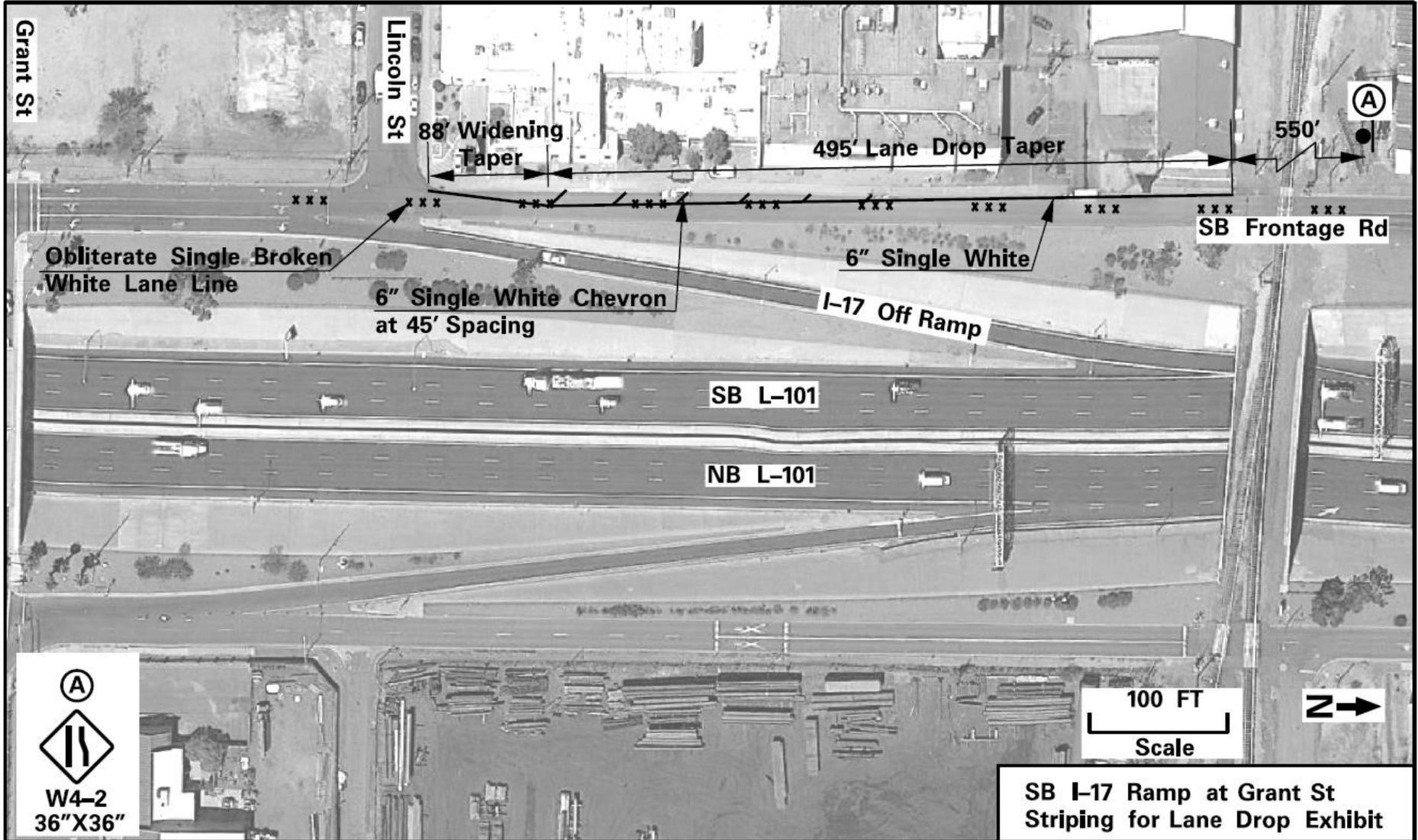


Figure 16: Recommended Pavement Marking Schematic at I-17 and Grant Street SB Ramp

## SR 101 and Ray Road southbound direction

### Existing Conditions

- One lane exists on the frontage road and one lane on the exit ramp. There is one exclusive left-turn lane, one shared thru/left-turn lane, one thru lane and one exclusive right turn lane at the Ray Road intersection. The frontage road lane directly aligns with the downstream thru lane and the right-turn lane at the intersection. The exit ramp lane aligns with the downstream exclusive left-turn lane and the shared thru/left at the intersection.
- There is existing YIELD sign and Yield Shark Teeth pavement marking approximately 30 feet from the tip of the striped gore. A supplemental “To Ramp” plaque exists under the Yield sign.
- There is no advance Yield Ahead sign.
- Chevron markings exist between the physical gore and the tip of the striped gore.
- The existing weave length is 280 feet. Distance from the physical gore to the tip of the striped gore is 130 feet.
- There are no existing driveways within the weave length.
- A total of nine crashes were reported at this location between 2012 and 2016. Five of the nine crashes are rear end crashes, three are side swipe crashes in the same direction and one single vehicle crash. There was one reported sideswipe crash in the same direction within the weave length.
- Seven of the nine crashes are no injury crashes, one possible injury crash and one non-incapacitating injury crash.
- Seven of the nine crashes reported were during day light, and two during dark not lighted conditions.
- The year 2019 ADT is 4,728 on frontage road and 15,498 ADT on the exit ramp.

### Analysis and Recommendations

- Based on application of the flowchart shown in **Figure 11**, for a one-lane frontage road, if the weave length is between 250 feet and 350 feet, no traffic control sign is recommended with an option of installing a STOP sign.
- There is no major crash history at this location, however, the heavy traffic volumes on the exit ramp are expected to result in fewer gaps for the frontage road traffic to merge and/or weave. Therefore, a STOP sign is recommended to be installed at this location.
- It is recommended that the existing YIELD sign assembly be removed from its current location and a new 36”X36” STOP sign and a Stop bar be installed 50 feet from the new tip of the striped gore as shown in **Figure 12**.
- Because of the presence of the driveways, it is recommended that the a new 36”x36” advance STOP Ahead (W3-1) warning sign be installed along frontage road 270 feet from the new STOP sign.
- Bollards may be recommended along the exit ramp solid white striped gore with the approval of the ADOT Regional Traffic Engineer to restrict the lane changes within the striped gore. Type and specifications of the bollards shall be determined by the ADOT Regional Traffic Engineer.
- ADOT should evaluate the ramp to determine the costs and potential benefits of installing an additional exit ramp lane at this location.

## SR 101 and 35<sup>th</sup> Avenue eastbound direction

### Existing Conditions

- Two lanes exist on the frontage road and one lane on the exit ramp. There is one exclusive left-turn lane, one shared thru/left-turn lane, one shared thru/right-turn lane and one exclusive right turn lane at the 35<sup>th</sup> Avenue intersection. The two frontage road lanes are directly aligned with the downstream shared thru/left and the shared thru/right turn lanes at the intersection. The exit ramp lane aligns with the downstream exclusive left-turn lane at the intersection.
- There is an existing YIELD sign approximately 315 feet from the tip of the striped gore. A supplemental “To Ramp” plaque exists under the Yield sign.
- There is no advance Yield Ahead sign at this location.
- The existing weave length is 330 feet. Distance from the physical gore to the tip of the striped gore is 300 feet.
- There are no existing driveways within the weave length.
- A total of seven crashes were reported at this location between 2012 and 2016. Four of the seven crashes are rear end crashes, one rear-to-side crashes, one single vehicle crash and one crash is reported as “other”.
- Four of the seven crashes are no injury crashes and the remaining three are possible injury crashes.
- Six of the seven crashes reported were during day light and one during dark lighted conditions.
- The year 2019 ADT is 5,401 on frontage road and 8,368 ADT on the exit ramp.

### Analysis and Recommendations

- Based on application of the flowchart shown in **Figure 11**, for a two-lane frontage road, if the weave length is between 250 feet and 350 feet, no traffic control sign is recommended with an option of installing a STOP sign.
- Based on discussions with Stanley Consultants who are working on *SR 101L, 75<sup>th</sup> Avenue to I-17 General Purpose Lanes* project, two exit ramp lanes and two frontage road lanes are being recommended at this location. The existing striped gore is being pulled back by 85 feet thereby increasing the weave length to 420 feet. Existing YIELD signs are recommended to be removed. It is Michael Baker’s understanding that these recommendations are preliminary recommendations only and are subject to change with the project is finalized.
- Due to the relatively lower traffic volumes on the frontage road and exit ramp, and no reported major crash history caused due to the weaving between vehicles from the frontage road and exit ramp, the recommended No Control is appropriate at this location.
- It is recommended that the existing YIELD sign assembly be removed from its current location.
- It is recommended that the location be monitored for safety for 3 – 6 months after the existing YIELD sign is removed. If the recommended No Control results in more crashes compared to the crash data that was analyzed as part of this project, a STOP sign shall be installed while considering other measures to reduce the undue delays that are expected to be caused by the shopping center driveways.
- 12” white chevron markings may be recommended to be installed within the striped gore with the approval of the ADOT Regional Traffic Engineer.

- Bollards may be recommended along the exit ramp solid white striped gore with the approval of the ADOT Regional Traffic Engineer to restrict the lane changes within the striped gore. Type and specifications of the bollards shall be determined by the ADOT Regional Traffic Engineer.
- The existing frontage road lane is aligned with the exclusive left-turn lane at the intersection resulting in left-turn lane traps. Short skip stripe is recommended to be installed when lane traps exist. However, the lane geometry at this location is being recommended to be changed based on the recommendation of the *SR 101L, 75<sup>th</sup> Avenue to I-17 General Purpose Lanes* project. It is recommended that the short skip stripe and W9-101 sign be considered and installed if lane traps exist with the additional lanes on the frontage road and the exit ramp.

## Additional Suggested Recommendations to Improve Safety

In addition to the recommendations included with each spot improvement location, the following additional recommendations are suggested to be evaluated and/or applied at all the frontage road/exit ramp convergence locations in the Central District to improve safety:

- Optimize signal timing at the downstream arterial intersection, revisit, and change the signal clearance intervals and improve the signal visibility by installing signal back plates to mitigate rear end crashes. Traffic signals at the downstream arterial intersections are typically operated and maintained by the local agency and could be part of a coordinated system. If traffic signal equipment and/or timing changes are considered, progression of the signal coordination should be considered, and the changes should be coordinated with the respective local agency.
- Install an advisory speed limit along exit ramps and improve existing sign visibility by maintenance (tree trimming). A speed study shall be completed to determine the advisory speed limit.
- An advisory speed of 10 mph below the posted speed limit, or an advisory speed of 35 mph, whichever is lower, should be considered along the frontage road approaching the gore. A speed study shall be completed to determine the appropriate advisory speed limit.
- Refresh existing striping from the physical gore to the downstream intersection to increase reflectivity.
- Adequate lighting shall be maintained in the vicinity of the merge area and at the downstream intersection.
- Consider High Friction Surface Treatment (HFST) at high crash locations to reduce crashes and related injuries and fatalities.

# **APPENDIX A**

## **SURVEY RESULTS AND STANDARDS/BEST PRACTICES**

**Michael Baker**

**INTERNATIONAL**

**Michael Baker  
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*Phoenix, Arizona*

# TEXAS

**Michael Baker**

INTERNATIONAL

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*Phoenix, Arizona*

**ADOT CENTRAL DISTRICT FREEWAY  
FRONTAGE ROAD TRAFFIC CONTROL STUDY  
TASK 3: NATIONWIDE SURVEY OF BEST PRACTICES  
SURVEY QUESTIONS**

1. Do you currently have one-way frontage roads along and/or adjacent to state, county or local highways within your City/State?

Yes, TxDOT has a very large inventory of continuous one way frontage roads that run adjacent to many interstate, US, and some state highways. They are located in primarily urban areas as well as in some rural areas.

2. If answered YES for question 1, do you have adopted standards/policies and/or best practices for traffic control where frontage roads merge with exit ramp?

We do have a few manuals that are considered best practices, while the TMUTCD and our traffic engineering standard sheets are considered 'standards'. Figure 7-20 in our Sign Crew Field Book shows an example where we cut off a frontage road lane to give full access to exiting traffic. Figures 6-4 and 6-5 in the Freeway Signing Handbook show a few configurations also. In one of the configurations, a lane is added for the exiting ramp. Figures 5-1 and 5-2 in the Sign Guidelines and Applications Manual also show similar treatments. We make use of 'Do Not Cross Double White Line' signs to try to restrict merge movements where the exit ramp meets with the frontage road. We also deny access to adjacent property owners as described in Chapter 3, Section 6 of the Roadway Design Manual. Note that the Roadway Design Manual is managed out of a separate division within TxDOT.

3. If answered YES for question 2, what is the basis for the recommended traffic control?
  - a. Volume,
  - b. Sight Distance,
  - c. Speed,
  - d. Crashes,
  - e. Number of Lanes,
  - f. All of the above, or
  - g. Other (Specify)

To be clear, the drawings in our traffic engineering manuals are mainly providing guidance on how to sign/stripe various lane configurations for an exit ramp. They are not making recommendations on when to reduce a lane on the frontage road, use a deceleration lane, etc. The Roadway Design Manual gives recommendations in Table 3-16 of distance required between the exit ramp and any side streets/driveways, with a recommended 250' distance. The decision on lane movements/access is done by designer with engineering judgment.

4. Do you currently have any traffic calming elements/policies specific to locations where the frontage road merges with the exit ramp?

No, most frontage roads in Texas operate at higher speeds (50 mph or higher) except in highly urban areas where there are multiple side streets and intersection spacing is closer together.

5. Do you currently have any pavement marking recommendations/ policies specific to locations where the frontage road merges with the exit ramp?

As mentioned previously, we often use a double white stripe for a distance of at least 80' to deter merging movements. Note that in many urban areas, the exit ramp essentially becomes a frontage road auxiliary lane where it will ultimately become an entrance ramp downstream. In these case, we usually stripe the lane with a dotted line instead of a broken white line and include 'Left Lane Must Enter Ramp' signs. We may also use left turn arrow and ONLY markings within the lane as further guidance. This treatment is similar to what is shown on our Freeway Pavement Markings (FPM) standards. Those standards are for mainlanes, but the striping on the frontage roads is the same.

6. What is the posted speed limit on the EXIT ramp that merge onto or with the frontage roads?

We do not post separate regulatory speed limits on the exit ramp itself, but will post advisory speed limits if ramp geometrics necessitate it. We then install downstream speed limit signs on the frontage road to inform exiting traffic.

7. What is the posted speed limit on frontage road that have ramps merging into them? They are entirely based on the 85<sup>th</sup> percentile speed zone study, not based on the fact that an exit ramp is present. We have a separate manual, Procedures for Establishing Speed Zones, that defines this process.

8. If there are more than one lane on frontage road, do they merge the lanes in advance of the gore point?

Yes, if we are giving the exit ramp one of the lanes on the frontage road. But in many cases, the exiting ramp will form a new lane on the frontage road that often becomes an auxiliary lane as described above. In rare instances, we do not create a new lane for the exit ramp and we install Yield signs and To Ramp plaques with yield triangle markings on the frontage road to give access to exiting traffic.

9. Are there bike lanes on frontage road? If yes, what kind of traffic control do you use for the bike lanes?

This would be a rare occurrence due to the fact most frontage roads are high speed and due to difficulties at intersections with turning movements.

10. If there are driveways in the vicinity of the frontage road merging with the exit ramp, what type of traffic control is used for the driveways? Eg: One-way, right-turn only, wrong way, do not enter, no left-turns etc.

The typical treatment is a One-Way sign across from the driveway between the frontage road and mainlanes. Per memo issued in 2013, TxDOT should only be installing these when there is alternate access to the property from another street.

## Barrientes, Vivianna

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**From:** Mark Johnson <Mark.J.Johnson@txdot.gov>  
**Sent:** Wednesday, June 13, 2018 2:15 PM  
**To:** Kundur, Smitha  
**Cc:** Doug Skowronek; Heather Lott  
**Subject:** EXTERNAL: RE: Frontage Road Traffic Control Study for Arizona DOT - Survey to agencies  
**Attachments:** Survey Questions-Frontage Roads.docx

Hi Smitha,

Good chatting with you this morning. As Texas is the land of one way frontage roads (and pickup trucks for that matter), we have a lot of experience in this area. As discussed, in almost all exit ramp scenarios, we either create a new lane on the frontage road, or merge one of the lanes on the frontage road to make way for the ramp, or provide a significant decel lane distance to merge into the frontage road lanes. On very rare occasions, we do not provide any lane or merging area for the exiting ramp and instead install Yield To Ramp signs/plaques with yield triangles on the frontage road. But in my experience, these type of designs are often confusing to the traveling public.

Note that in Texas, exiting ramp traffic has the right of way per Section 545.154 of the Texas Transportation Code:

*VEHICLE ENTERING OR LEAVING LIMITED-ACCESS OR CONTROLLED-ACCESS HIGHWAY. An operator on an access or feeder road of a limited-access or controlled-access highway shall yield the right-of-way to a vehicle entering or about to enter the access or feeder road from the highway or leaving or about to leave the access or feeder road to enter the highway.*

I have answered your questions as best to my knowledge in the attachment. Here are links to the various standards mentioned:

Sign Guidelines and Applications Manual: [http://onlinemanuals.txdot.gov/txdotmanuals/smk/stop\\_yield.htm](http://onlinemanuals.txdot.gov/txdotmanuals/smk/stop_yield.htm)

Sign Crew Field Book: [http://onlinemanuals.txdot.gov/txdotmanuals/sfb/interchange\\_applications.htm](http://onlinemanuals.txdot.gov/txdotmanuals/sfb/interchange_applications.htm)

Freeway Signing Handbook: [http://onlinemanuals.txdot.gov/txdotmanuals/fsh/exit\\_ramp\\_signing.htm](http://onlinemanuals.txdot.gov/txdotmanuals/fsh/exit_ramp_signing.htm)

Roadway Design Manual: <http://gsd-ultraseek/txdotmanuals/rdw/freeways.htm>

Freeway Pavement Marking Standard Sheets: <ftp://ftp.dot.state.tx.us/pub/txdot-info/cmd/cserve/standard/traffic/FPM.pdf>

Procedures for Establishing Speed Zones: <http://gsd-ultraseek/txdotmanuals/szn/index.htm>

Please note that many of the manuals listed above are in the process of revision.

I am copying some of our traffic engineers if they have thoughts on this matter as well.

Thanks,

Mark Johnson, PE

Traffic Operations Division-TxDOT

[Mark.J.Johnson@txdot.gov](mailto:Mark.J.Johnson@txdot.gov)

Office: (512) 416-3247

Cell: (512) 221-8993

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**From:** Kundur, Smitha [mailto:Smitha.Kundur@mbakerintl.com]

**Sent:** Wednesday, June 13, 2018 11:27 AM

**To:** Mark Johnson

**Subject:** Frontage Road Traffic Control Study for Arizona DOT - Survey to agencies

Hello Mark,

This is Smitha Kundur from Michael Baker International Phoenix office. I talked to you earlier regarding the Frontage Road traffic control study that we are working with Arizona DOT.

The goal of the project is to develop standards for traffic control on frontage roads (signing, striping, traffic control, traffic calming etc.) where one-way frontage roads converge with the exit ramps. As part of the project, we are required to research, survey and document any adopted standards, policies and/or best practices for different agencies for the above mentioned scenario.

Attached with this email is a survey with a list of 10 questions relevant to the study. I would really appreciate it if you can please take the survey and provide me with the responses.

Also, based on our conversation earlier, can you please send me the link to your standards/manuals, or attach them to the email if they are not available online. Also, can you please summarize your thoughts based on our discussion this morning. If they are part of your standards, I can find them in your manuals, but your observations from your experiences would be really useful for me. If you think of anything else that you have that is relevant to the above mentioned scenario, can you please let me know.

I really appreciate your input in this regards. Please let me know if you have any questions.

Thanks.

**Smitha Kundur, PE** | Traffic Engineer | Michael Baker International  
Phoenix Plaza Tower II, 2929 N. Central Avenue, 8th Floor | Phoenix, AZ 85012 | [O] 602-294-2253 | [M] 479-871-4110  
[smitha.kundur@mbakerintl.com](mailto:smitha.kundur@mbakerintl.com) | [www.mbakertnl.com](http://www.mbakertnl.com)



# MINNESOTA

**Michael Baker**

INTERNATIONAL

**Michael Baker  
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*Phoenix, Arizona*

**ADOT CENTRAL DISTRICT FREEWAY  
FRONTAGE ROAD TRAFFIC CONTROL STUDY  
TASK 3: NATIONWIDE SURVEY OF BEST PRACTICES  
SURVEY QUESTIONS**

1. Do you currently have one-way frontage roads along and/or adjacent to state, county or local highways within your City/State?
  - a. **YES, examples include**
    - i. **I-94 through Saint Paul between Rice Street and Snelling Avenue**
    - ii.
2. If answered YES for question 1, do you have adopted standards/policies and/or best practices for traffic control where frontage roads merge with exit ramp? **Not specific to Frontage Roads.**
3. If answered YES for question 2, what is the basis for the recommended traffic control?
  - a. Volume,
  - b. Sight Distance,
  - c. Speed,
  - d. Crashes,
  - e. Number of Lanes,
  - f. All of the above, or
  - g. Other (Specify)
4. Do you currently have any traffic calming elements/policies specific to locations where the frontage road merges with the exit ramp? **No**
5. Do you currently have any pavement marking recommendations/ policies specific to locations where the frontage road merges with the exit ramp?
  - a. **No. Use typical MUTCD practices for striping.**
6. What is the posted speed limit on the EXIT ramp that merge onto or with the frontage roads? **Varies by location and ramp design.**
7. What is the posted speed limit on frontage road that have ramps merging into them? **Typically 30 mph. Statutory limits for local roads that meet the definition of Urban District is 30 mph. Urban district is defined in Minnesota Statute 169.14 as “the territory contiguous to and including any city street or town road that is built up with structures devoted to business, industry, or dwelling houses situated at intervals of less than 100 feet for a distance of a quarter of a mile or more.” Depending on the amount and type of development, and driveway access, this could be higher say 35 to 40 mph in some locations.**
8. If there are more than one lane on frontage road, do they merge the lanes in advance of the gore point?
  - a. **It would depend on the traffic analysis.**
9. Are there bike lanes on frontage road? If yes, what kind of traffic control do you use for the bike lanes?

- a. Not sure if we have bike lanes on the MN examples, but if we did, we would use typical bike lane designs as the bike lanes would be on the right side of the frontage road.
10. If there are driveways in the vicinity of the frontage road merging with the exit ramp, what type of traffic control is used for the driveways? Eg: One-way, right-turn only, wrong way, do not enter, no left-turns etc. Driveways are not allowed between the cross street intersection and the gore area. Driveways are not restricted on the frontage road beyond the gore are where access is physical separated from the ramp. See Section 6-4 of the MnDOT Road Design Manual.  
<https://roaddesign.dot.state.mn.us/>

## Barrientes, Vivianna

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**From:** Zellers, Ryan  
**Sent:** Monday, April 09, 2018 1:46 PM  
**To:** Kundur, Smitha; Tiwari, Pradeep; Kugler, Kevin  
**Subject:** ADOT Traffic Study: Wisconsin and Minnesota DOT phone surveys

All,

Here are some notes from the folks I've been in contact with. I just did a bunch of copy and paste for now. I've been trading phone calls with Wisconsin DOT and had a discussion with Minnesota DOT. I should have a bit more info by tomorrow. Just checking in and showing what I've done to date.

Thanks!

---

Wisconsin DOT  
Elizabeth "Liz" Schneider  
(414) 225-3728

- No policies known (looking into it)
- Control varies depending on:
  - Lanes dedicated to off and on traffic
  - Traffic volumes of roads they are crossing
  - Sometimes right-of-way from frontage road, sometimes off ramp.

### AWAITING PHONE CALL FOR MORE INFO

---

Minnesota DOT  
Traffic Safety and Operations  
Peter Buchen  
(651) 234-7010

- They have one and two-way frontage roads that merge (and diverge)
- Covered in the road design manual
- Access Management <http://www.dot.state.mn.us/accessmanagement/resources.html>
- Guidance in Street Design Manual Sections 2-3.06 and 6-4

### 2-3.06 Access Management

Access management is the planning, design, and implementation of land use and transportation strategies that control the flow of traffic between the road and adjacent land uses. The proper location and design of public street and private driveway connections to the highway can greatly enhance the safety and mobility of the traveling public, preserve capacity, and extend the useful life of the facility. Where access to a highway is managed, entrances and exits are located at points best suited to fit the traffic and land-use needs. The goal is to allow vehicles to enter and leave safely with minimum interference to through traffic, preserving service and reducing the potential for crashes.

Figures 2-3.06A to 2-3.06H detail typical access control for at-grade intersections and interchanges.

Access management involves three related activities: Access Management System Planning, Access Control, and Access Regulation.

#### 2-3.06.01 Access Management System Planning

Access Management System Planning views the highway and its surrounding elements as part of a single system. Individual parts of the system include the land uses and their circulation systems as well as access to and circulation among the land uses provided by the system of local streets and highways. Careful coordination of the planning and design of each land use in relation to the supporting road network is critical to preserve the capacity of the overall system and to allow efficient access to and from the surrounding elements.

To provide a framework for system planning, MnDOT has adopted a Highway Access Category System and Spacing Guidelines. Every highway segment is assigned to an Access Category based on its functional classification, strategic importance in the statewide transportation system, and the existing and planned land use of the surrounding area. The recommended spacing and allowance of public street intersections and private access varies by category, with the most restrictive access recommended for the higher order roadways. The designer or District Traffic Engineer should consult these guidelines during the planning and design of new roads and the retrofitting of existing roads and accesses.2-3(8)  
ROAD DESIGN MANUAL JULY, 2007

#### 2-3.06.02 Access Control

Access Control is the condition where the right of access of abutting properties is fully or partially acquired by a public authority, usually at the time of purchase of right of way. Full control of access gives priority to through traffic by providing access only at grade-separated interchanges with selected public roads. At-grade crossing and private driveway connections are not allowed. These facilities are typically called “freeways.” The highly restricted access to freeways has made them the most efficient motor vehicle traffic movers and safest highway systems in the nation. At interchanges, access should also be managed along the intersecting cross street to ensure safe movement to and from the freeway ramps. The appropriate access management plan for cross streets at interchanges will depend on the function of the cross street, projected traffic volumes and turning movements, and the character of the existing and planned surrounding land use. As such, the access management plan should be coordinated with the local land use and road authorities.

Partial control of access also gives priority to through traffic but maintains some at-grade intersections and private access connections. Partial control of access may be provided for certain major urban and rural arterials.

#### 2-3.06.03 Access Regulation

Access may also be managed through the police power of the road authority to regulate access by either geometric design or access permit. Geometric design features such as medians, turn lanes, and turning restrictions regulate the direction and flow of traffic within the right of way. Access to the highway from private property or the local street network is regulated by permit. The location and design of access to an individual property may be restricted to the extent that reasonably convenient and suitable access is provided. Individual property access may be required to obtain access to the adjacent highway by means of the available local supporting street network or frontage road, rather than by direct driveway connection.

Local governments exercising statutory land use planning authority may also regulate access through the provisions of their zoning and/or subdivision ordinance. Local governments are required by statute to provide MnDOT the opportunity to review and comment on all preliminary plats of land abutting trunk highways. MnDOT Districts also encourage local governments to submit other development proposals affecting the trunk highway for review and comment. Local governments may incorporate MnDOT’s comments and recommendations as conditions of zoning or subdivision/plat approval.

The Highway Access Category System and Spacing Guidelines provide the framework for reviewing the location and general design of the access for proposed development. Chapter 5 provides more specific guidance for the design of at-

grade intersections and private driveways. Minnesota Rules Chapter 8810 describes the general regulations governing driveway permits.

## **6-4.0 RAMP AND MINOR ROAD JUNCTION**

### **6-4.01 General**

At service interchanges, the ramp or loop normally intersects the minor road at-grade at approximately a 90 degree angle. This intersection should be treated as described in Chapter Five, "At-Grade Intersections." This will involve a consideration of the appropriate traffic control devices, capacity, and the physical geometric design elements such as sight distance, angle of intersection, grade, channelization, and turning lanes. Two points warrant special attention in the design of the ramp/minor road intersection:

1. Capacity - In urban areas where traffic volumes may be high, inadequate capacity of the ramp/minor road intersection can adversely affect the operation of the ramp/freeway junction. In a worst case situation, the safety and operation of the mainline itself may be impaired. Therefore, special attention should be given to providing sufficient capacity and storage for an at-grade intersection or a merge with the minor road. This could lead to the addition of lanes at the intersection or on the ramp proper such as free right, double left, double right or a combination thereof. It may involve advanced signalization where the ramp traffic is given priority. The analysis must also consider the operational impacts on the intersecting roads. The latest Highway Capacity Manual should be used to calculate capacity and level of service for the ramp/minor road intersections.

2. Sight distance - Section 5-2.0 discusses the procedure for addressing sight distance at the at-grade intersections. This procedure should be used for the ramp/minor road intersection. However, special attention must be given to the location of the bridge rail, pier or abutment because these will present major sight distance obstacles. The Case IIIB and IIIC methodology for left-turning vehicles presented in Section 5-2.0 should be used to determine if adequate sight distance is available. The combination of the bridge obstruction and the needed sight distance may result in relocating the ramp/minor road intersection to provide the needed sight distance. The design of the minor road, if a county or municipal road, will be in accordance with the criteria and procedures presented in the State Aid Manual where appropriate.

### **6-4.02 Frontage Road Intersections**

The separation between the mainline and the frontage road along the length of the facility, called the outer separation, is shown as X in Figure 6-4.02A. The desirable minimum value of X is 50 ft. However, in very restricted R/W areas, a concrete barrier and the shoulders of each roadway may be used for separation. The distance separating the ramp/minor road intersection from the frontage road/minor road intersection is shown as Y in Figure 6-4.02A. Y should be wide enough to: allow the two intersections to operate independently, and eliminate the operational and signing problems of providing the same point of exit and entrance for the frontage road and freeway ramp.

At a minimum, a Y value of 780 ft is needed to accommodate back-to-back left turn lanes between the mainline and the frontage road. Refer to Chapter 2, Figures 2-3.06A, C, and D, and contact MnDOT's Access Management Unit for additional guidance. Figure 2-3.06B illustrates a design for a "ramp acceleration and merge" with a frontage road intersection downstream from the merge. In urban areas, when due to R/W constraints, it is not possible to make Y wide enough to develop full right turn lanes, a minimum of 300 ft separation should be provided. If a 300 ft separation is not available, the following design applications may be considered:

1. One-way frontage road - Figure 6-4.02B provides the basic schematic for the layout, and Figure 6-4.02C provides the design details for the merging and the diverging operations for the

frontage road and ramp. The critical design element is the distance "A" between the ramp/frontage road merge and the minor road. This distance must be sufficient to allow traffic weave, vehicle deceleration and stop, and vehicle storage to avoid interference with the merge point. No points of access can be allowed in this section. Table 6-4.02A presents general guidelines which may be used to estimate this distance during the preliminary design phase. A number of assumptions have been made including weaving volume, operating speeds, and intersection queue distance. Therefore, a detailed design will be necessary to firmly establish the needed distance to properly accommodate traffic volumes and speed, weaving, stopping, and intersection storage.

#### FRONTAGE ROAD DESIGN

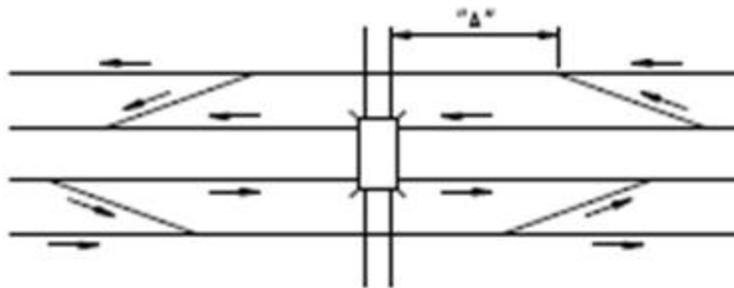
Figure 6-4.02A

#### FRONTAGE ROAD SCHEMATICS

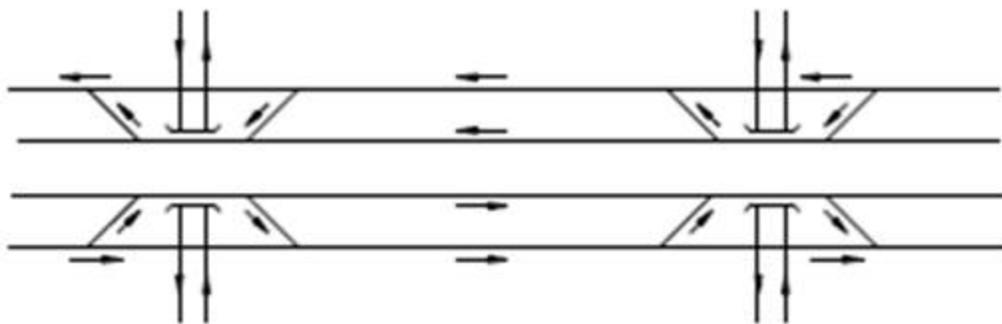
Figure 6-4.02B



**FRONTAGE ROAD DESIGN**  
Figure 6-4.02A



**ONE-WAY FRONTAGE ROAD**  
SEE TABLE 6-4.02A



**X - PATTERN RAMP ARRANGEMENT**  
**FRONTAGE ROAD SCHEMATICS**  
Figure 6-4.02B

2. When there is a series of cross roads with a need for a number of on- and off-ramps along such a

corridor, it may be beneficial to consider the use of 'X' pattern ramps at diamond interchanges, see Figure 6-4.02B. With this type of ramp pattern, the entrance occurs prior to the intersection, while the exit occurs after the cross street. This configuration can improve traffic flow characteristics for the through roadways around diamond interchanges. The only drawback is that the driver expectancy may be altered slightly in comparison to a conventional diamond configuration.

3. The merge and diverge designs for the ramp and the frontage road will be according to Figure 6-4.02C.

Table 6-4.02A

DISTANCE "A" FROM RAMP/FRONTAGE ROAD TO INTERSECTION WITH MINOR ROAD

**Table 6-4.02A**  
**DISTANCE "A" FROM RAMP/FRONTAGE ROAD TO INTERSECTION WITH MINOR ROAD**

Frontage Road Volume (VPH) <sup>1</sup>	Exit Ramp Volume (VPH) <sup>2</sup>	"A" (ft)		
		Desirable	Minimum	Absolute Minimum
200	140	500	380	260
400	275	560	460	360
600	410	630	500	400
800	550	690	540	430
1,000	690	760	590	450
1,200	830	870	640	480
1,400	980	970	690	500
1,600	1,100	1,070	770	530
1,800	1,240	1,180	860	550
2,000	1,380	1,300	970	580

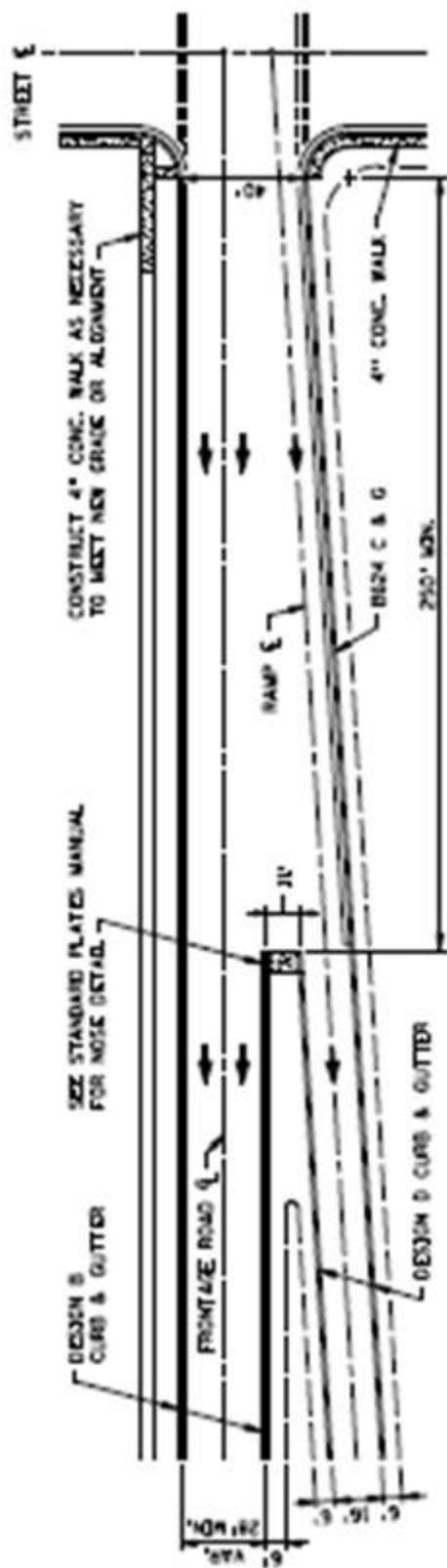
Distance A is shown on Figure 6-4.02B.

- 1) Total frontage road and exit ramp volume between merge to intersection with minor road.
- 2) Assumed to be 69 percent of total volume in first column.

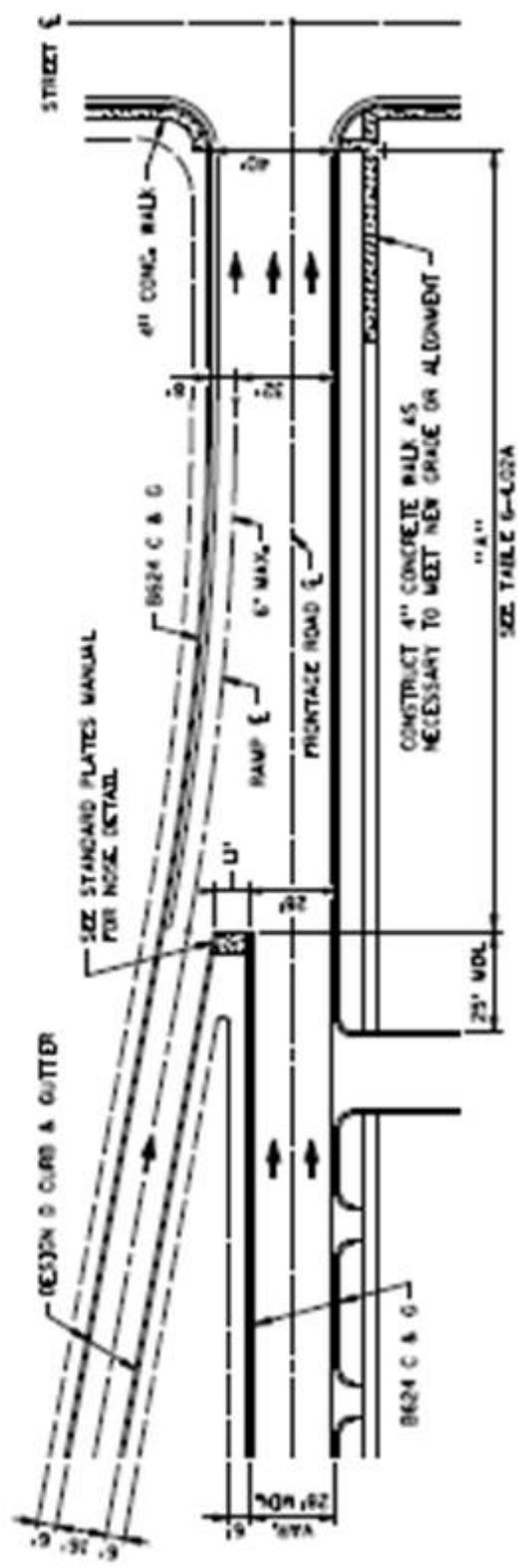
**REFERENCE:**

"Frontage Road Ramp To Cross-street Distance Requirements In Urban Freeway Design," J. Michael Turner and Carroll J. Messer, Texas Transportation Institute, January 1978.

Figure 6-4.02C



DIVERGING OF RAMP AND FRONTAGE ROAD



MERCING OF RAMP AND FRONTAGE ROAD

RAMP AND FRONTAGE ROAD ARRANGEMENTS  
Figure 6-4.02C

# ARKANSAS

**Michael Baker**

INTERNATIONAL

**Michael Baker  
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*Phoenix, Arizona*

**ADOT CENTRAL DISTRICT FREEWAY  
FRONTAGE ROAD TRAFFIC CONTROL STUDY  
TASK 3: NATIONWIDE SURVEY OF BEST PRACTICES  
SURVEY QUESTIONS**

1. Do you currently have one-way frontage roads along and/or adjacent to state, county or local highways within your City/State? **Yes along Interstate routes**
2. If answered YES for question 1, do you have adopted standards/policies and/or best practices for traffic control where frontage roads merge with exit ramp? **Yes**
3. If answered YES for question 2, what is the basis for the recommended traffic control?
  - a. Volume,
  - b. Sight Distance,
  - c. Speed,
  - d. Crashes,
  - e. Number of Lanes,
  - f. **All of the above**, or
  - g. Other (Specify)
4. Do you currently have any traffic calming elements/policies specific to locations where the frontage road merges with the exit ramp? **No**
5. Do you currently have any pavement marking recommendations/ policies specific to locations where the frontage road merges with the exit ramp? **Yes, directional arrows on pavement**
6. What is the posted speed limit on the EXIT ramp that merge onto or with the frontage roads? **Typically 40 – 45 MPH**
7. What is the posted speed limit on frontage road that have ramps merging into them? **45 – 55 MPH**
8. If there are more than one lane on frontage road, do they merge the lanes in advance of the gore point? **Yes**
9. Are there bike lanes on frontage road? If yes, what kind of traffic control do you use for the bike lanes? **No**
10. If there are driveways in the vicinity of the frontage road merging with the exit ramp, what type of traffic control is used for the driveways? Eg: One-way, right-turn only, wrong way, do not enter, no left-turns etc. **R6-2R One-Ways, Do Not Enter, Wrong Way, Red delineators along ramp etc.**

## Barrientes, Vivianna

---

**From:** Weston, David <David.Weston@ardot.gov>  
**Sent:** Tuesday, April 10, 2018 7:33 AM  
**To:** Kundur, Smitha  
**Subject:** EXTERNAL: RE: Frontage Road Traffic Control standards and/or best practices  
**Attachments:** FrontageRoadDwgs.pdf

Good Morning,

I researched through our typical drawings and did not find a standard for one-way frontage roads. However, I made a simple sketch that shows some of the best practices that we utilize in this application.

1. The two-lane one-way frontage road is narrowed to one-lane (merge signs etc...)
2. The exit-ramp is given a designated lane for a brief distance before the frontage road becomes two-lanes again.
3. At every drive or intersection, a R6-2R is installed and corresponding R5-1 Do Not Enter
4. Near the exit-ramp transition, we gate the Do Not Enters and sometimes also add R5-1A's Wrong Ways.

Hope this helps a little.

Have a great day,

David Weston

Sign Designer

ARDOT – Maintenance Division

501-569-2565

---

**From:** Kundur, Smitha [mailto:Smitha.Kundur@mbakerintl.com]  
**Sent:** Monday, April 09, 2018 2:18 PM  
**To:** Weston, David  
**Subject:** Frontage Road Traffic Control standards and/or best practices

Hello David,

This is Smitha Kundur from Michael Baker International Phoenix office. I just talked to you over the phone regarding the One-Way Frontage Road traffic control standards and/best practices in Arkansas. As mentioned, below is my contact information for you to send me any info that you have.

I really appreciate your input on this. Please call or email me if you have any questions.

Thanks.

**Smitha Kundur, PE** | Traffic Engineer | Michael Baker International  
Phoenix Plaza Tower II, 2929 N. Central Avenue, 8th Floor | Phoenix, AZ 85012 | [O] 602-294-2253 | [M] 479-871-4110  
[smitha.kundur@mbakerintl.com](mailto:smitha.kundur@mbakerintl.com) | [www.mbakintl.com](http://www.mbakintl.com)



ONE-WAY FRONTAGE ROAD BEST PRACTICES FOR ARDOT



R6-2R

Exit Ramp

Two Lanes

One Lane



Gated R5-1's

Two Lanes

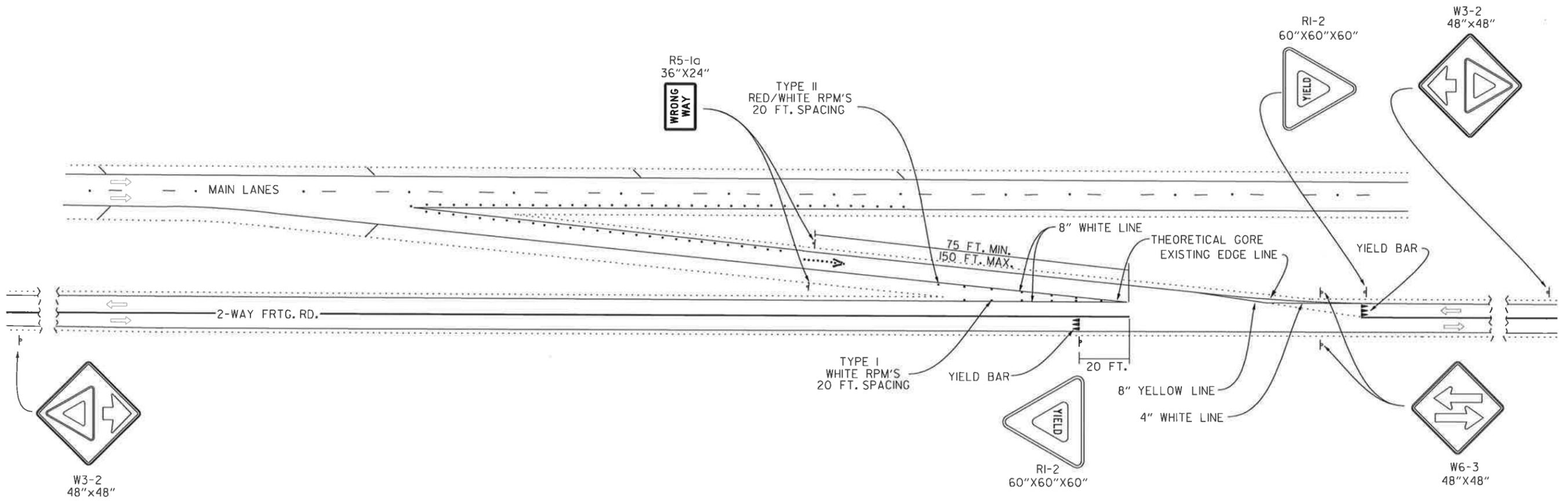


R5-1's

© 2018 Google

Google earth

TOP



TYPICAL OFF RAMP @ TWO WAY FRONTAGE ROADS

# OKLAHOMA

**Michael Baker**

INTERNATIONAL

**Michael Baker  
International, Inc.**

*Phoenix, Arizona*

**ADOT CENTRAL DISTRICT FREEWAY  
FRONTAGE ROAD TRAFFIC CONTROL STUDY  
TASK 3: NATIONWIDE SURVEY OF BEST PRACTICES  
SURVEY QUESTIONS**

1. Do you currently have one-way frontage roads along and/or adjacent to state, county or local highways within your City/State? **Yes.**
2. If answered YES for question 1, do you have adopted standards/policies and/or best practices for traffic control where frontage roads merge with exit ramp? **No.**
3. If answered YES for question 2, what is the basis for the recommended traffic control?
  - a. Volume,
  - b. Sight Distance,
  - c. Speed,
  - d. Crashes,
  - e. Number of Lanes,
  - f. All of the above, or
  - g. Other (Specify)
4. Do you currently have any traffic calming elements/policies specific to locations where the frontage road merges with the exit ramp? **No.**
5. Do you currently have any pavement marking recommendations/ policies specific to locations where the frontage road merges with the exit ramp? **No.**
6. What is the posted speed limit on the EXIT ramp that merge onto or with the frontage roads? **45 MPH or less (varies).**
7. What is the posted speed limit on frontage road that have ramps merging into them? **45 MPH or less (varies).**
8. If there are more than one lane on frontage road, do they merge the lanes in advance of the gore point? **Most of our frontage roads keep their lanes, and the exit lane continues to become a left-turn lane and/or U-turn.**
9. Are there bike lanes on frontage road? If yes, what kind of traffic control do you use for the bike lanes? **I am not aware of bike lanes on our frontage roads.**
10. If there are driveways in the vicinity of the frontage road merging with the exit ramp, what type of traffic control is used for the driveways? Eg: One-way, right-turn only, wrong way, do not enter, no left-turns etc. **we use the traffic control listed in your example.**

## Barrientes, Vivianna

---

**From:** Hebret Bokhru <HBokhru@odot.org>  
**Sent:** Thursday, June 14, 2018 8:25 AM  
**To:** Kundur, Smitha  
**Subject:** EXTERNAL: RE: Frontage Road Traffic Control for Arizona DOT - Survey to agencies

Smitha,

It was nice talking to you on the phone. Here is the link to our traffic control standards:  
[http://www.okladot.state.ok.us/traffic/traffic2009/trf\\_std\\_2009-control.php](http://www.okladot.state.ok.us/traffic/traffic2009/trf_std_2009-control.php)

Please, let me know if you find the answers to your survey questions from our traffic control standards. Regardless, I or someone from Traffic Engineering Division will get back to you with the survey answers.

Thanks,

Hebret Bokhru, P.E.  
Engineering Manager  
Traffic Engineering Division  
Oklahoma Dept. of Transportation  
200 NE 21st street, 2-A7  
Oklahoma City, OK, 73105-3204  
office: 405-522-5373  
Fax : 405-521-2865

---

**From:** Kundur, Smitha [mailto:Smitha.Kundur@mbakerintl.com]  
**Sent:** Thursday, June 14, 2018 10:17 AM  
**To:** Hebret Bokhru  
**Subject:** Frontage Road Traffic Control for Arizona DOT - Survey to agencies

Hello Herbert,

This is Smitha Kundur from Michael Baker International Phoenix office. I talked to you earlier regarding the Frontage Road traffic control study that we are working with Arizona DOT.

The goal of the project is to develop standards for traffic control on frontage roads (signing, striping, traffic control, traffic calming etc.) where one-way frontage roads converge with the exit ramps. As part of the project, we are required to research, survey and document any adopted standards, policies and/or best practices for different agencies for the above mentioned scenario.

Attached with this email is a survey with a list of 10 questions relevant to the study. I would really appreciate it if you or anyone else in your office can please take the survey and provide me with the responses. Also, as discussed over the phone, I would really appreciate it if you can please send me any standards/policies that you have for the above mentioned scenario.

As I mentioned to you, below is the Arizona DOT project manager, Jason Bottjen's contact information, for you to be able to verify that this is a legitimate project/survey:

**Jason Bottjen**

Planning Program Manager  
ADOT Multimodal Planning Division  
206 S. 17<sup>th</sup> Avenue, MD310B  
Phoenix, AZ 85007  
602-712-6166  
azdot.gov



Please let me know if you have any questions.

Thanks.

**Smitha Kundur, PE** | Traffic Engineer | Michael Baker International  
Phoenix Plaza Tower II, 2929 N. Central Avenue, 8th Floor | Phoenix, AZ 85012 | [O] 602-294-2253 | [M] 479-871-4110  
[smitha.kundur@mbakerintl.com](mailto:smitha.kundur@mbakerintl.com) | [www.mbakerial.com](http://www.mbakerial.com)



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# LOUISIANA

**Michael Baker**

INTERNATIONAL

**Michael Baker  
International, Inc.**

*Phoenix, Arizona*

**ADOT CENTRAL DISTRICT FREEWAY  
FRONTAGE ROAD TRAFFIC CONTROL STUDY  
TASK 3: NATIONWIDE SURVEY OF BEST PRACTICES  
SURVEY QUESTIONS**

1. Do you currently have one-way frontage roads along and/or adjacent to state, county or local highways within your City/State? **Yes**
1. If answered YES for question 1, do you have adopted standards/policies and/or best practices for traffic control where frontage roads merge with exit ramp? **No. Traffic Control would be managed on a case by case basis with the objective to ensure that there is no back up on the ramp or other impact to the free flow speed on the Interstate. Our intent would be to either add a free flow lane on the frontage road, or an accelerations lane. If that is not possible, than we would have to control the traffic on the frontage road with either a stop control, signal control, or Yield. The traffic analysis would dictate the appropriate strategy.**
2. If answered YES for question 2, what is the basis for the recommended traffic control?

**The basis would be to not impact interstate free flow speed.**

- a. Volume,
  - b. Sight Distance,
  - c. Speed,
  - d. Crashes,
  - e. Number of Lanes,
  - f. All of the above, or
  - g. Other (Specify)
3. Do you currently have any traffic calming elements/policies specific to locations where the frontage road merges with the exit ramp? **No.**
  4. Do you currently have any pavement marking recommendations/ policies specific to locations where the frontage road merges with the exit ramp? **The MUTCD. We do have Pavement Marking Standards, but they are not specific to a frontage Road. The Frontage Road is like any other road and the Pavement Markings are as required. Any special pavement markings at the merge point (I.E. Shark Teeth For Yield Condition) would be added on case by case basis and those markings would follow MUTCD standards.**
  5. What is the posted speed limit on the EXIT ramp that merge onto or with the frontage roads? **We post an advisory speed on every exit ramp that is dependent on the ramp geometry.**
  6. What is the posted speed limit on frontage road that have ramps merging into them? **Normally designed for 45 mph for Urban and 50 mph for rural but also dependent on traffic analysis and roadway geometry.**

7. If there are more than one lane on frontage road, do they merge the lanes in advance of the gore point? That is an appropriate strategy but the Access Management Policy requires an added for the exit ramp volume so merging frontage traffic to one lane may not be required.
8. Are there bike lanes on frontage road? If yes, what kind of traffic control do you use for the bike lanes? Complete Street Policy requires that all projects be evaluated for complete street elements. The appropriate facility is dependent on the local bike and Ped Plan. In the absence of a plan, a minimum facility on a new frontage road would be a 4 ft. shoulder. On a rehab project, restriping the roadway to create space for complete street elements may be considered.
9. If there are driveways in the vicinity of the frontage road merging with the exit ramp, what type of traffic control is used for the driveways? Eg: One-way, right-turn only, wrong way, do not enter, no left-turns etc. One-way frontage roads would require a right in- right out driveway. The spacing requirements are outlined in our Control Access Policy.

## Kundur, Smitha

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**From:** Joshua Harrouch <Joshua.Harrouch@LA.GOV>  
**Sent:** Friday, June 29, 2018 9:32 AM  
**To:** Kundur, Smitha  
**Subject:** EXTERNAL: RE: Frontage Road Traffic Control for Arizona DOT - Survey to agencies

Here is a link to the LA DOTD Pavement Marking Standards. Nothing specific to Frontage Roads, but you can see what our standard pavement marking plans look like.

[http://wwwsp.dotd.la.gov/Inside\\_LaDOTD/Divisions/Engineering/Standard\\_Plans/Pages/default.aspx?RootFolder=%2FInside%5FLaDOTD%2FDivisions%2FEngineering%2FStandard%5FPlans%2FStandard%20Plans%2FSigning%20and%20Pavement%20Markers&FolderCTID=0x012000759B9DC184A87A4E8BAEACED94697A67&View={6CA8D877-4BA0-45CA-83B0-350384A89137}](http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Standard_Plans/Pages/default.aspx?RootFolder=%2FInside%5FLaDOTD%2FDivisions%2FEngineering%2FStandard%5FPlans%2FStandard%20Plans%2FSigning%20and%20Pavement%20Markers&FolderCTID=0x012000759B9DC184A87A4E8BAEACED94697A67&View={6CA8D877-4BA0-45CA-83B0-350384A89137})

Let me know if you need anything else.

Thank you,

Joshua Harrouch, P.E., PTOE  
LA DOTD Traffic Engr. Development Administrator  
225-242-4640 (office)  
225-242-4630 (fax)  
joshua.harrouch@ la.gov

*This correspondence and the information contained herein is prepared solely for the purpose of identifying, evaluating and planning safety improvements on public roads which may be implemented utilizing federal aid highway funds; and is therefore exempt from discovery or admission into evidence pursuant to 23 U.S.C. 409.*

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**From:** Joshua Harrouch  
**Sent:** Friday, June 29, 2018 11:29 AM  
**To:** 'Smitha.Kundur@mbakerintl.com' <Smitha.Kundur@mbakerintl.com>  
**Subject:** RE: Frontage Road Traffic Control for Arizona DOT - Survey to agencies

A little longer than an hour. Hope this helps.

Joshua Harrouch, P.E., PTOE  
LA DOTD Traffic Engr. Development Administrator  
225-242-4640 (office)  
225-242-4630 (fax)  
joshua.harrouch@ la.gov

*This correspondence and the information contained herein is prepared solely for the purpose of identifying, evaluating and planning safety improvements on public roads which may be implemented utilizing federal aid highway funds; and is therefore exempt from discovery or admission into evidence pursuant to 23 U.S.C. 409.*

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**From:** Ann Guarino2 (DOTD)  
**Sent:** Friday, June 29, 2018 9:20 AM  
**To:** Joshua Harrouch <[Joshua.Harrouch@LA.GOV](mailto:Joshua.Harrouch@LA.GOV)>  
**Subject:** FW: Frontage Road Traffic Control for Arizona DOT - Survey to agencies

Here you go.

Regards,

Ann Guarino  
Administrative Assistant  
LA DOTD – Traffic Engineering Division  
225-242-4632  
[ann.guarino2@la.gov](mailto:ann.guarino2@la.gov)



---

**From:** Kunder, Smitha [<mailto:Smitha.Kunder@mbakerintl.com>]  
**Sent:** Monday, June 25, 2018 10:15 AM  
**To:** Ann Guarino2 (DOTD) <[Ann.Guarino2@la.gov](mailto:Ann.Guarino2@la.gov)>  
**Subject:** Frontage Road Traffic Control for Arizona DOT - Survey to agencies

Hello Ann,

This is Smitha Kunder from Michael Baker International Phoenix office. I talked to you earlier regarding the Frontage Road traffic control study that we are working with Arizona DOT.

The goal of the project is to develop standards for traffic control on frontage roads (signing, striping, traffic control, traffic calming etc.) where one-way frontage roads converge with the exit ramps. As part of the project, we are required to research, survey and document any adopted standards, policies and/or best practices for different agencies for the above mentioned scenario.

Attached with this email is a survey with a list of 10 questions relevant to the study. I would really appreciate it if you can forward to the traffic team/anyone else in your office who can please fill the survey and provide me with the responses. Also, I would really appreciate it if someone can please send me any standards/policies that you have for the above mentioned scenario.

Please feel free to call or email me if you have any questions.

Thanks,  
Smitha.

**Smitha Kunder, PE** | Traffic Engineer | Michael Baker International  
Phoenix Plaza Tower II, 2929 N. Central Avenue, 8th Floor | Phoenix, AZ 85012 | [O] 602-294-2253 | [M] 479-871-4110  
[smitha.kunder@mbakerintl.com](mailto:smitha.kunder@mbakerintl.com) | [www.mbakintl.com](http://www.mbakintl.com)



# NEW MEXICO

**Michael Baker**

INTERNATIONAL

**Michael Baker  
International, Inc.**

*Phoenix, Arizona*

**ADOT CENTRAL DISTRICT FREEWAY  
FRONTAGE ROAD TRAFFIC CONTROL STUDY  
TASK 3: NATIONWIDE SURVEY OF BEST PRACTICES  
SURVEY QUESTIONS**

1. Do you currently have one-way frontage roads along and/or adjacent to state, county or local highways within your City/State? **Yes**
2. If answered YES for question 1, do you have adopted standards/policies and/or best practices for traffic control where frontage roads merge with exit ramp? **No, each location is addressed individually.**
3. If answered YES for question 2, what is the basis for the recommended traffic control?
  - a. Volume,
  - b. Sight Distance,
  - c. Speed,
  - d. Crashes,
  - e. Number of Lanes,
  - f. All of the above, or
  - g. Other (Specify)
4. Do you currently have any traffic calming elements/policies specific to locations where the frontage road merges with the exit ramp? **No Policies**
5. Do you currently have any pavement marking recommendations/ policies specific to locations where the frontage road merges with the exit ramp? **No**
6. What is the posted speed limit on the EXIT ramp that merge onto or with the frontage roads? **Varies**
7. What is the posted speed limit on frontage road that have ramps merging into them? **Varies, but typically at 45 mph**
8. If there are more than one lane on frontage road, do they merge the lanes in advance of the gore point? **Not necessarily.**
9. Are there bike lanes on frontage road? If yes, what kind of traffic control do you use for the bike lanes? **I don't recall of any bike lanes at this time.**
10. If there are driveways in the vicinity of the frontage road merging with the exit ramp, what type of traffic control is used for the driveways? Eg: One-way, right-turn only, wrong way, do not enter, no left-turns etc. **There could be driveways but State Access manual sets the parameters for the distance to the merge or intersections.**

**WISCONSIN**

**Michael Baker**

**INTERNATIONAL**

**Michael Baker  
International, Inc.**

*Phoenix, Arizona*

## **Barrientes, Vivianna**

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**From:** Zellers, Ryan  
**Sent:** Monday, April 09, 2018 1:46 PM  
**To:** Kundur, Smitha; Tiwari, Pradeep; Kugler, Kevin  
**Subject:** ADOT Traffic Study: Wisconsin and Minnesota DOT phone surveys

All,

Here are some notes from the folks I've been in contact with. I just did a bunch of copy and paste for now. I've been trading phone calls with Wisconsin DOT and had a discussion with Minnesota DOT. I should have a bit more info by tomorrow. Just checking in and showing what I've done to date.

Thanks!

---

Wisconsin DOT  
Elizabeth "Liz" Schneider  
(414) 225-3728

- No policies known (looking into it)
- Control varies depending on:
  - Lanes dedicated to off and on traffic
  - Traffic volumes of roads they are crossing
  - Sometimes right-of-way from frontage road, sometimes off ramp.

### **AWAITING PHONE CALL FOR MORE INFO**

---

Minnesota DOT  
Traffic Safety and Operations  
Peter Buchen  
(651) 234-7010

- They have one and two-way frontage roads that merge (and diverge)
- Covered in the road design manual
- Access Management <http://www.dot.state.mn.us/accessmanagement/resources.html>
- Guidance in Street Design Manual Sections 2-3.06 and 6-4

### **2-3.06 Access Management**

Access management is the planning, design, and implementation of land use and transportation strategies that control the flow of traffic between the road and adjacent land uses. The proper location and design of public street and private driveway connections to the highway can greatly enhance the safety and mobility of the traveling public, preserve capacity, and extend the useful life of the facility. Where access to a highway is managed, entrances and exits are located at points best suited to fit the traffic and land-use needs. The goal is to allow vehicles to enter and leave safely with minimum interference to through traffic, preserving service and reducing the potential for crashes.

Figures 2-3.06A to 2-3.06H detail typical access control for at-grade intersections and interchanges.

# **APPENDIX B**

## **DATA COLLECTION SHEETS**

# **INTERSTATE 17**

**Location: I-17 & McDowell NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & McDowell NB	
LINK: <a href="https://earth.google.com/web/@33.46404126,-112.10768362,326.07768116a,396.4104684d,35y,0h,0t,0r">https://earth.google.com/web/@33.46404126,-112.10768362,326.07768116a,396.4104684d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

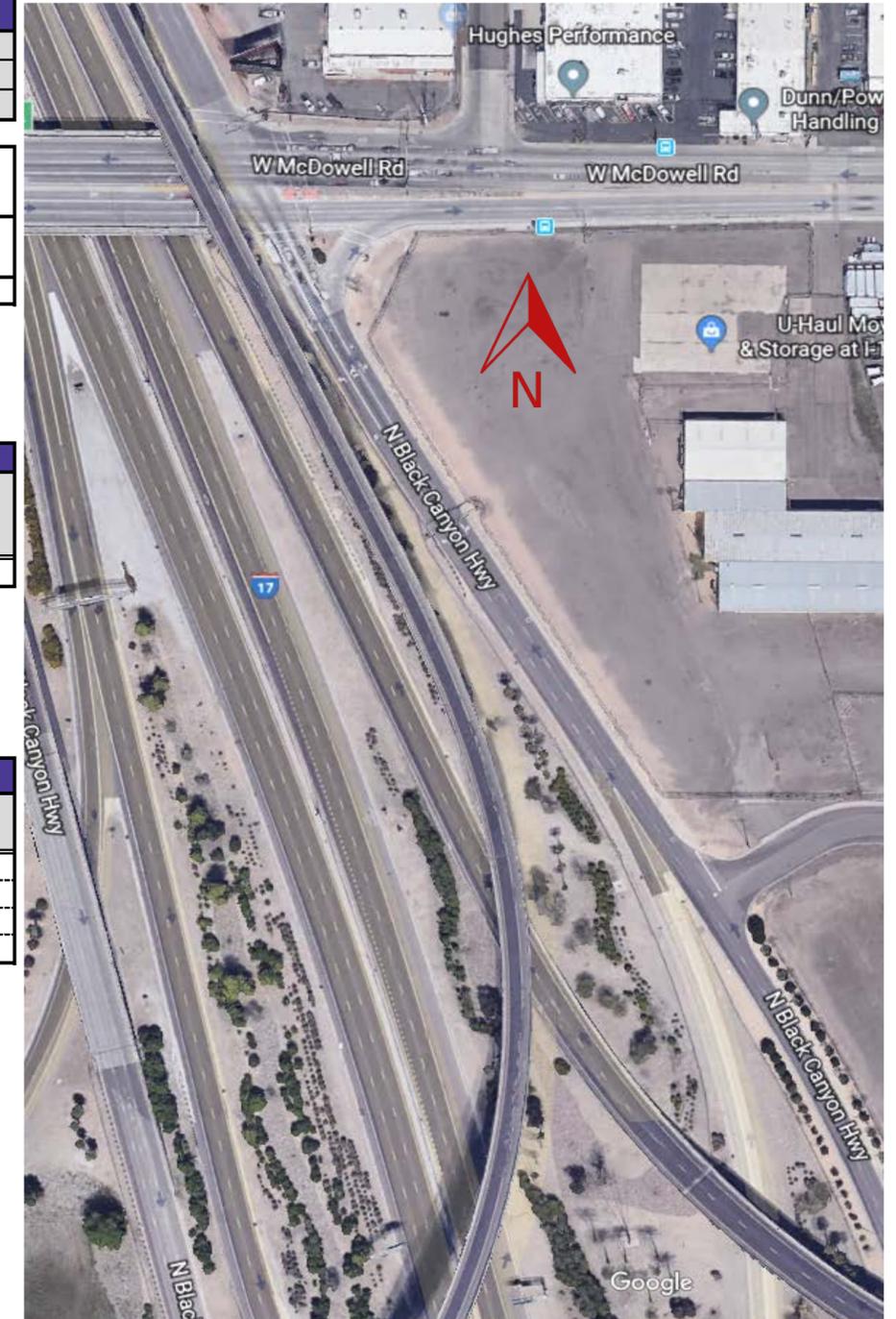
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	No
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	30	120	280	350	330

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3	Left	Lane Configuration
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & McDowell SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & McDowell SB	
LINK: <a href="https://earth.google.com/web/@33.4686934,-112.11097108,327.2447767a,197.57793247d,35v,337.46087967h,0t,0r">https://earth.google.com/web/@33.4686934,-112.11097108,327.2447767a,197.57793247d,35v,337.46087967h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

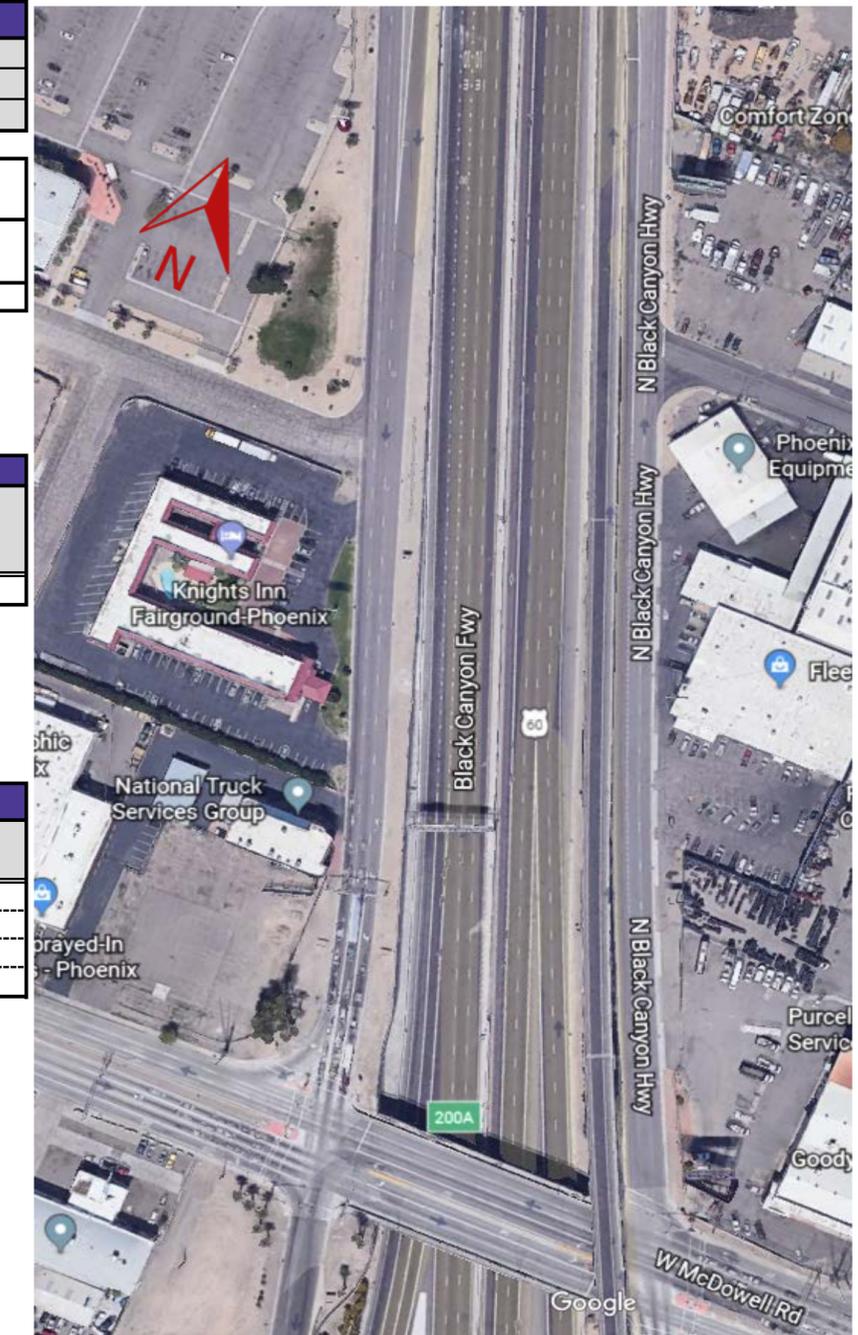
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
no advance warning signs	20	370	670	210	200

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3, OM-3C	Left	Lane Configuration
TOTAL # of Warning Signs:		TOTAL # of Traffic Control Signs:		
0		1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Thomas NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Thomas NB	
LINK: <a href="https://earth.google.com/web/@33.47598241,-112.11259092,331.61364754a,422.7614056d,35v,-0h,0t,0r">https://earth.google.com/web/@33.47598241,-112.11259092,331.61364754a,422.7614056d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No advanced warning signs	W4-3 Sign at Gore	150	1,270	290	140

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3	Left	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines	NO



**Location: I-17 & Thomas SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Thomas SB	
LINK: <a href="https://earth.google.com/web/@33.48255098,-112.11323991,330.90225954a,145.38100525d,35y,0h,0t,0r">https://earth.google.com/web/@33.48255098,-112.11323991,330.90225954a,145.38100525d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
no advance warning signs	70	100	430	170	170

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Indian School NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Indian School NB	
LINK: <a href="https://earth.google.com/web/@33.4928762,-112.11260236,339.13305407a,212.98823156d,35y,0h,0t,0r">https://earth.google.com/web/@33.4928762,-112.11260236,339.13305407a,212.98823156d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

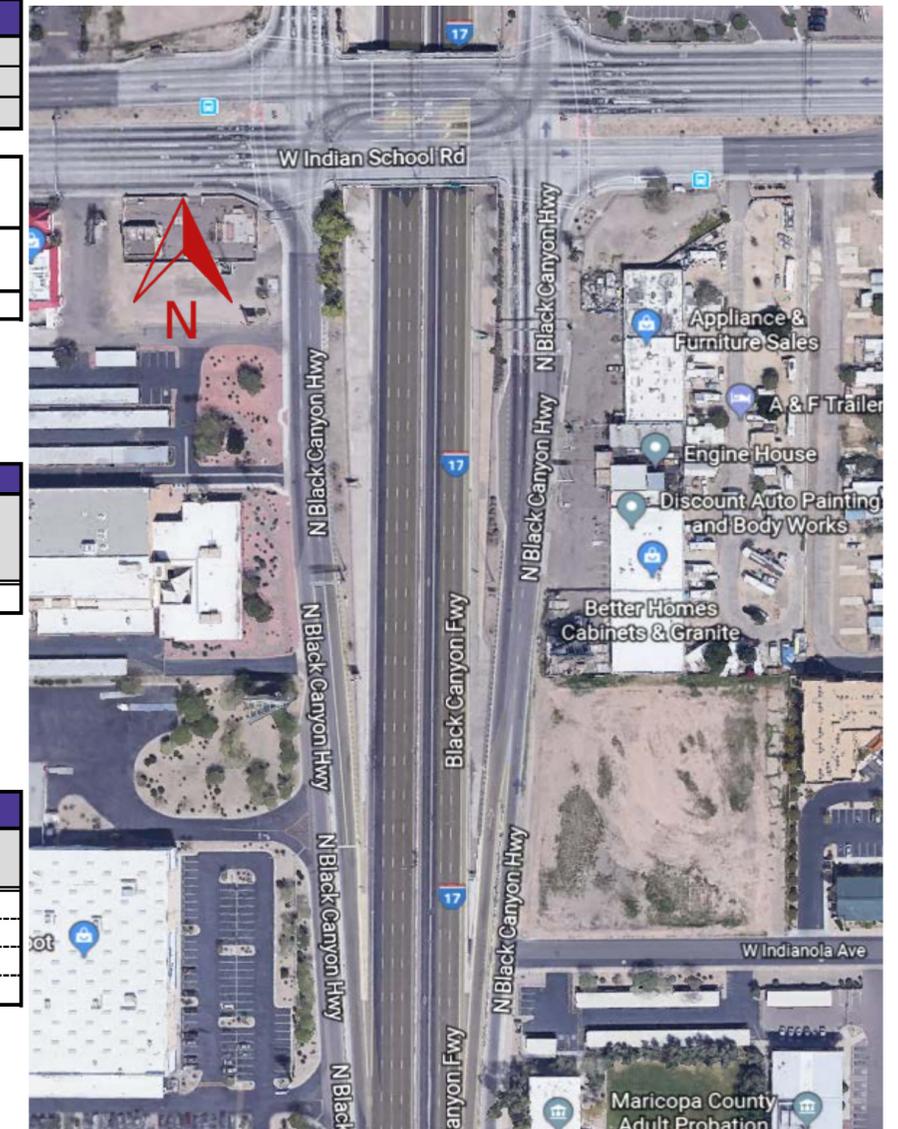
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
no advance warning signs	W4-3 sign at gore	110	340	200	140

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3	Left	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Indian School SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Indian School SB	
LINK: <a href="https://earth.google.com/web/@33.49713208,-112.11334696,340.39463377a,316.11937038d,35y,0.00000001h,44.3112617t,0r">https://earth.google.com/web/@33.49713208,-112.11334696,340.39463377a,316.11937038d,35y,0.00000001h,44.3112617t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

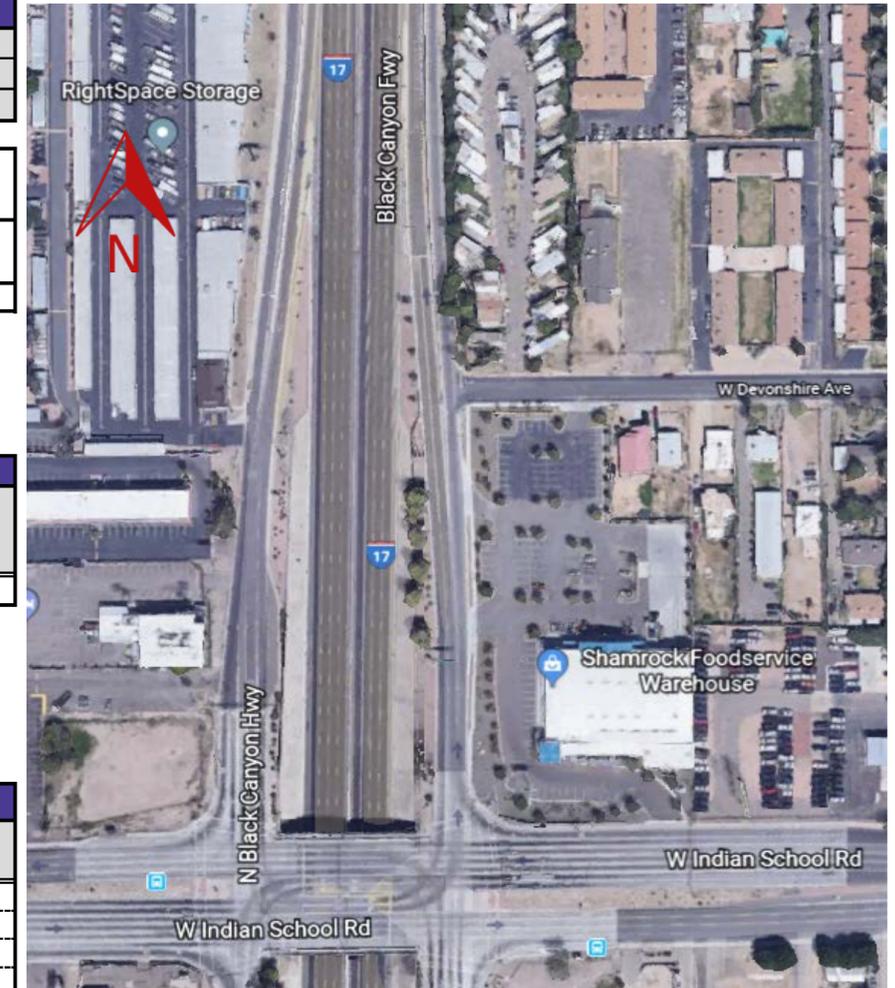
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No advance warning signs	W4-3 on Physical Gore	100	340	200	140

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3	Left	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Camelback NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Camelback NB	
LINK: <a href="https://earth.google.com/web/@33.50696847,-112.11191154,342.46504364a,297.40445553d,35y,0h,0t,0r">https://earth.google.com/web/@33.50696847,-112.11191154,342.46504364a,297.40445553d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPUI	

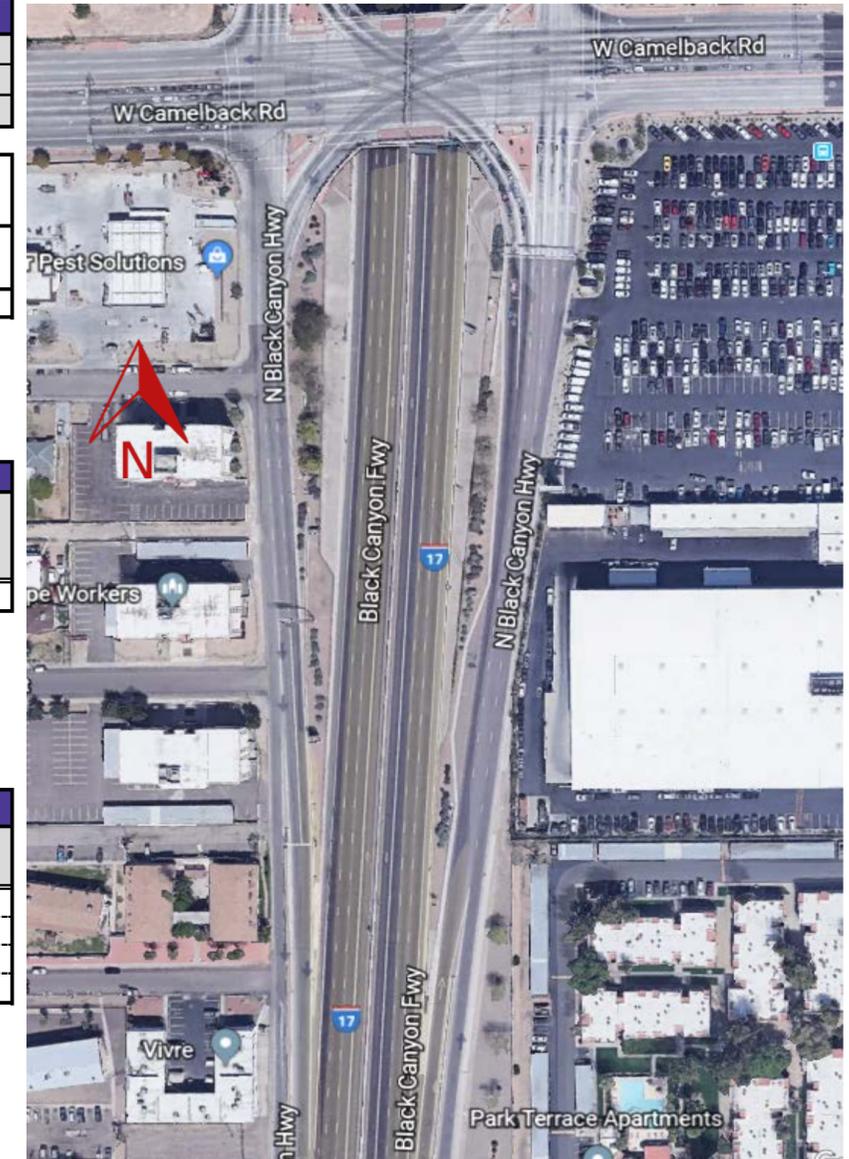
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Regulatory Sign	440	100	700	130	110

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3	Left	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Camelback SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Camelback SB	
LINK: <a href="https://earth.google.com/web/@33.51153303,-112.11305322,345.39606955a,262.34886959d,35y,187.34569767h,0t,0r">https://earth.google.com/web/@33.51153303,-112.11305322,345.39606955a,262.34886959d,35y,187.34569767h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPU	

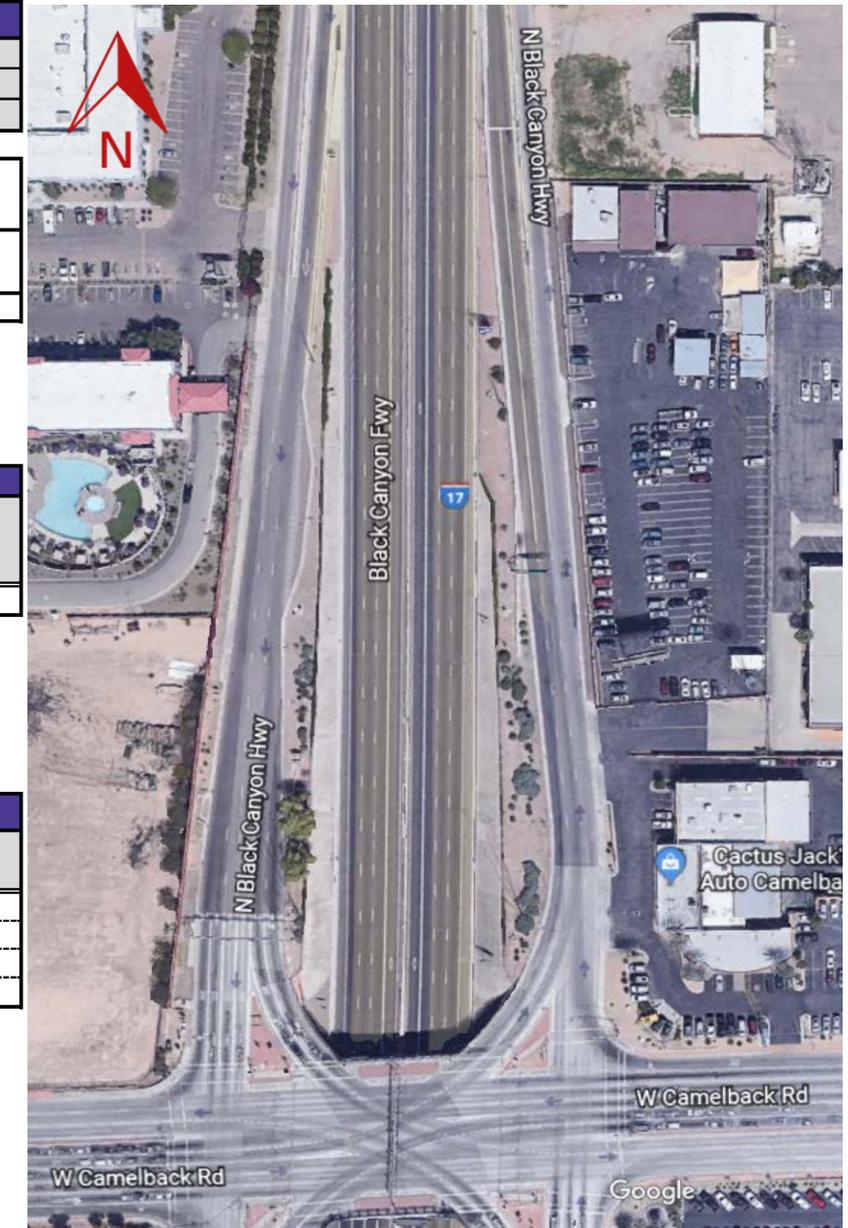
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	540	110	470	140	130

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3	Left	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 and Bethany Home NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 and Bethany Home NB	
LINK: <a href="https://earth.google.com/web/@33.52201421,-112.1119078,350.51757512a,236.00303146d,35y,-0h,0t,0r">https://earth.google.com/web/@33.52201421,-112.1119078,350.51757512a,236.00303146d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPU	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	310	100	550	120	140

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3	Right	Lane Configuration
		W4-3	Left	
TOTAL # of Warning Signs:		0	TOTAL # of Traffic Control Signs:	
			2	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Bethany Home SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Bethany Home SB	
LINK: <a href="https://earth.google.com/web/@33.52619403,-112.11249511,349.62747734a,253.68295061d,35y,-0h,0t,0r">https://earth.google.com/web/@33.52619403,-112.11249511,349.62747734a,253.68295061d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPUI	

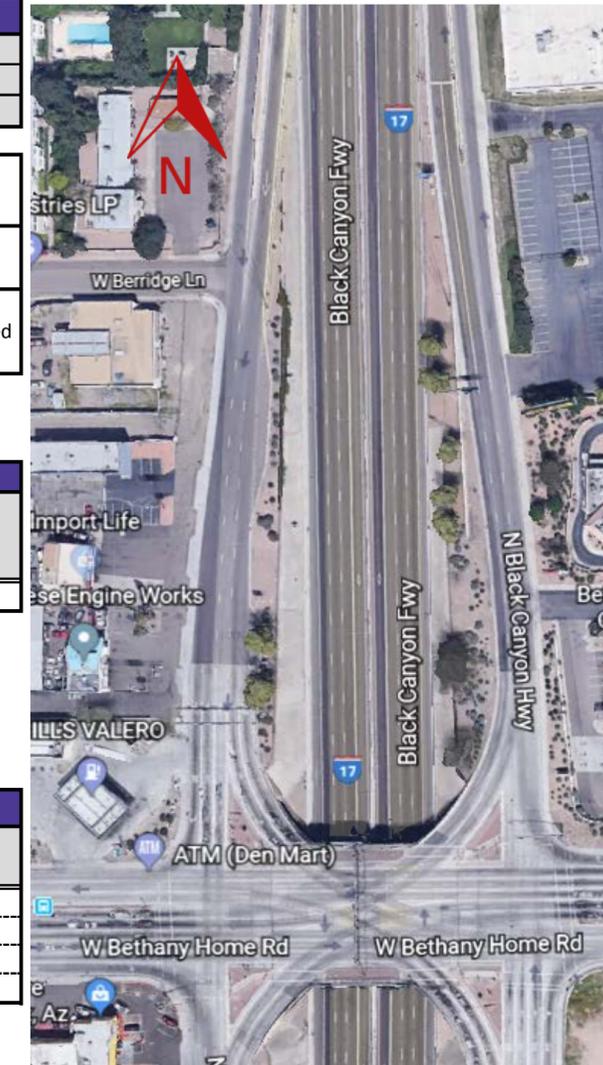
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	Right W4-3 Blocked by Bush
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
650	100	100	410	140	120

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	W4-3	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Glendale NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Glendale NB	
LINK: <a href="https://earth.google.com/web/@33.53688892,-112.1114781,360.09387324a,302.98200575d,35v,-0h,0t,0r">https://earth.google.com/web/@33.53688892,-112.1114781,360.09387324a,302.98200575d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPU	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Traffic Control Signs	No Traffic Control Signs	100	450	130	140

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left			Lane Configuration
W4-3	Right			
TOTAL # of Warning Signs: 2		TOTAL # of Traffic Control Signs: 0		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



Location: I-17 & Glendale SB

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Glendale SB	
LINK: <a href="https://earth.google.com/web/@33.54078875,-112.11251582,358.65904583a,204.25247847d,35y,0h,0t,0r">https://earth.google.com/web/@33.54078875,-112.11251582,358.65904583a,204.25247847d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPUI	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Traffic Control Signs	No Traffic Control Signs	100	490	110	110

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Right			Lane Configuration
TOTAL # of Warning Signs:	1	TOTAL # of Traffic Control Signs:	0	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Northern NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Northern NB	
LINK: <a href="https://earth.google.com/web/@33.55174653,-112.11125443,365.38441424a,506.78984516d,35y,0h,0t,0r">https://earth.google.com/web/@33.55174653,-112.11125443,365.38441424a,506.78984516d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPUI	

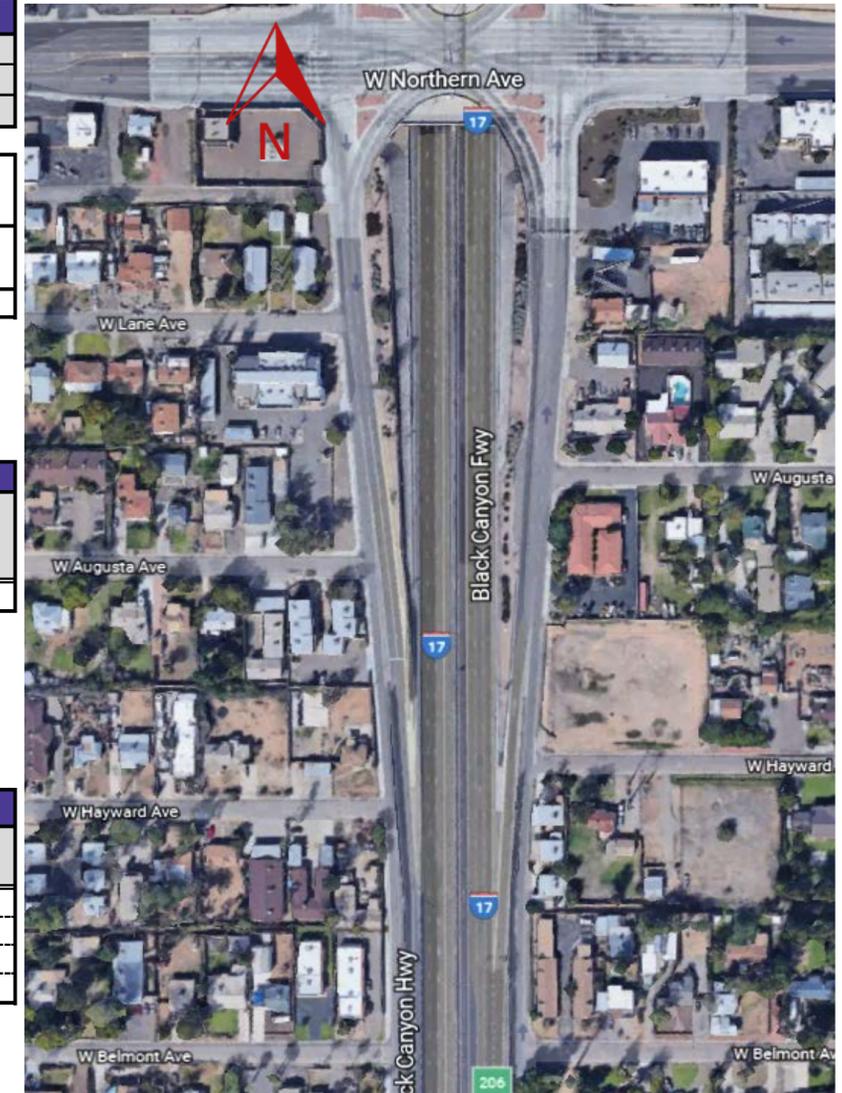
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Traffic Control Signs	No Traffic Control Signs	100	570	160	180

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left			Lane Configuration
<b>TOTAL # of Warning Signs:</b>	1	<b>TOTAL # of Traffic Control Signs:</b>	0	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	YES
Yield Ahead:	YES
Stop Ahead:	YES
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Northern SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Northern SB	
LINK: <a href="https://earth.google.com/web/@33.55640267,-112.11281097,368.03890736a,150.32184364d,35y,-0h,0t,0r">https://earth.google.com/web/@33.55640267,-112.11281097,368.03890736a,150.32184364d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPU	

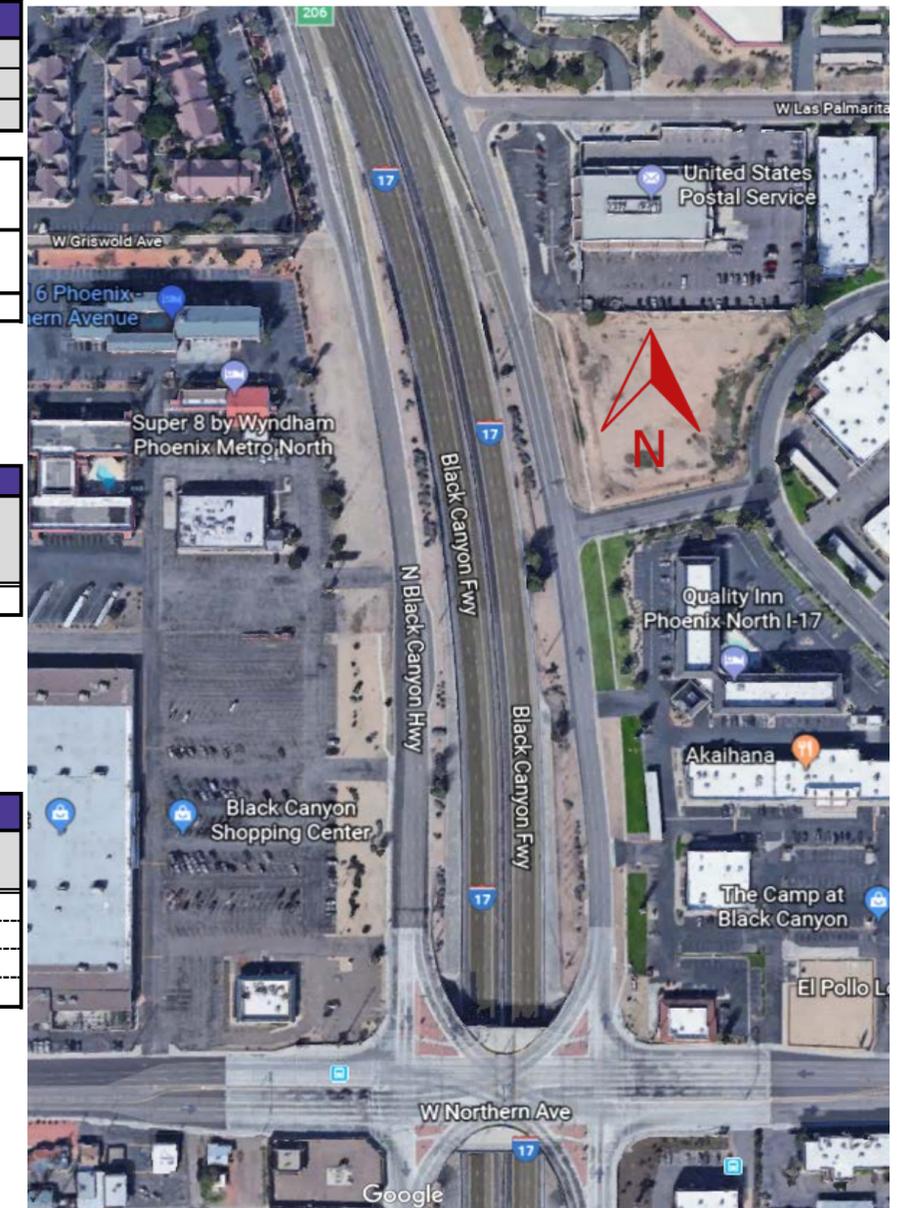
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Traffic Control Signs	No Traffic Control Signs	120	910	160	160

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left			Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 0		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Dunlap NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Dunlap NB	
LINK: <a href="https://earth.google.com/web/@33.56463286,-112.11607772,372.02932101a,243.9597159d,35y,0h,0t,0r">https://earth.google.com/web/@33.56463286,-112.11607772,372.02932101a,243.9597159d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPUI	

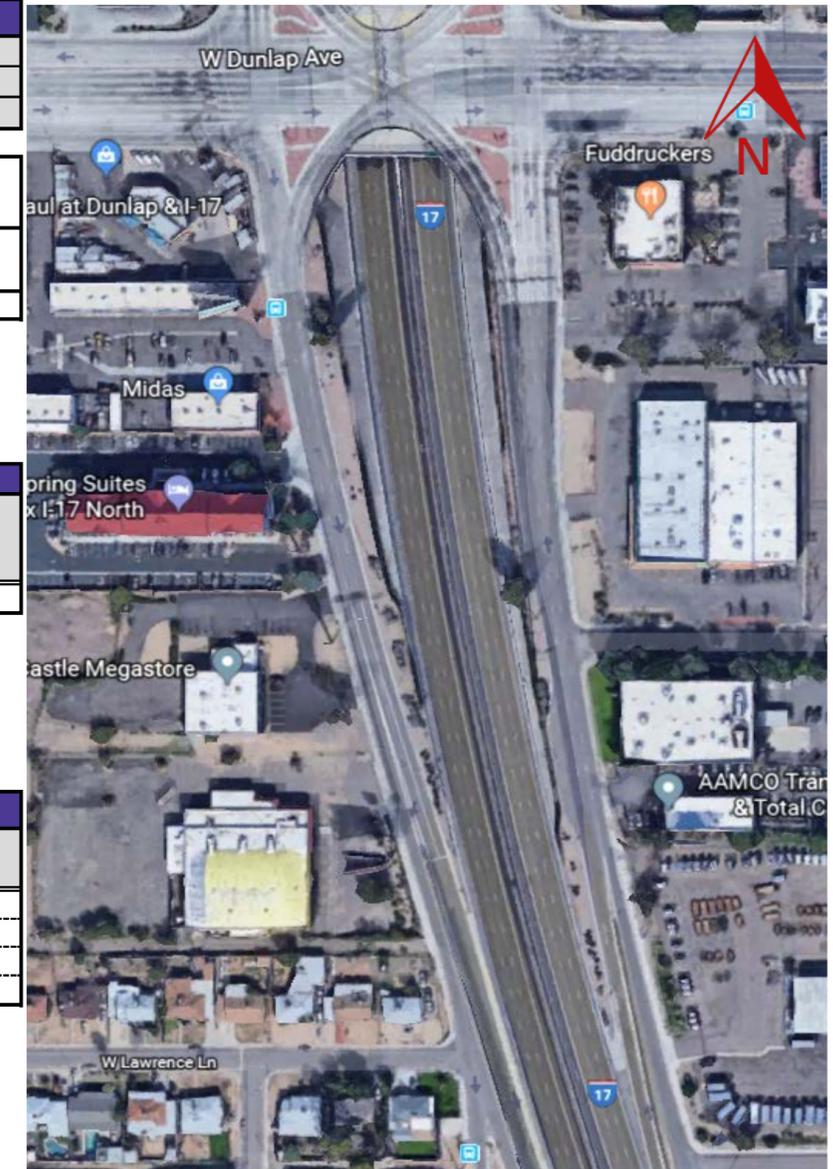
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Traffic Control Signs	No Traffic Control Signs	80	680	170	170

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left			Lane Configuration
TOTAL # of Warning Signs:	1	TOTAL # of Traffic Control Signs:	0	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Dunlap SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Dunlap SB	
LINK: <a href="https://earth.google.com/web/@33.57190618,-112.11741706,376.71331956a,263.80018132d,35y,0h,0t,0r">https://earth.google.com/web/@33.57190618,-112.11741706,376.71331956a,263.80018132d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPUI	

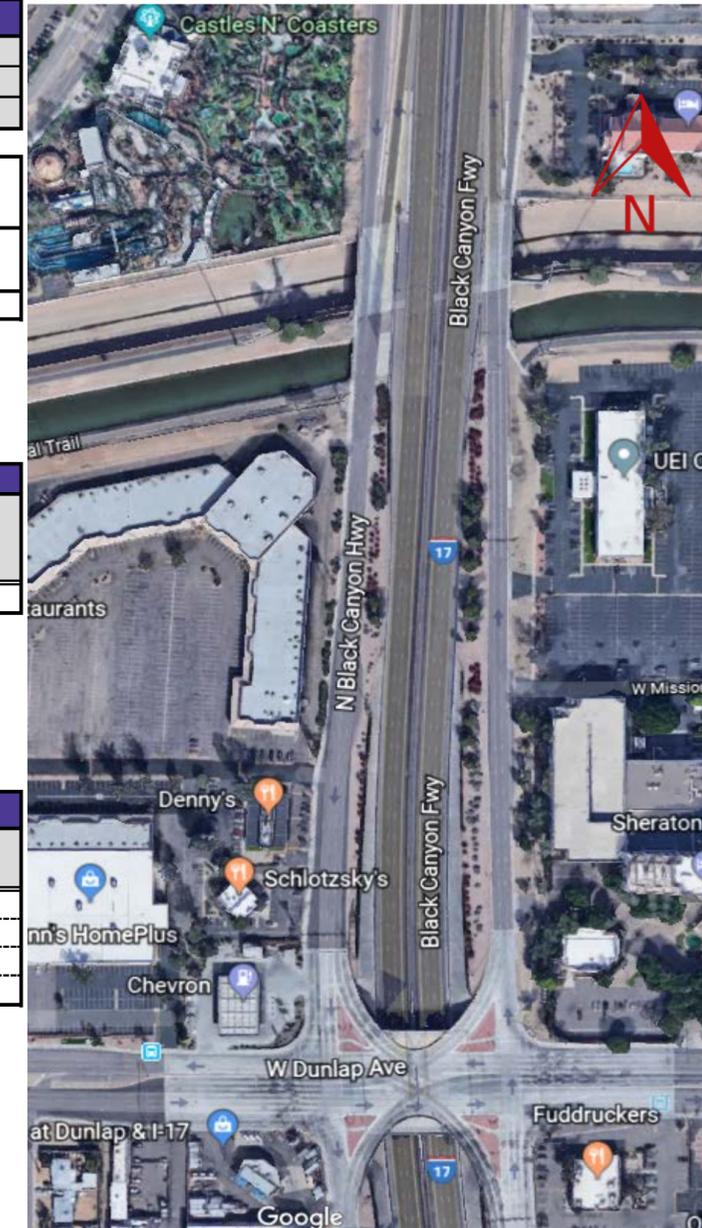
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
510	200	190	1,120	160	160

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Peoria NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Peoria NB	
LINK: <a href="https://earth.google.com/web/@33.57897463,-112.116373,382.66093643a,203.3218515d,35y,0h,0t,0r">https://earth.google.com/web/@33.57897463,-112.116373,382.66093643a,203.3218515d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

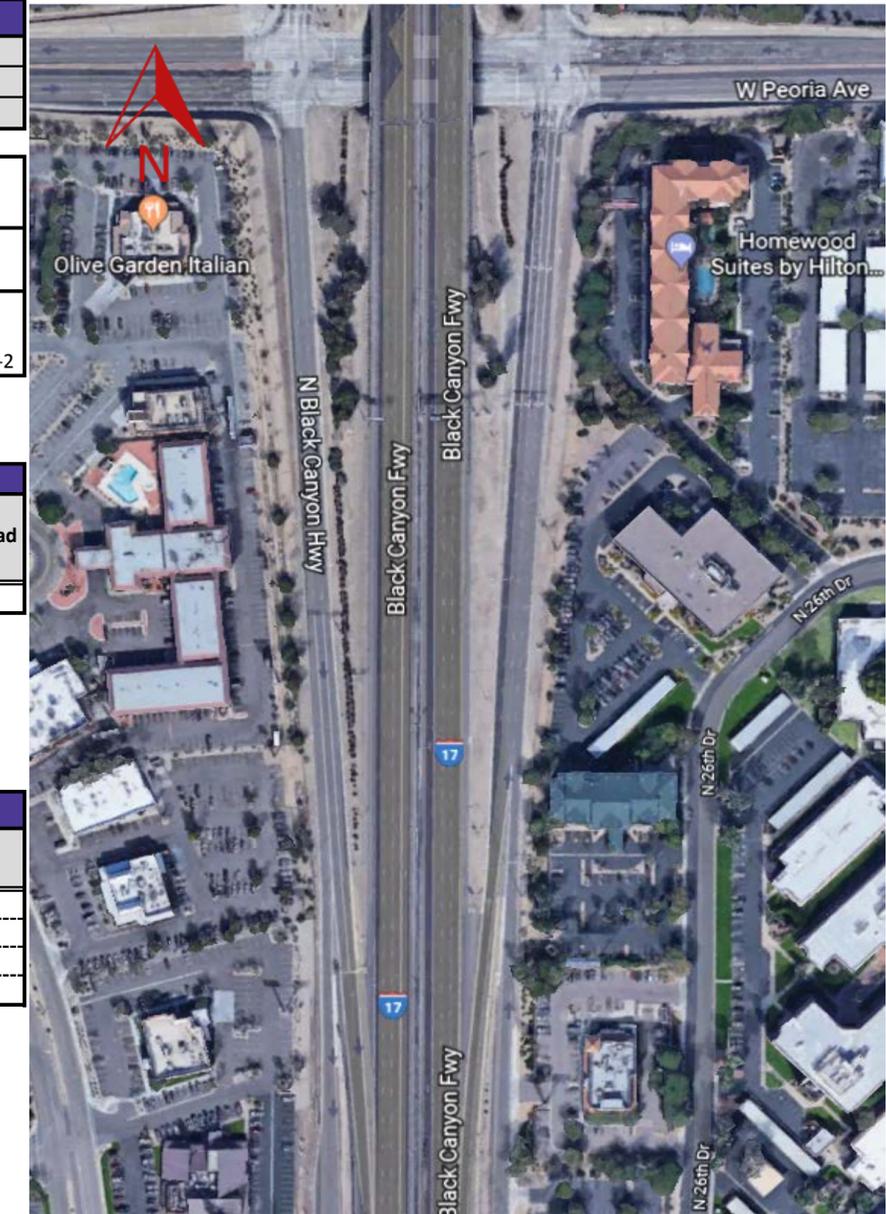
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	Tree is blocking W3-2
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
410	-60	190	520	430	440

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2, R1-2rP	Right	Lane Configuration
W3-4	Left			
TOTAL # of Warning Signs:	2	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: I-17 & Peoria SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Peoria SB	
LINK: <a href="https://earth.google.com/web/@33.58517928,-112.11709413,383.65207682a,252.14326268d,35y,-0h,0t,0r">https://earth.google.com/web/@33.58517928,-112.11709413,383.65207682a,252.14326268d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

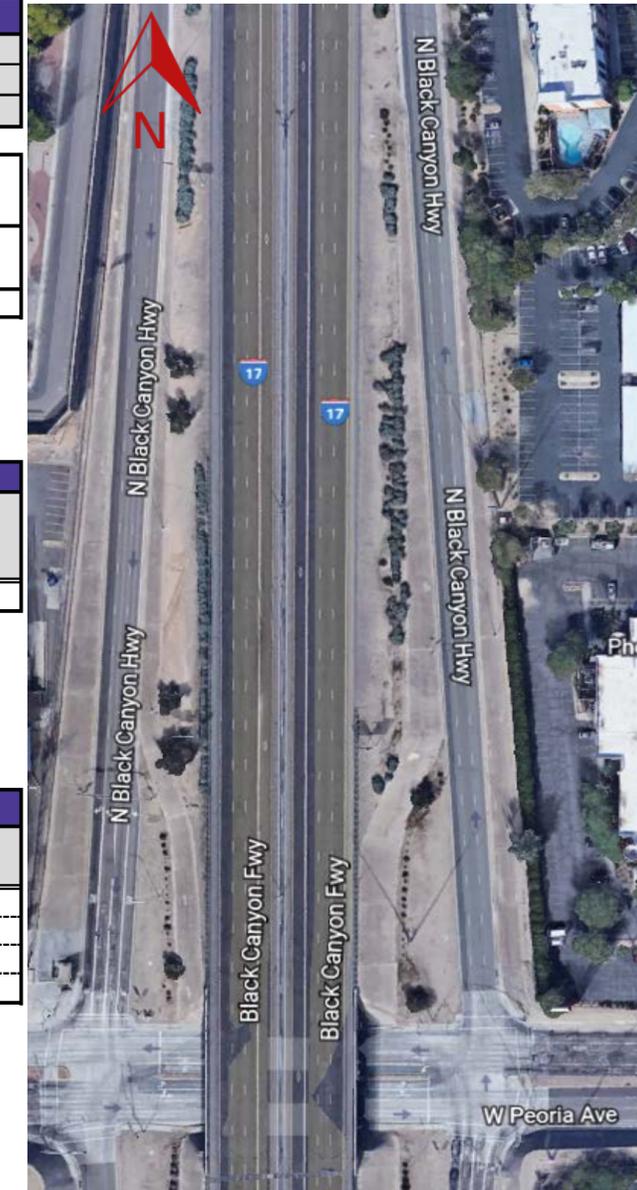
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
250	-240	650	860	210	220

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Right	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Cactus NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Cactus NB	
LINK: <a href="https://earth.google.com/web/@33.59317991,-112.11644083,391.23378533a,495.96984645d,35y,-0h,0t,0r">https://earth.google.com/web/@33.59317991,-112.11644083,391.23378533a,495.96984645d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

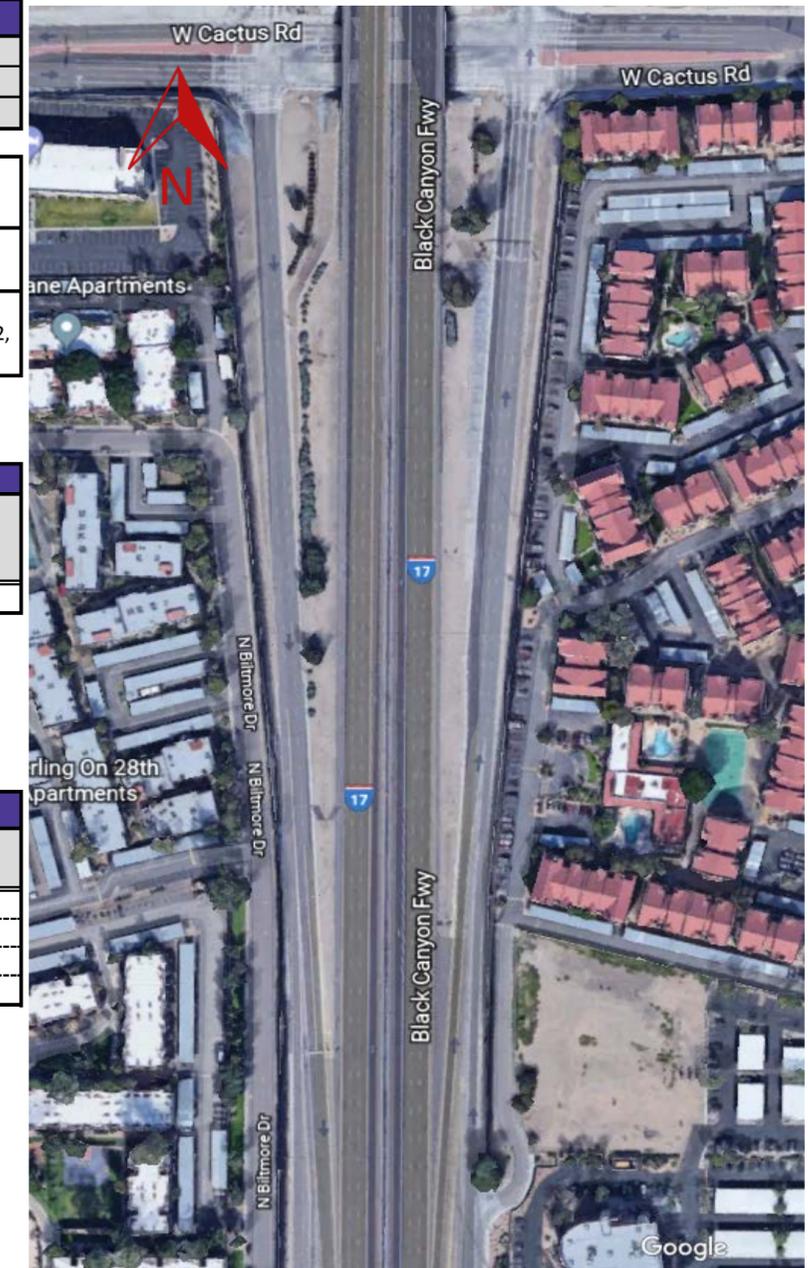
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	Wall Blocking R1-2, R1-2rP
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
1,240	-480	480	670	220	220

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-4	Left	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Cactus SB**

[Back to Index](#)

**EXISTING INVENTORY**

<b>LOCATION: I-17 &amp; Cactus SB</b>	
<b>LINK: <a href="https://earth.google.com/web/@33.59848468,-112.11702076,390.27872313a,218.49237832d,35y,-0h,0t,0r">https://earth.google.com/web/@33.59848468,-112.11702076,390.27872313a,218.49237832d,35y,-0h,0t,0r</a></b>	
<b>ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond</b>	

<b>Posted Speed Limit on Frontage Road (mph):</b>	45	<b>AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :</b>	930
<b>Divider Between Frontage Road and Exit Ramp:</b>	Sound Wall	<b>AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):</b>	800
<b>Downgrade or Upgrade?</b>	Downgrade	<b>Physical Obstruction to Sight Distance?</b>	R1-2 Blocked by Wall
<b>Sidewalk Along Frontage?</b>	NO		
<b>Bicycle Lane Along Frontage?</b>	NO		
<b>Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?</b>	NO		

**DISTANCES (NEAREST 10 FEET)**

Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	-360	400	290	300	200

**Lanes**

<b>Number of Lanes on Frontage Road Approach:</b>	1
<b>Number of Lanes on Ramp at Merge:</b>	1
<b>Number of Lanes on Frontage Road Departure:</b>	4

**Advance Warning Signs**

Sign Code	Side of Road
<b>TOTAL # of Warning Signs:</b>	0

**Traffic Control Signs**

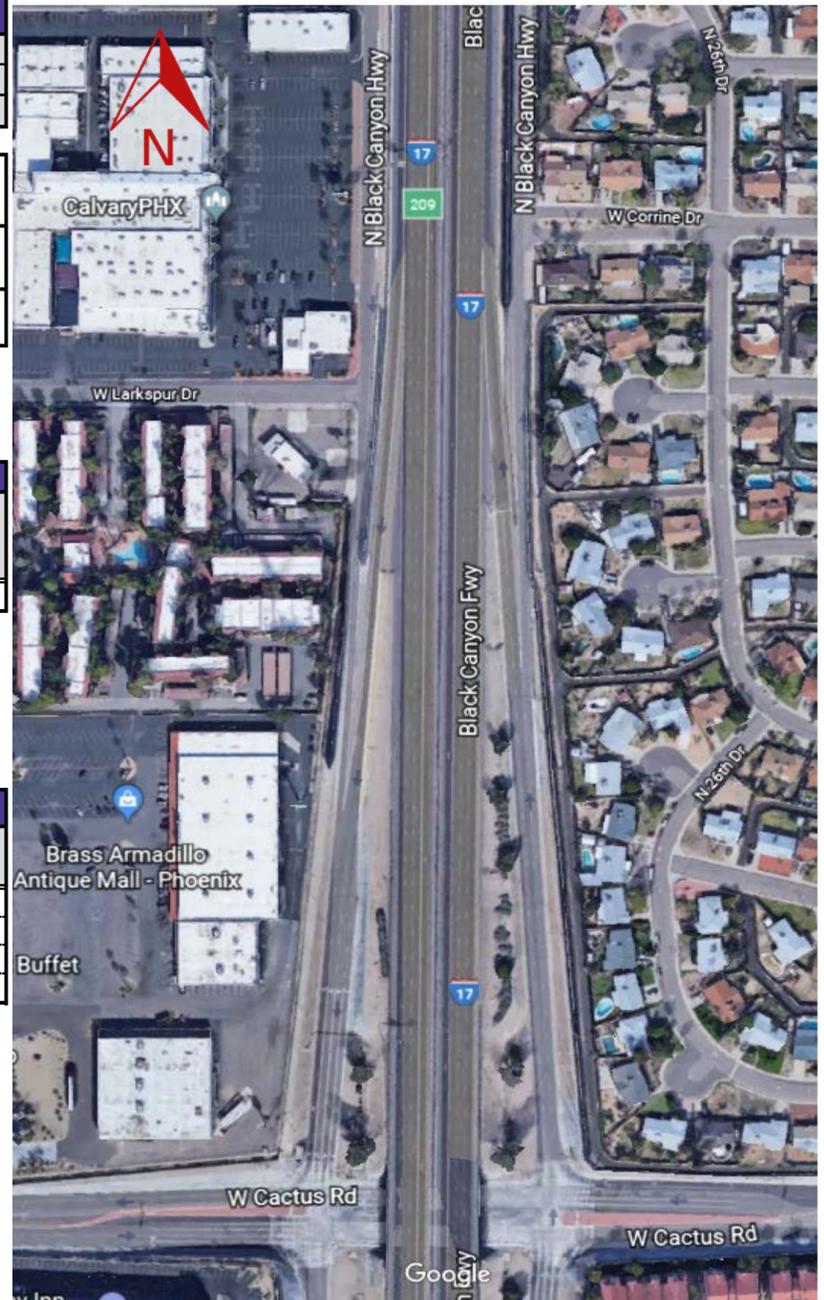
Sign Code	Side of Road
R1-2	Right
<b>TOTAL # of Traffic Control Signs:</b>	1

**Overhead Signs**

Description (Guide, Lane Configuration)
Lane Configuration

**Pavement Markings at Frontage/Ramp**

<b>Stop Bar for Frontage:</b>	NO
<b>Yield Ahead:</b>	NO
<b>Stop Ahead:</b>	NO
<b>Wrong-way Arrows with RPMs (M-12):</b>	YES
<b>Yield Lines:</b>	NO



**Location: I-17 & Thunderbird NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Thunderbird NB	
LINK: <a href="https://earth.google.com/web/@33.6076039,-112.11613393,393.34721246a,234.68536176d,35y,0h,0t,0r">https://earth.google.com/web/@33.6076039,-112.11613393,393.34721246a,234.68536176d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

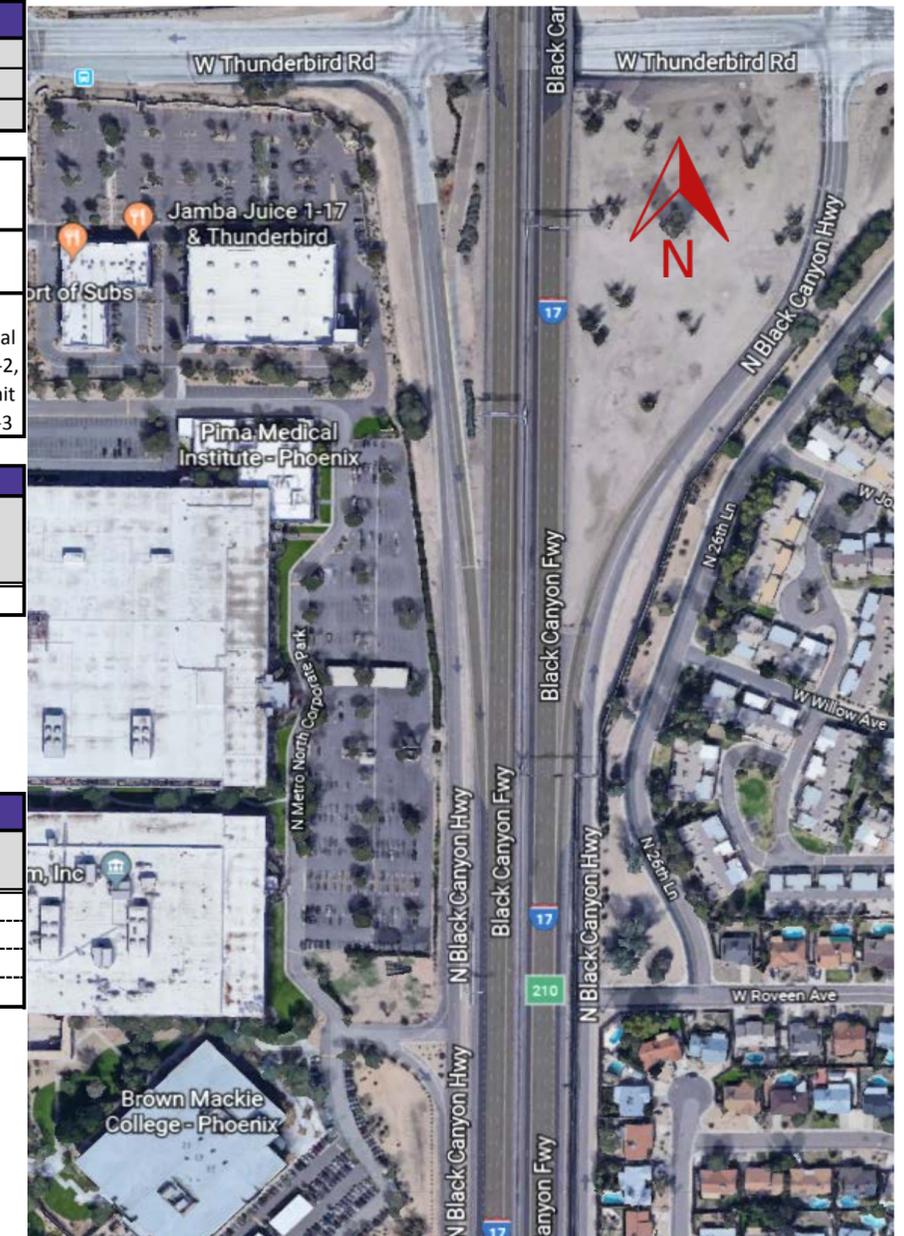
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	Wall and Horizontal Curve Blocking R1-2, R1-2rP, Speed Limit Sign Blocking W4-3
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
	-100	290	380	390	290

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Right	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Thunderbird SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Thunderbird SB	
LINK: <a href="https://earth.google.com/web/@33.6076039,-112.11613393,393.34721246a,234.68536176d,35y,0h,0t,0r">https://earth.google.com/web/@33.6076039,-112.11613393,393.34721246a,234.68536176d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

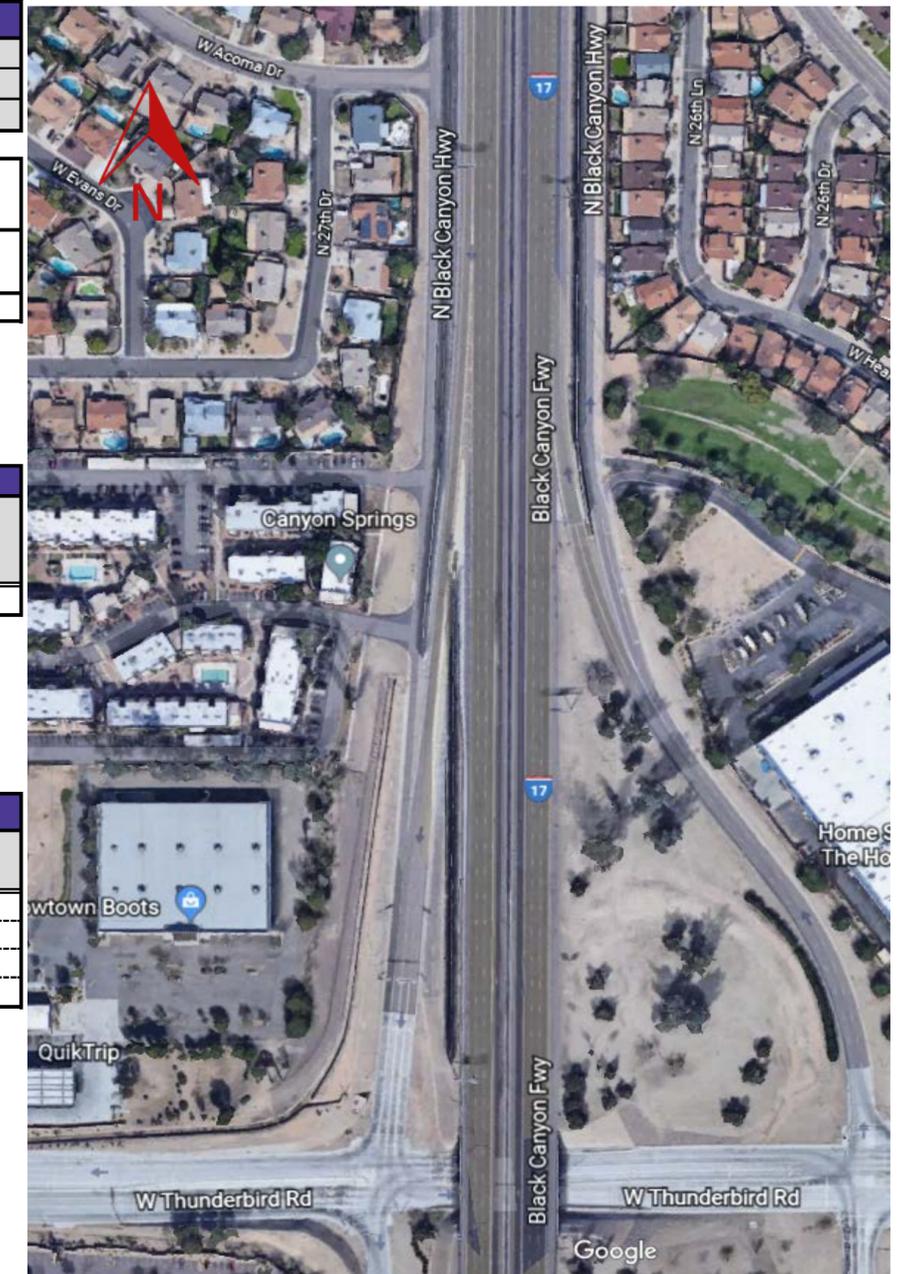
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
650	-60	270	230	250	250

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Greenway NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Greenway NB	
LINK: <a href="https://earth.google.com/web/@33.62259265,-112.11604739,399.23819573a,156.94013761d,35y,-0h,0t,0r">https://earth.google.com/web/@33.62259265,-112.11604739,399.23819573a,156.94013761d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

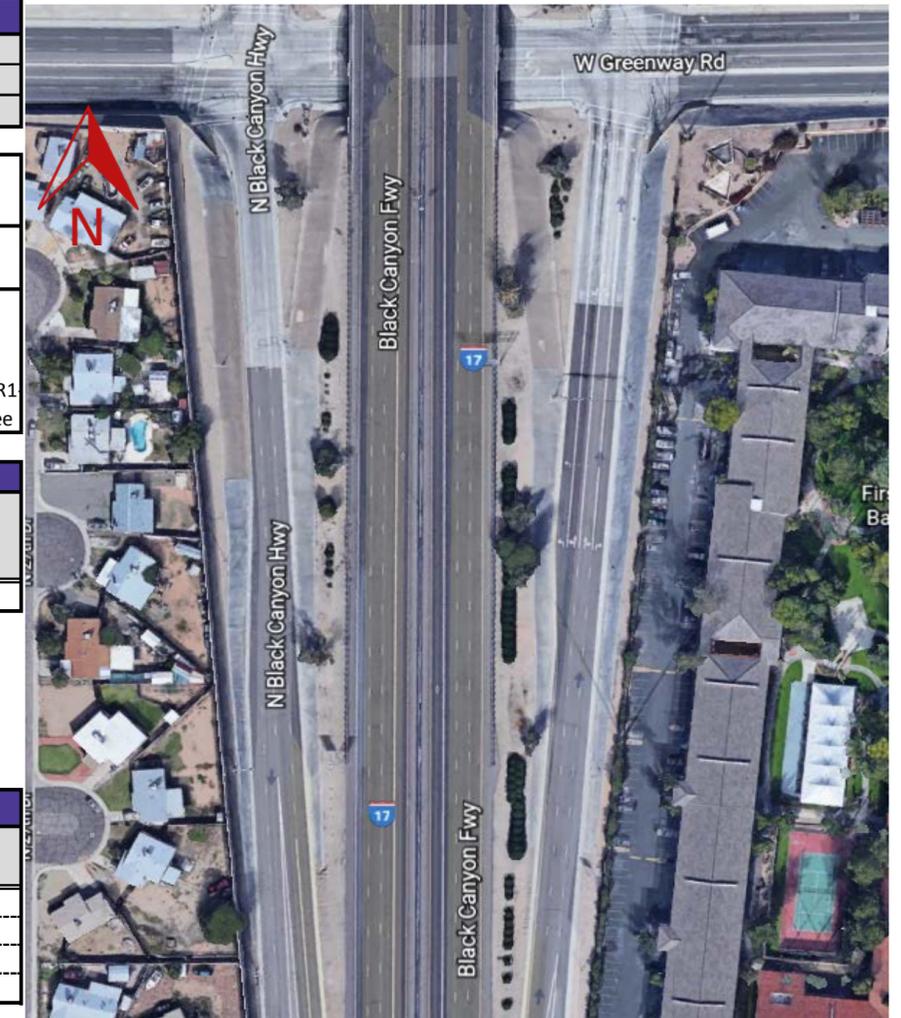
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	W3-2 Blocked by School Sign, R1-2, R1-2rP Blocked by Tree
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
300	-190	210	410	420	270

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Greenway SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Greenway SB	
LINK: <a href="https://earth.google.com/web/@33.62872376,-112.11683331,401.26922962a,136.93950338d,35y,-0h,0t,0r">https://earth.google.com/web/@33.62872376,-112.11683331,401.26922962a,136.93950338d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

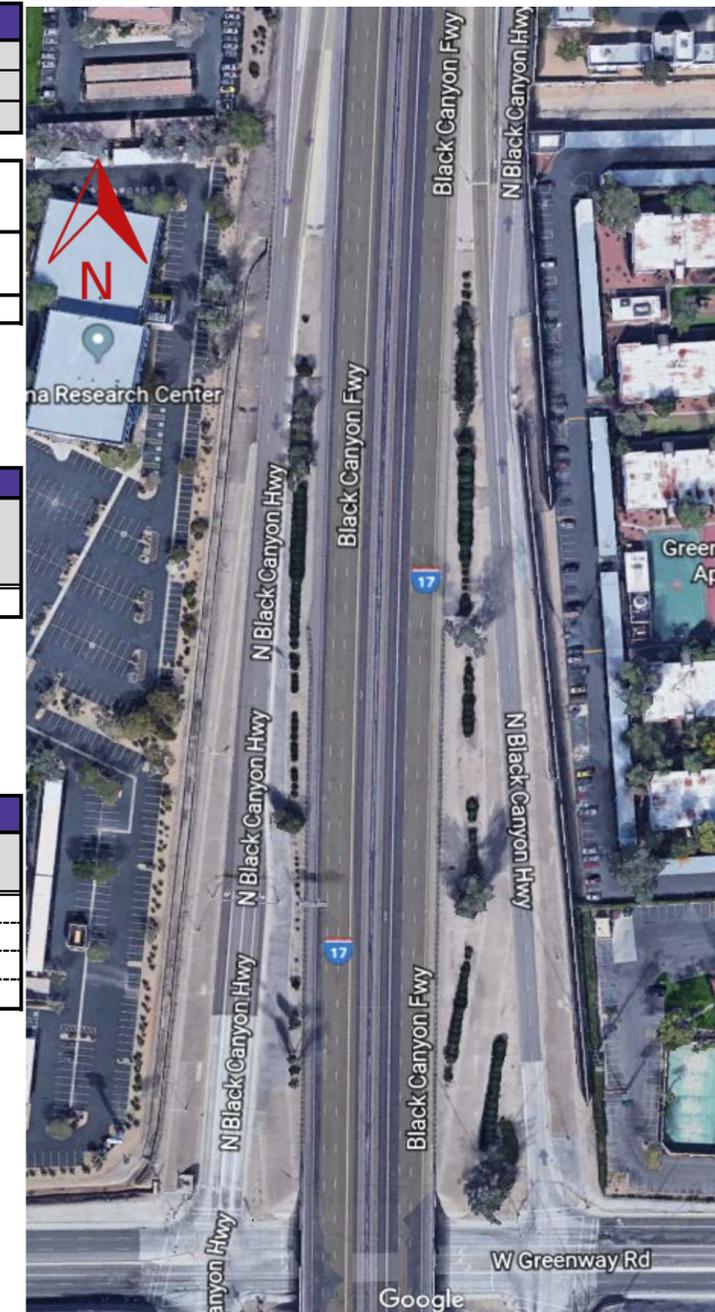
Posted Speed Limit on Frontage Road (mph):	50	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	1030
Divider Between Frontage Road and Exit Ramp:	Guard Rail	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	910
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	310	400	730	360	350

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Bell NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Bell NB	
LINK: <a href="https://earth.google.com/web/@33.63787911,-112.11499413,404.41920202a,253.54228575d,35y,-0h,0t,0r">https://earth.google.com/web/@33.63787911,-112.11499413,404.41920202a,253.54228575d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

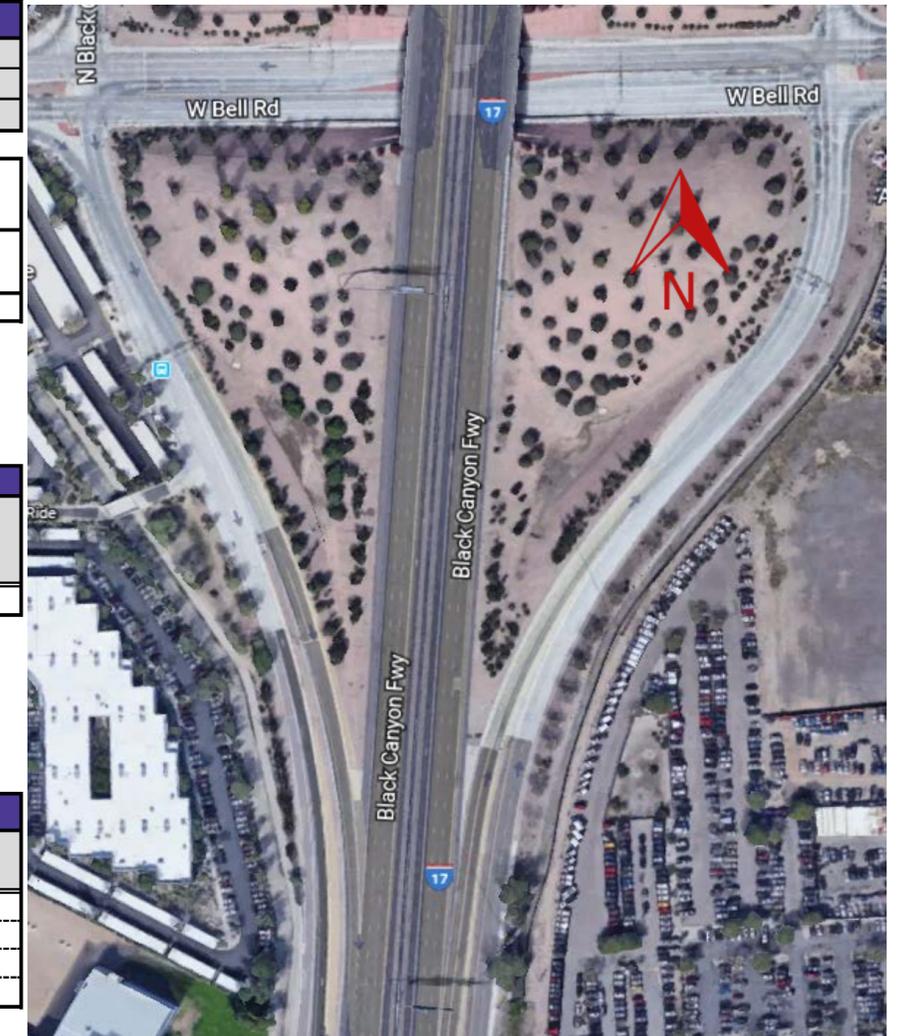
Posted Speed Limit on Frontage Road (mph):	50	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	1030
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	910
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	20	370	390	250	260

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	2
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3	Left	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Bell SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Bell SB	
LINK: <a href="https://earth.google.com/web/@33.64231536,-112.11571178,408.22336962a,203.60454868d,35y,0h,0t,0r">https://earth.google.com/web/@33.64231536,-112.11571178,408.22336962a,203.60454868d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

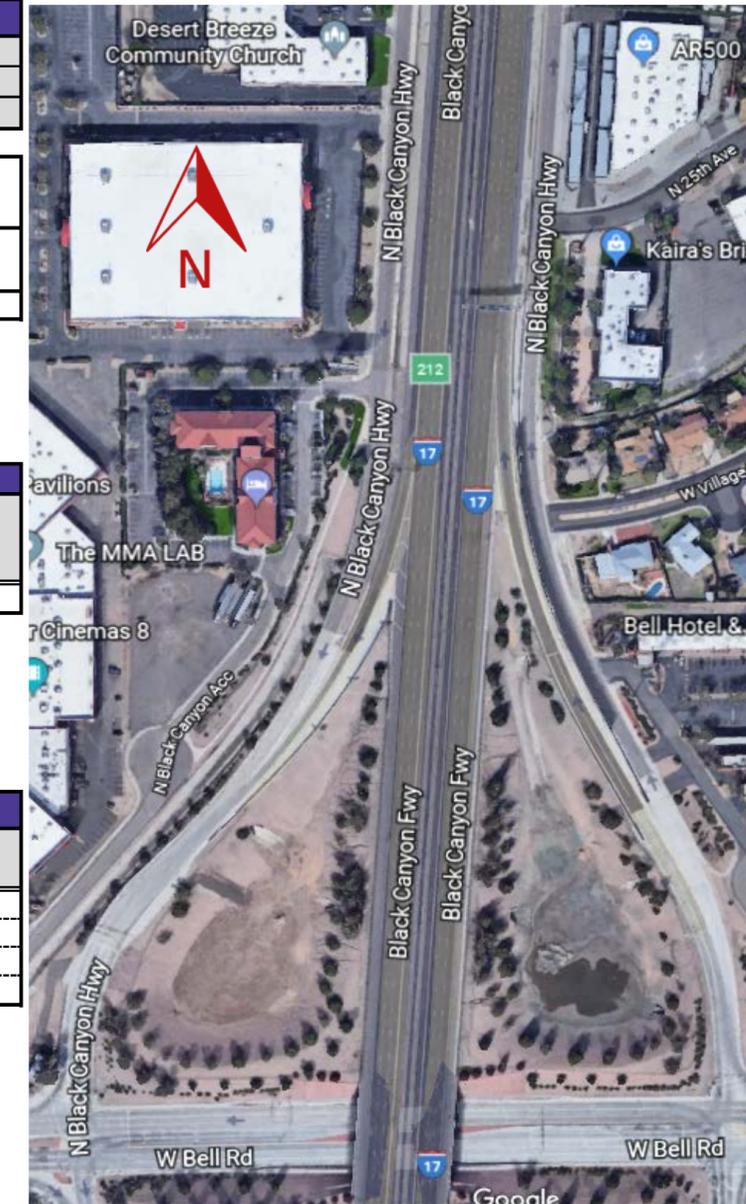
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	-10	300	340	250	260

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3	Left	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Union Hills NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Union Hills NB	
LINK: <a href="https://earth.google.com/web/@33.65316201,-112.11403016,413.59792272a,214.92817345d,35y,0.00000085h,0t,0r">https://earth.google.com/web/@33.65316201,-112.11403016,413.59792272a,214.92817345d,35y,0.00000085h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

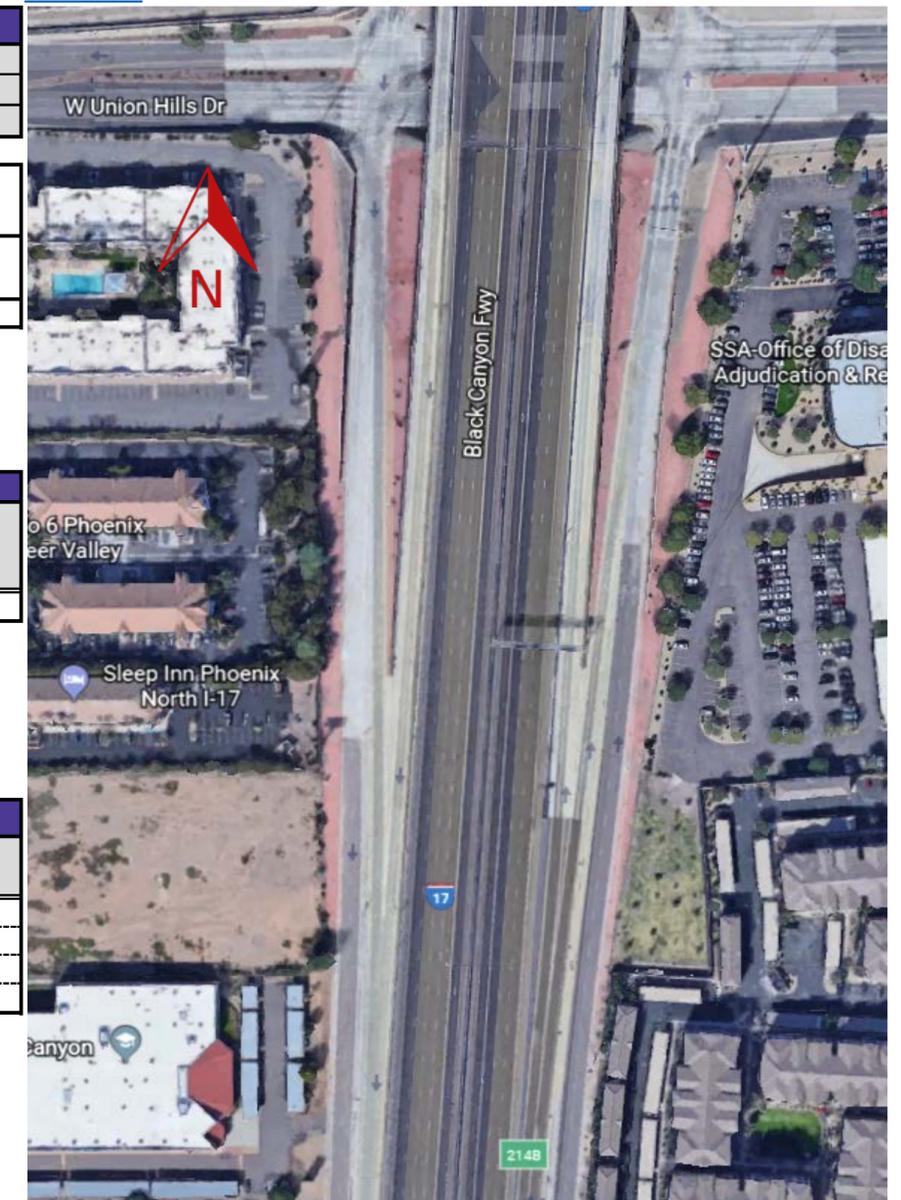
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	W3-2 Blocked
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
470	80	120	350	130	110

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Utopia NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Utopia NB	
LINK: <a href="https://earth.google.com/web/@33.65913516,-112.11334813,414.37845451a,317.44086438d,35y,-0h,0t,0r">https://earth.google.com/web/@33.65913516,-112.11334813,414.37845451a,317.44086438d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

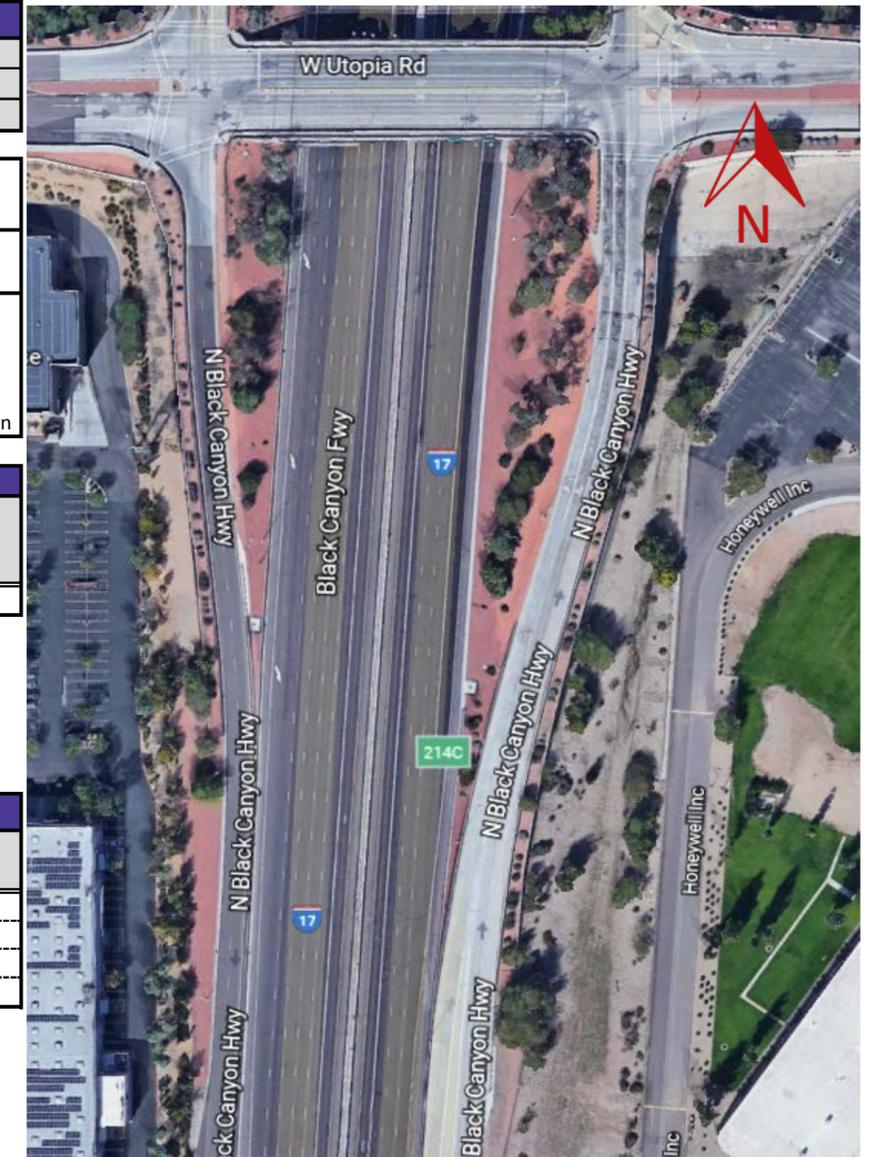
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	R1-2, R1-2rP Blocked by Advertisement Sign
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	40	220	430	340	180

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Deer Valley NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Deer Valley NB	
LINK: <a href="https://earth.google.com/web/@33.68192697,-112.11134024,427.2159695a,232.84649738d,35y,0h,0t,0r">https://earth.google.com/web/@33.68192697,-112.11134024,427.2159695a,232.84649738d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond (partial clover)	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	Horizontal Curve Blocking R1-2, R1-2rP
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	-150	150	230	260	270

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	YES



**Location: I-17 & Deer Valley SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Deer Valley SB	
LINK: <a href="https://earth.google.com/web/@33.68581876,-112.11305918,429.07786047a,208.1907698d,35y,0h,0t,0r">https://earth.google.com/web/@33.68581876,-112.11305918,429.07786047a,208.1907698d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond (partial clover)	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	Horizontal Curve and Wall Block R1-2, R1-2rP
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	40	140	320	270	270

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	YES



**Location: I-17 & Pinnacle Peak NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Pinnacle Peak NB	
LINK: <a href="https://earth.google.com/web/@33.69859819,-112.11336096,428.01022702a,167.4927943d,35y,0.07595487h,0t,0r">https://earth.google.com/web/@33.69859819,-112.11336096,428.01022702a,167.4927943d,35y,0.07595487h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

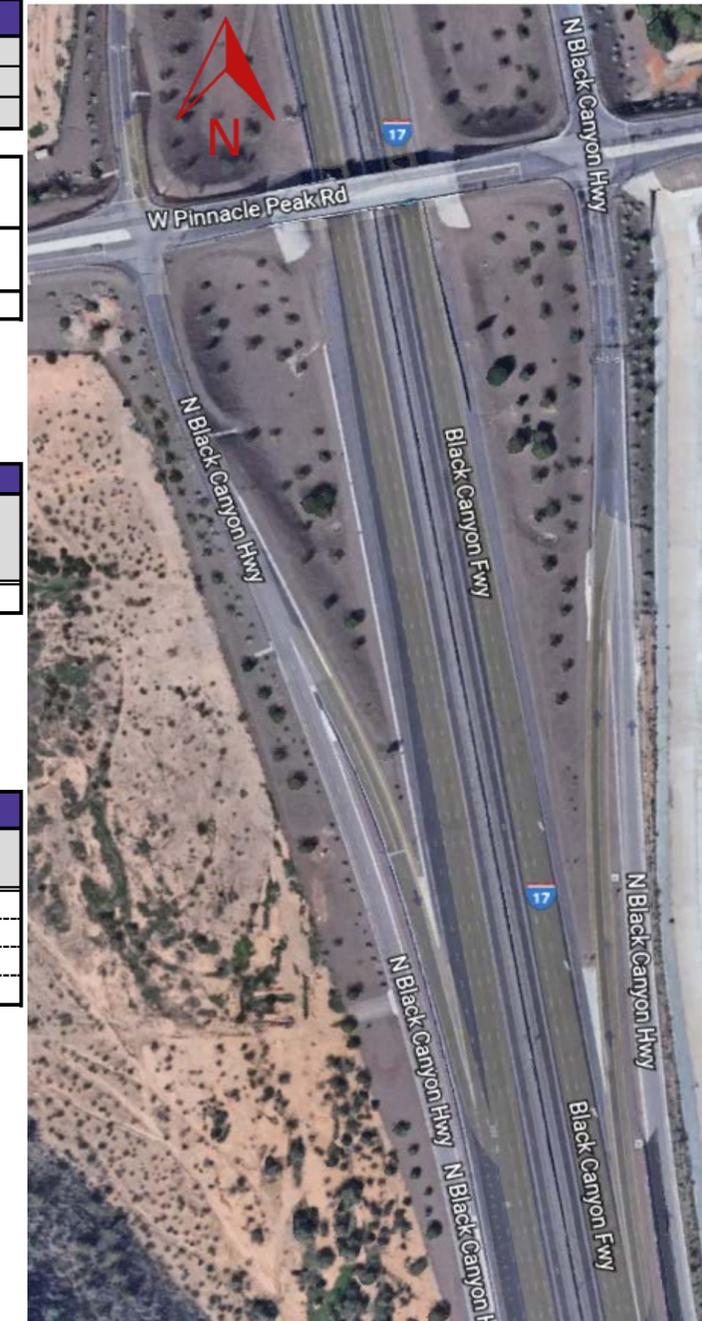
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	0	150	210	250	250

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	YES



**Location: I-17 & Happy Valley NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Happy Valley NB	
LINK: <a href="https://earth.google.com/web/@33.70984334,-112.11607738,437.26086177a,166.38283065d,35y,0h,0t,0r">https://earth.google.com/web/@33.70984334,-112.11607738,437.26086177a,166.38283065d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond w/ Roundabouts	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	W3-2 Blocked
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
210	-320	390	870	130	No Overhead Sign

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	1

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2	Right	None
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Happy Valley SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Happy Valley SB	
LINK: <a href="https://earth.google.com/web/@33.71496353,-112.11887065,441.35206636a,179.18686663d,35y,-0h,0t,0r">https://earth.google.com/web/@33.71496353,-112.11887065,441.35206636a,179.18686663d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond w/ Roundabouts	

Posted Speed Limit on Frontage Road (mph):	35	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	720
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	590
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	Horizontal Curve Blocks R1-2, R1-2rP
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	-330	360	420	250	No Overhead Sign

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	None
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Jomax NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Jomax NB	
LINK: <a href="https://earth.google.com/web/@33.72299099,-112.11868189,445.60581781a,238.34883629d,35y,-0h,0t,0r">https://earth.google.com/web/@33.72299099,-112.11868189,445.60581781a,238.34883629d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp: Downgrade or Upgrade?	Fence Upgrade	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Sidewalk Along Frontage?	NO	Physical Obstruction to Sight Distance?	NO
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
190	100	190	500	360	230

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Jomax SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Jomax SB	
LINK: <a href="https://earth.google.com/web/@33.7289307,-112.12146204,450.12869663a,239.4113438d,35v,0h,0t,0r">https://earth.google.com/web/@33.7289307,-112.12146204,450.12869663a,239.4113438d,35v,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

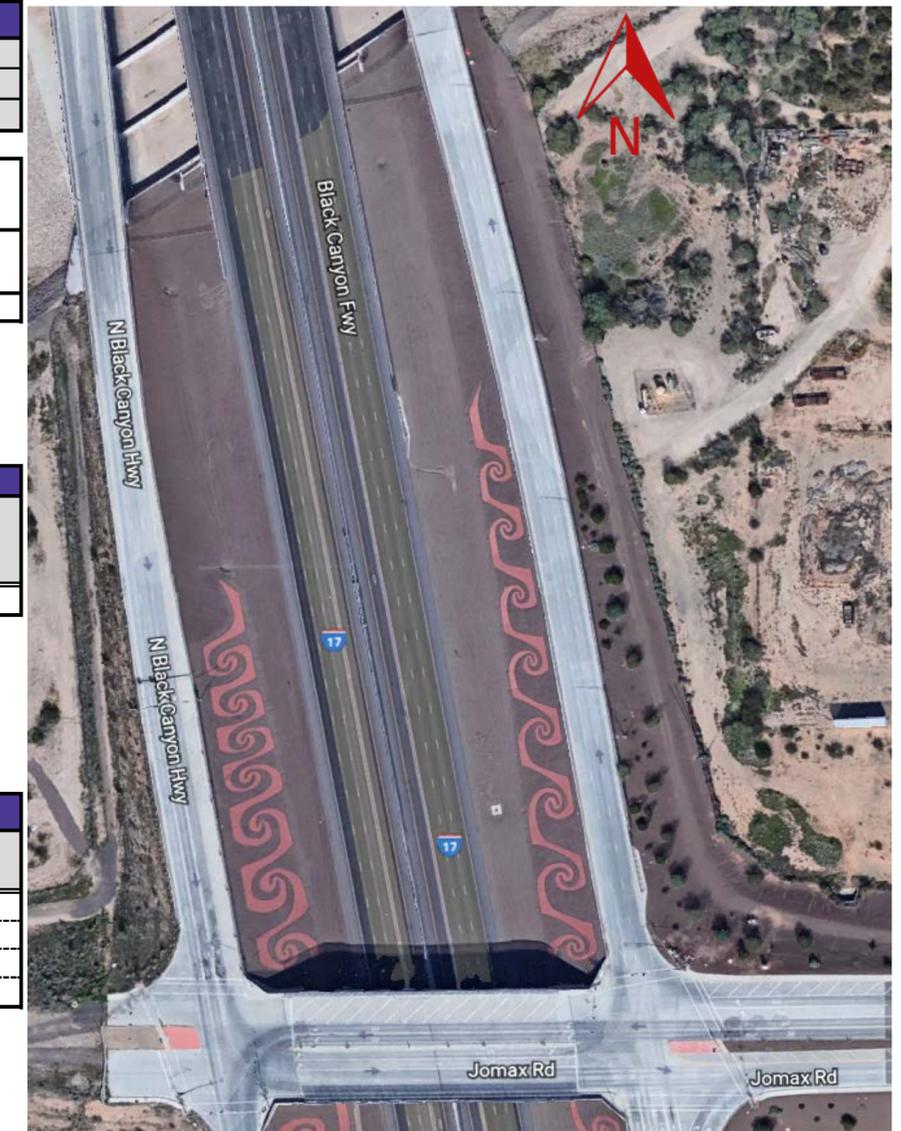
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	90	430	650	310	300

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Dixileta NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Dixileta NB	
LINK: <a href="https://earth.google.com/web/@33.75279436,-112.12465882,469.22238642a,287.22728754d,35y,-0h,0t,0r">https://earth.google.com/web/@33.75279436,-112.12465882,469.22238642a,287.22728754d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Half Diamond	

Posted Speed Limit on Frontage Road (mph):	35	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	720
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	590
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
410	-170	370	360	No Stop Bar	No Stop Bar

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	1

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-1	Left	R1-2, R1-2rP	Right	
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & Adams NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Adams NB	
LINK: <a href="https://earth.google.com/web/@33.44877308,-112.10762278,322.95706971a,74.89985514d,60y,0h,1.45583719t,-0r">https://earth.google.com/web/@33.44877308,-112.10762278,322.95706971a,74.89985514d,60y,0h,1.45583719t,-0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

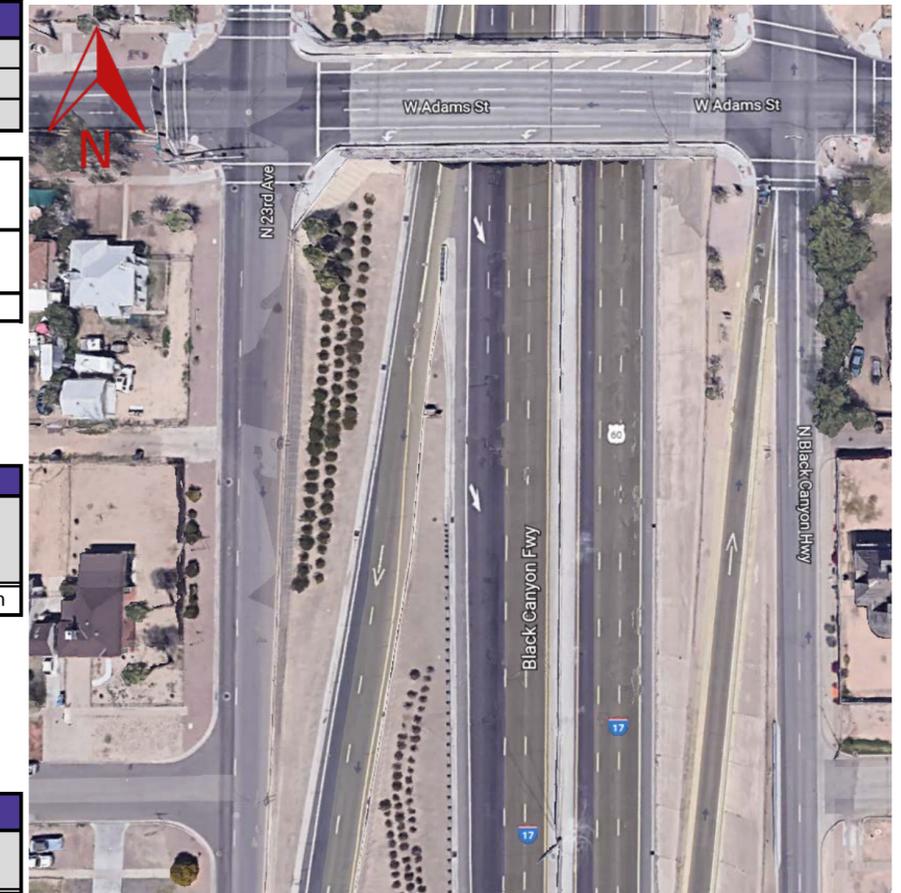
Posted Speed Limit on Frontage Road (mph):	35	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	720
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	590
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	10	80	Striped Gore Continues Until Stop Bar	"	No Overhead Sign

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	None
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Jefferson SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Jefferson SB	
LINK: <a href="https://earth.google.com/web/@33.4475498,-112.10868523,322.08413223a,220.93504234d,35v,-0h,0t,0r">https://earth.google.com/web/@33.4475498,-112.10868523,322.08413223a,220.93504234d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

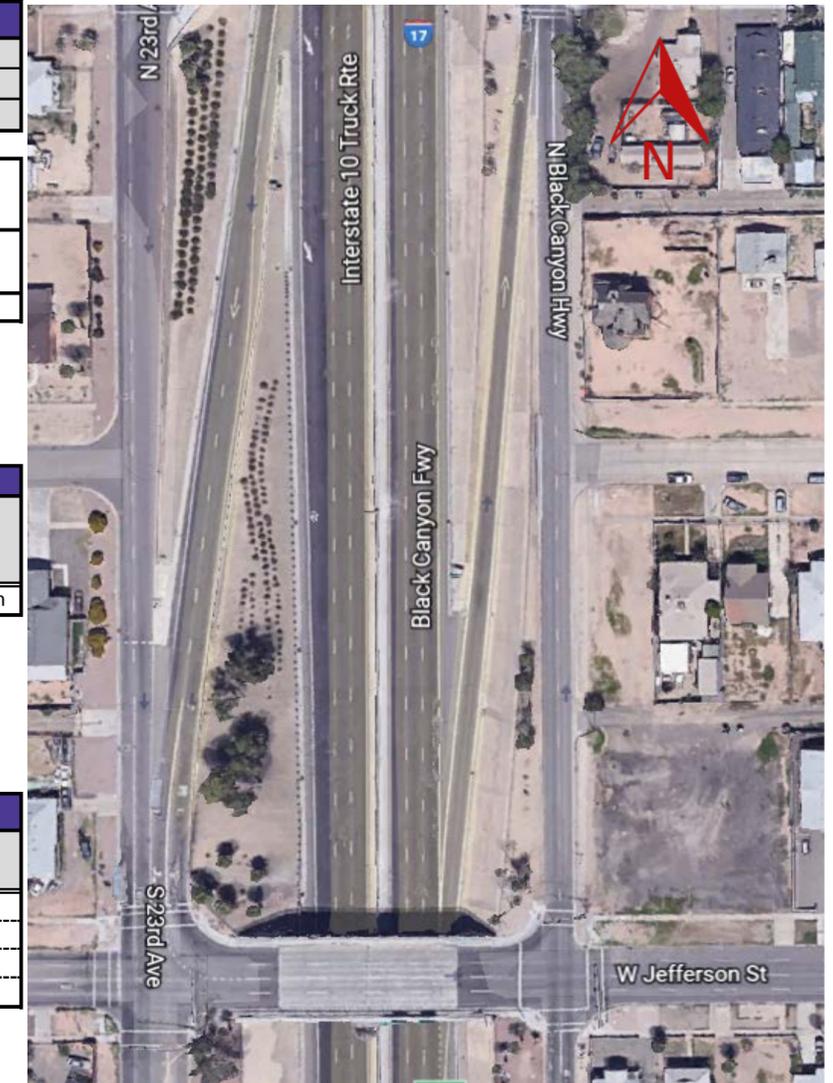
Posted Speed Limit on Frontage Road (mph):	35	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	720
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	590
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
250	30	140	Striping Begins Before Gore Ends	160	No Overhead Sign

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	2
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-1	Right	R1-1	Left	None
		R1-1	Right	
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	YES (very faded in sections)
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Grant SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Grant SB	
LINK: <a href="https://earth.google.com/web/@33.44197033,-112.10873078,321.55919541a,209.31210206d,35y,-0h,0t,0r">https://earth.google.com/web/@33.44197033,-112.10873078,321.55919541a,209.31210206d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
300	80	30	70	180	No Overhead Sign

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Left	R1-2, R1-2rP	Left	None
W3-2	Right	R1-2, R1-2rP	Right	
TOTAL # of Warning Signs: 2		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: I-17 & Grant NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Grant NB	
LINK: <a href="https://earth.google.com/web/@33.44026948,-112.10761033,320.56807881a,149.35767869d,35y,-0h,0t,0r">https://earth.google.com/web/@33.44026948,-112.10761033,320.56807881a,149.35767869d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

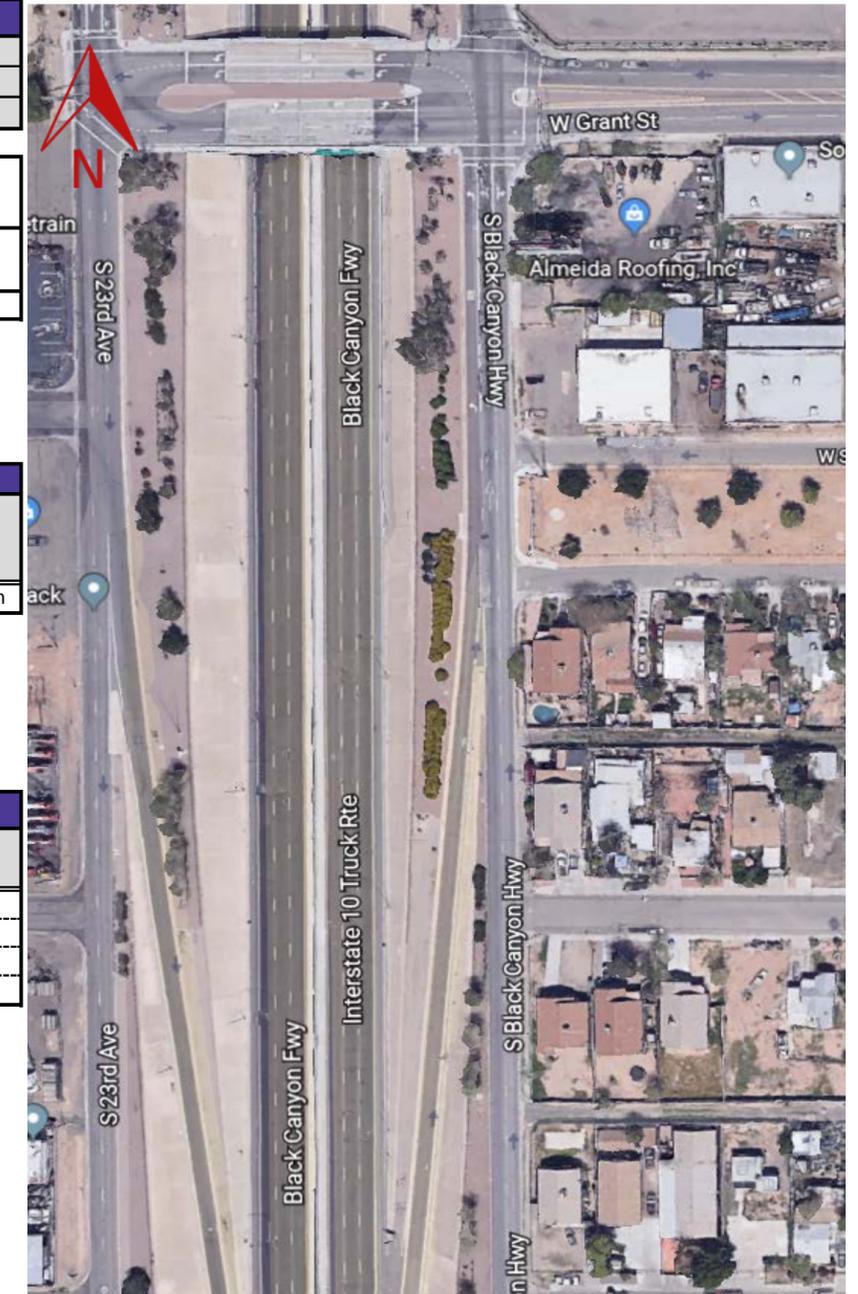
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	90	70	150	200	No Overhead Sign

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	None
		R1-2, R1-2rP	Left	
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & Buckeye NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Buckeye NB	
LINK: <a href="https://earth.google.com/web/@33.43374134,-112.10743293,322.08694279a,155.50619748d,35y,-0h,0t,0r">https://earth.google.com/web/@33.43374134,-112.10743293,322.08694279a,155.50619748d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	Check Horizontal Curve
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	190	160	720	250	150

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		W4-3	Left	Lane Configuration
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



Location: I-17 & Durango SB

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & Durango SB	
LINK: <a href="https://earth.google.com/web/@33.43211444,-112.10838927,318.94151226a,294.56735513d,35y,0.20729713h,0t,0r">https://earth.google.com/web/@33.43211444,-112.10838927,318.94151226a,294.56735513d,35y,0.20729713h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: At I-17 Curve	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
570	-90	90	380	480	No Overhead Sign

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-1	Right	None
W3-1	Right			
W3-1	Left			
<b>TOTAL # of Warning Signs:</b>	3	<b>TOTAL # of Traffic Control Signs:</b>	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	YES
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & 19th WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & 19th WB	
LINK: <a href="https://earth.google.com/web/@33.42936321,-112.0981797,319.93951847a,214.83991315d,35v,-0h,0t,0r">https://earth.google.com/web/@33.42936321,-112.0981797,319.93951847a,214.83991315d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

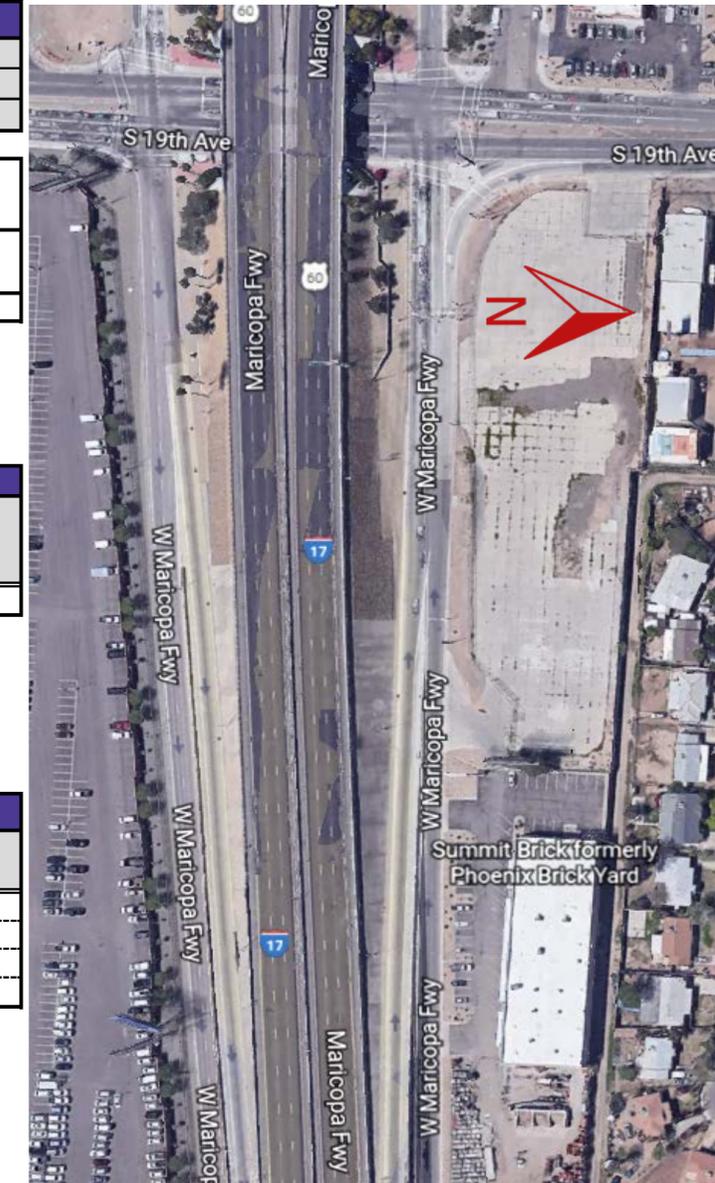
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
260	-60	130	250	150	150

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-1	Right	R1-1	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	YES
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-17 & 7th Ave EB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & 7th Ave EB	
LINK: <a href="https://earth.google.com/web/@33.42899463,-112.08368364,322.55895237a,178.67675085d,35y,-0h,0t,0r">https://earth.google.com/web/@33.42899463,-112.08368364,322.55895237a,178.67675085d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

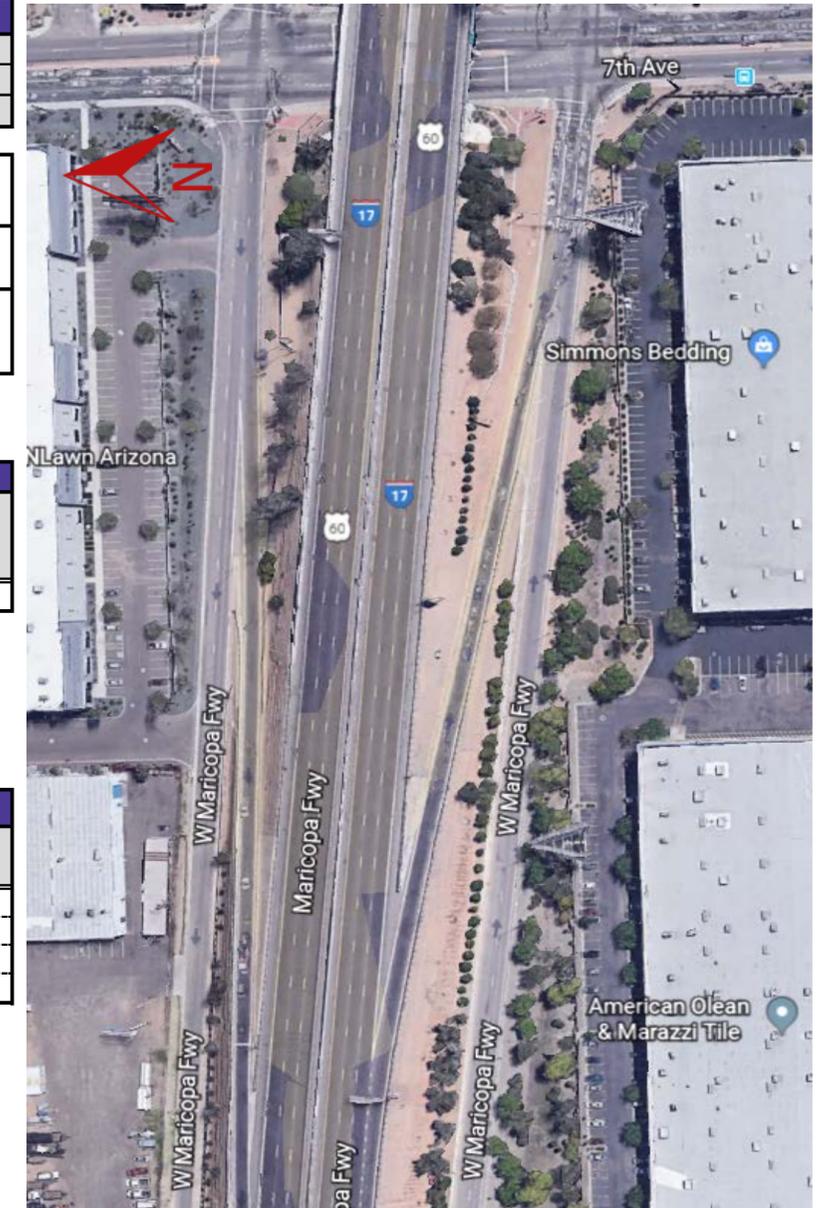
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	W3-1 Blocked by Pole, R1-1 Blocked by Pole
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
270	0	80	20	110	110

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-1	Right	R1-1	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	YES
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & 7th Ave WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & 7th Ave WB	
LINK: <a href="https://earth.google.com/web/@33.42963058,-112.08126495,323.79523801a,180.11912762d,35y,357.69621997h,0t,0r">https://earth.google.com/web/@33.42963058,-112.08126495,323.79523801a,180.11912762d,35y,357.69621997h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

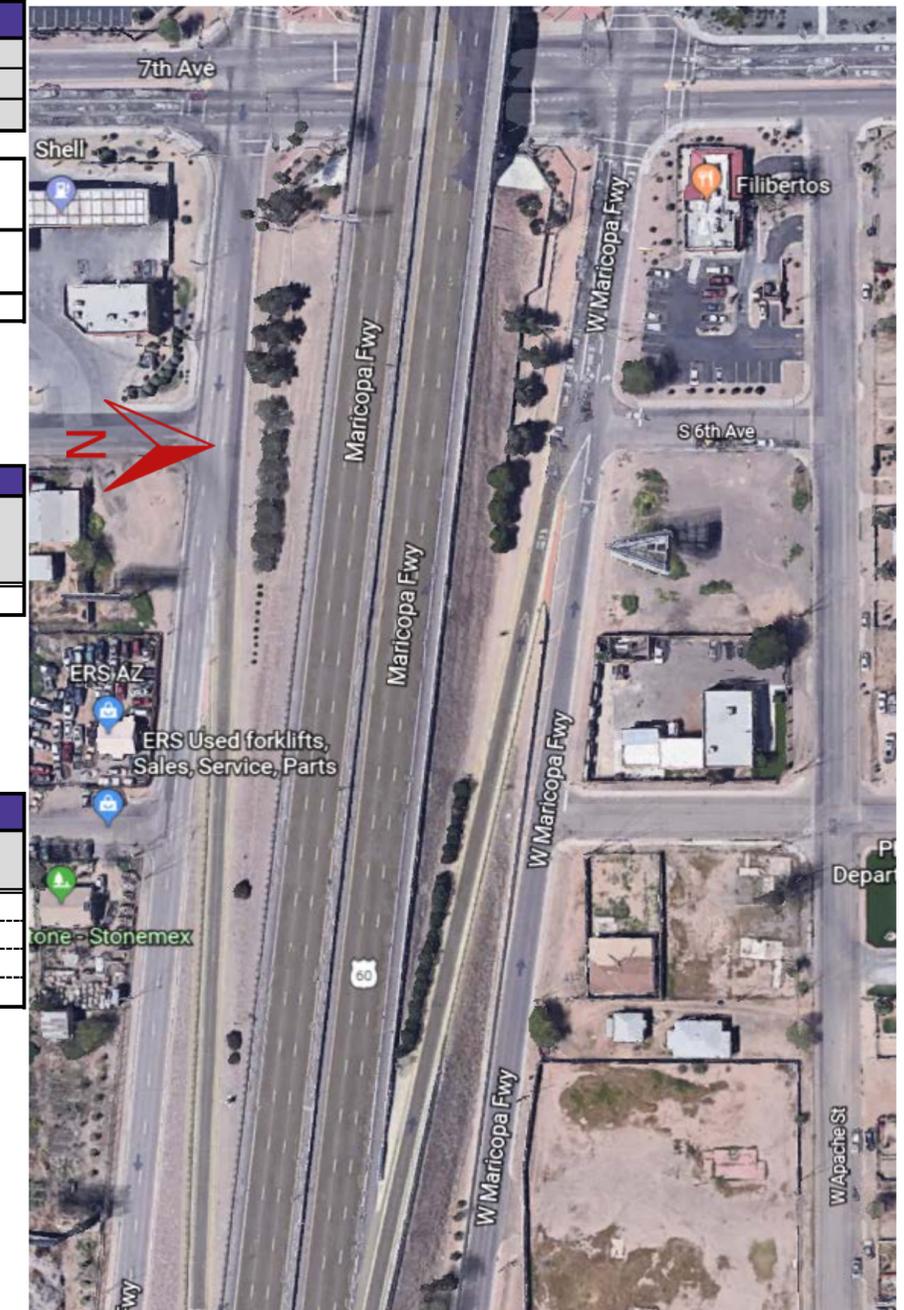
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
500	0	50	50	180	140

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-1	Right	R1-1	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	YES
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & 7th St EB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & 7th St EB	
LINK: <a href="https://earth.google.com/web/@33.42832922,-112.06641725,326.96798156a,223.00069953d,35y,0h,0t,0r">https://earth.google.com/web/@33.42832922,-112.06641725,326.96798156a,223.00069953d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

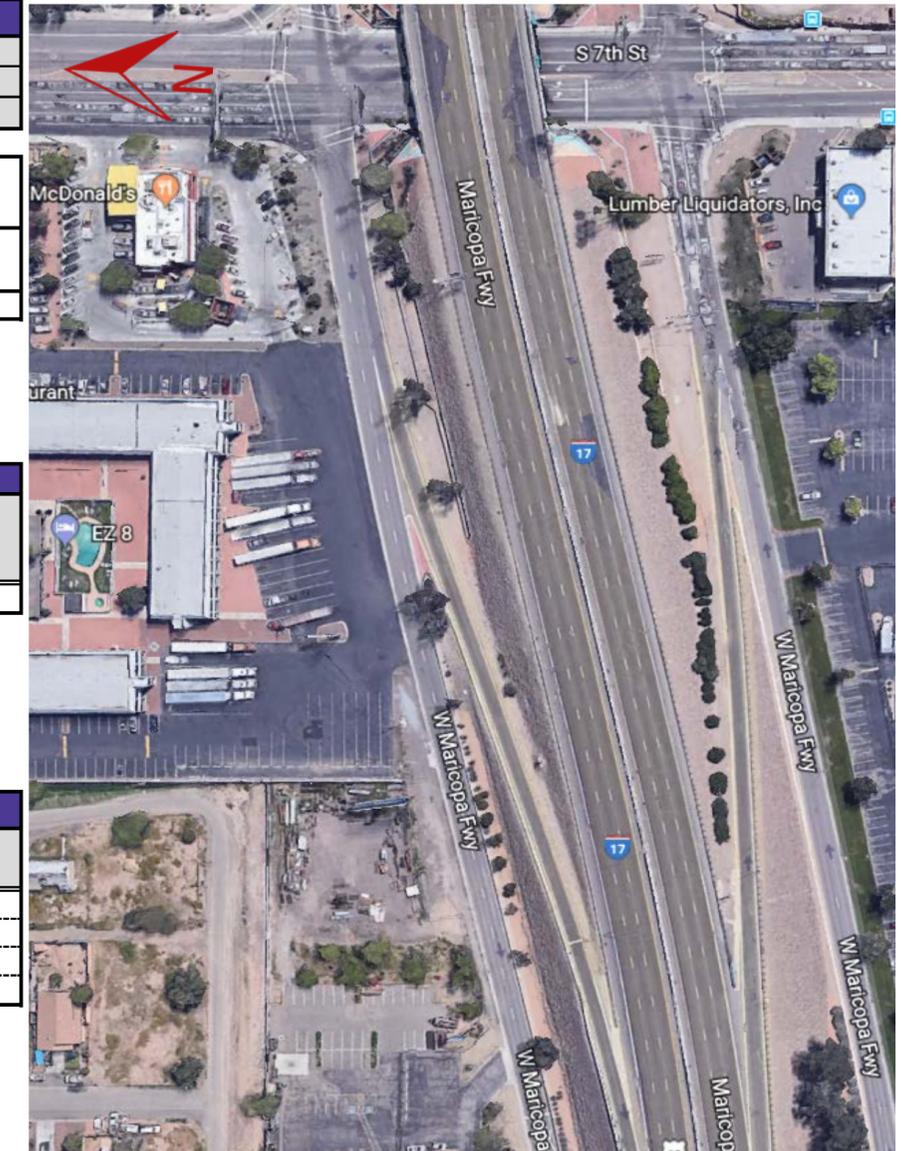
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
310	0	70	100	110	180

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-1	Right	R1-1	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	YES
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & 7th St WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & 7th St WB	
LINK: <a href="https://earth.google.com/web/@33.42941513,-112.06362421,327.50411811a,190.04522427d,35y,0h,0t,0r">https://earth.google.com/web/@33.42941513,-112.06362421,327.50411811a,190.04522427d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
400	0	130	100	210	270

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-1	Right	R1-1	Right	Lane Configuration
TOTAL # of Warning Signs:		TOTAL # of Traffic Control Signs:		1

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	YES
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: I-17 & 16th EB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-17 & 16th EB	
LINK: <a href="https://earth.google.com/web/@33.4269921,-112.04933595,329.30476261a,202.42383541d,35v,-0h,0t,0r">https://earth.google.com/web/@33.4269921,-112.04933595,329.30476261a,202.42383541d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Half Diamond	

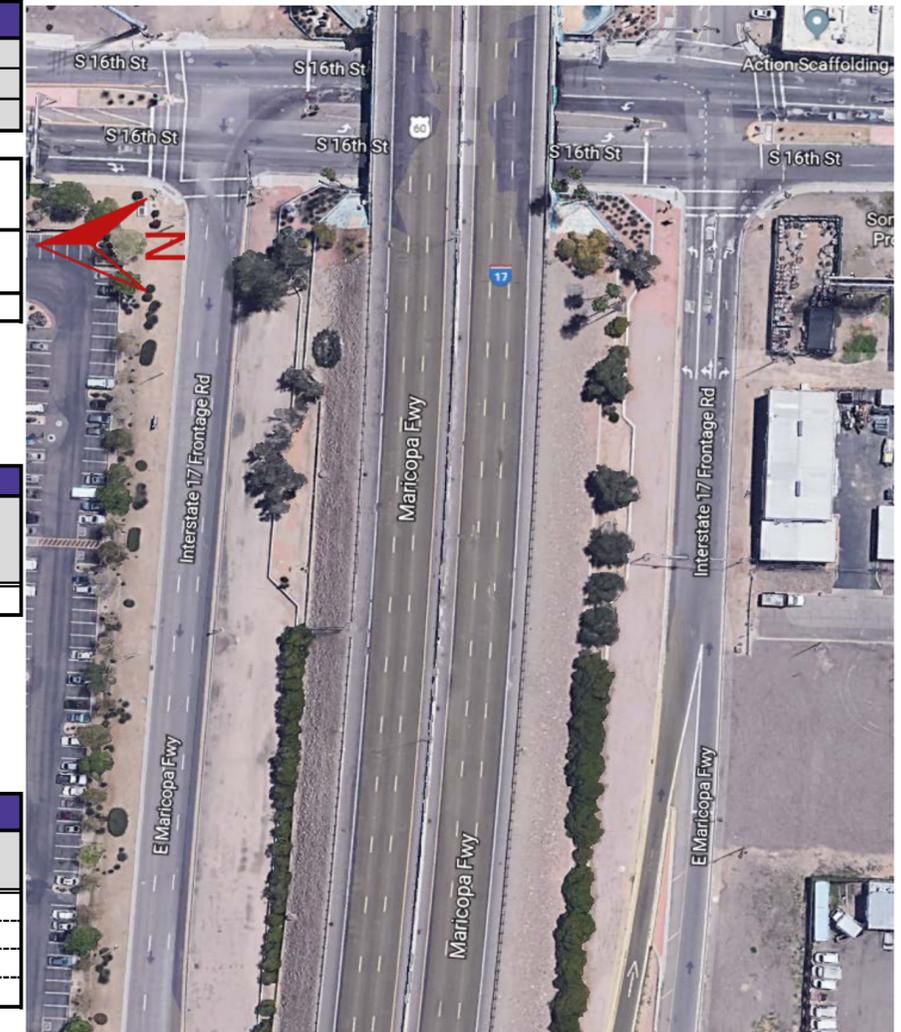
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
450	0	110	180	110	240

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-1	Left	R1-1	Right	Lane Configuration
W3-1	Right			
TOTAL # of Warning Signs:	2	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	YES
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



# **INTERSTATE 10**

**Location: I-10 & Jefferson NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-10 & Jefferson NB	
LINK: <a href="https://earth.google.com/web/@33.44621232,-112.03632513,333.41320844a,231.86464792d,35y,359.72339669h,0t,0r">https://earth.google.com/web/@33.44621232,-112.03632513,333.41320844a,231.86464792d,35y,359.72339669h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
500	-110	170	80	210	210

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	3
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-1	Left	R1-1	Right	Lane Configuration
W3-1	Right			
TOTAL # of Warning Signs:	2	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	YES
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-10 & 99th EB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-10 & 99th EB	
LINK: <a href="https://earth.google.com/web/@33.46081583,-112.28524526,309.05122723a,313.11951687d,35y,-0h,0t,0r">https://earth.google.com/web/@33.46081583,-112.28524526,309.05122723a,313.11951687d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond at Loop 101 Interchange	

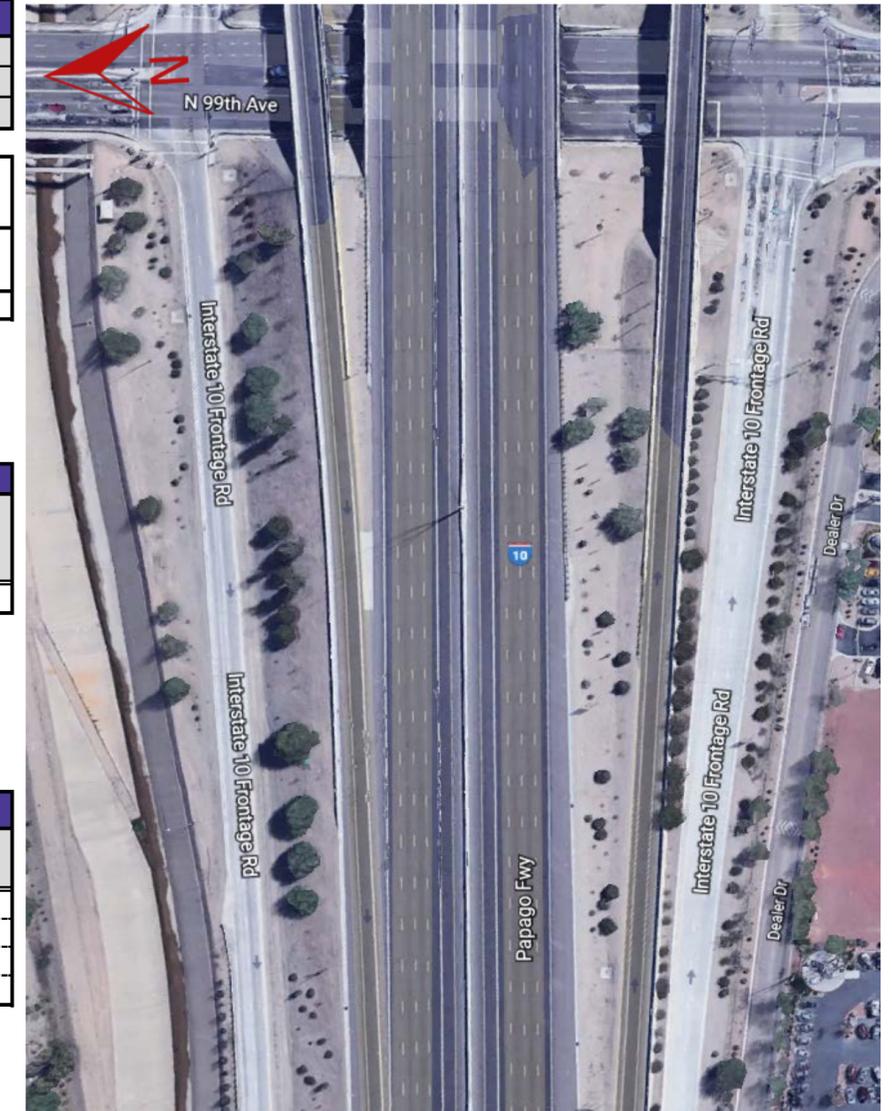
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	None
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	50	340	3,230	190	190

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2	Left	Lane Configuration
		R1-2	Right	
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	2	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: I-10 & 99th WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: I-10 & 99th WB	
LINK: <a href="https://earth.google.com/web/@33.46209793,-112.26863287,311.25531078a,544.48376042d,35y,0h,0t,0r">https://earth.google.com/web/@33.46209793,-112.26863287,311.25531078a,544.48376042d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond at Loop 101 Interchange	

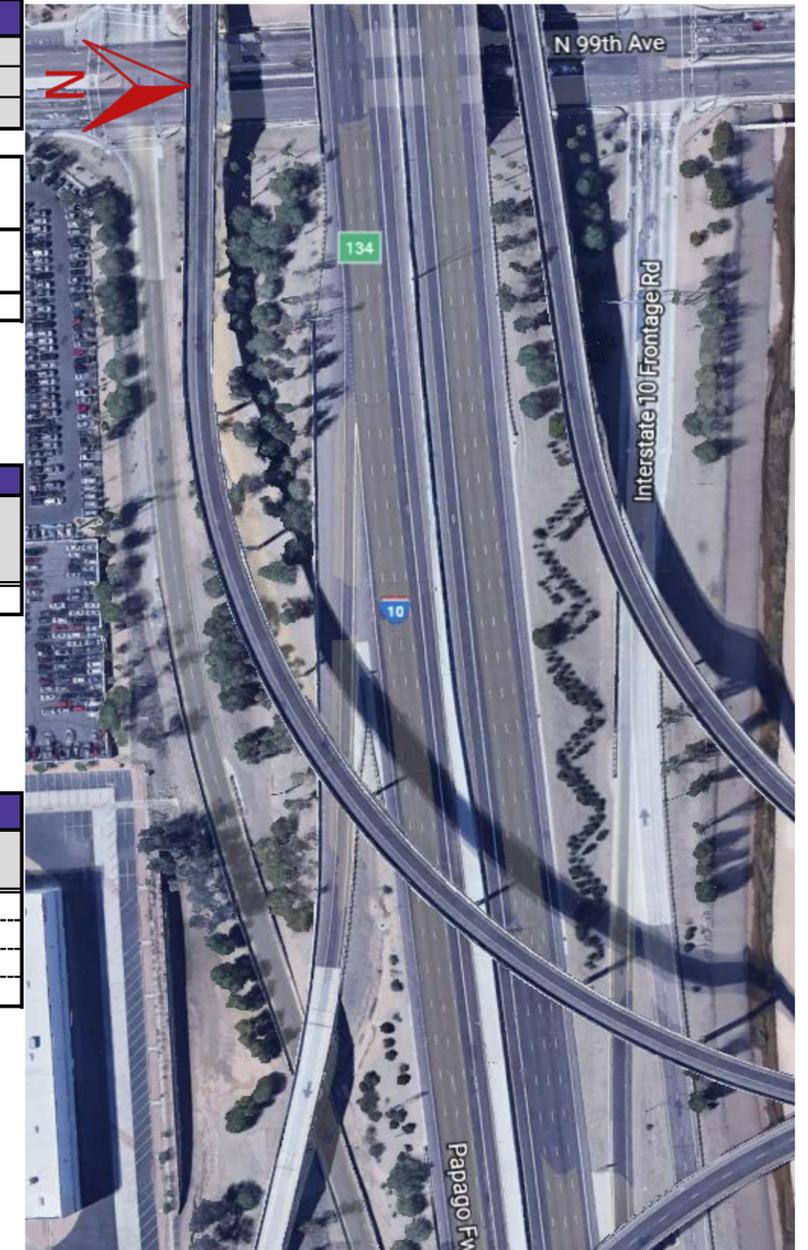
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Regulatory Signs	No Regulatory Signs	390	160	370	200

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left			Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 0		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



# **STATE ROUTE 101**

**Location: 101 & 78th WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 78th WB	
LINK: <a href="https://earth.google.com/web/@33.6669021,-112.22579286,377.83516949a,458.65706363d,35y,0h,0t,0r">https://earth.google.com/web/@33.6669021,-112.22579286,377.83516949a,458.65706363d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Not at Interchange	

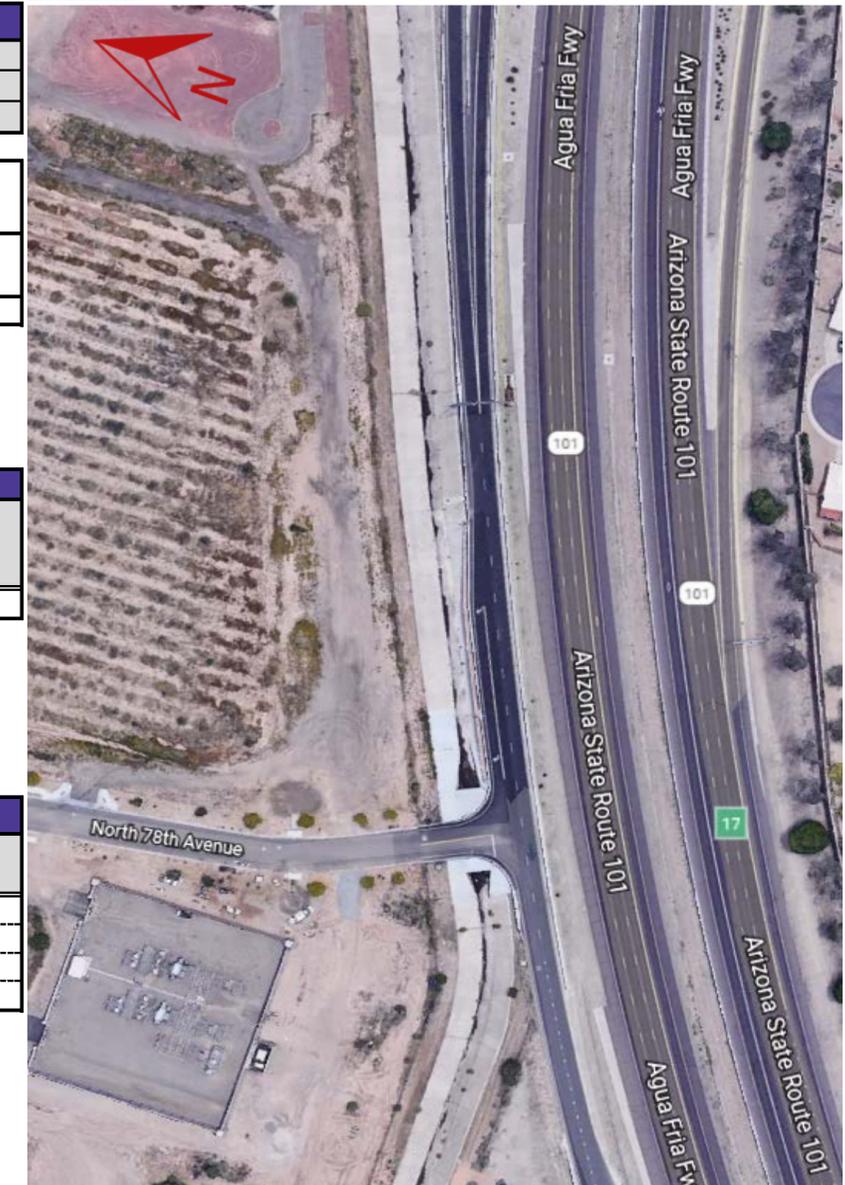
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Neither	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Regulatory Sign	No Regulatory Sign	330	No Solid White Striping	No Stop Bar	No Stop Bar

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left			Guide
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 0		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & 75th WB**

[Back to Index](#)

**EXISTING INVENTORY**

<b>LOCATION: 101 &amp; 75th WB</b>	
<b>LINK: <a href="https://earth.google.com/web/@33.66833079,-112.21820692,380.49733551a,236.14068322d,35y,0h,0t,0r">https://earth.google.com/web/@33.66833079,-112.21820692,380.49733551a,236.14068322d,35y,0h,0t,0r</a></b>	
<b>ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond</b>	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

**DISTANCES (NEAREST 10 FEET)**

Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	0	160	300	210	210

**Lanes**

Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

**Advance Warning Signs**

Sign Code	Side of Road
<b>TOTAL # of Warning Signs:</b>	0

**Traffic Control Signs**

Sign Code	Side of Road
R1-2, R1-2rP	Left
R1-2, R1-2rP	Right
<b>TOTAL # of Traffic Control Signs:</b>	2

**Overhead Signs**

Description (Guide, Lane Configuration)
Lane Configuration

**Pavement Markings at Frontage/Ramp**

Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & 67th EB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 67th EB	
LINK: <a href="https://earth.google.com/web/@33.66768666,-112.20520831,375.84615056a,481.53585738d,35y,-0h,0t,0r">https://earth.google.com/web/@33.66768666,-112.20520831,375.84615056a,481.53585738d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	On Physical Gore	280	150	270	260

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Left	Lane Configuration
		R1-2, R1-2rP	Right	
TOTAL # of Warning Signs:		TOTAL # of Traffic Control Signs:		2

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & 67th WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 67th WB	
LINK: <a href="https://earth.google.com/web/@33.66862465,-112.20069175,381.33401735a,302.26746354d,35y,-0h,0t,0r">https://earth.google.com/web/@33.66862465,-112.20069175,381.33401735a,302.26746354d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
460	10	240	240	250	250

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2, R1-2rP	Left	Lane Configuration
W3-2	Left	R1-2, R1-2rP	Right	
TOTAL # of Warning Signs: 2		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & 59th EB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 59th EB	
LINK: <a href="https://earth.google.com/web/@33.66784449,-112.18975353,383.91723911a,442.21538455d,35y,-0h,0t,0r">https://earth.google.com/web/@33.66784449,-112.18975353,383.91723911a,442.21538455d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
280	On Gore	340	180	260	270

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2, R1-2rP	Left	Lane Configuration
W3-2	Left	R1-2, R1-2rP	Right	
TOTAL # of Warning Signs: 2		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & 59th WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 59th WB	
LINK: <a href="https://earth.google.com/web/@33.66871435,-112.18469467,387.1524154a,235.52867871d,35y,0h,0t,0r">https://earth.google.com/web/@33.66871435,-112.18469467,387.1524154a,235.52867871d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

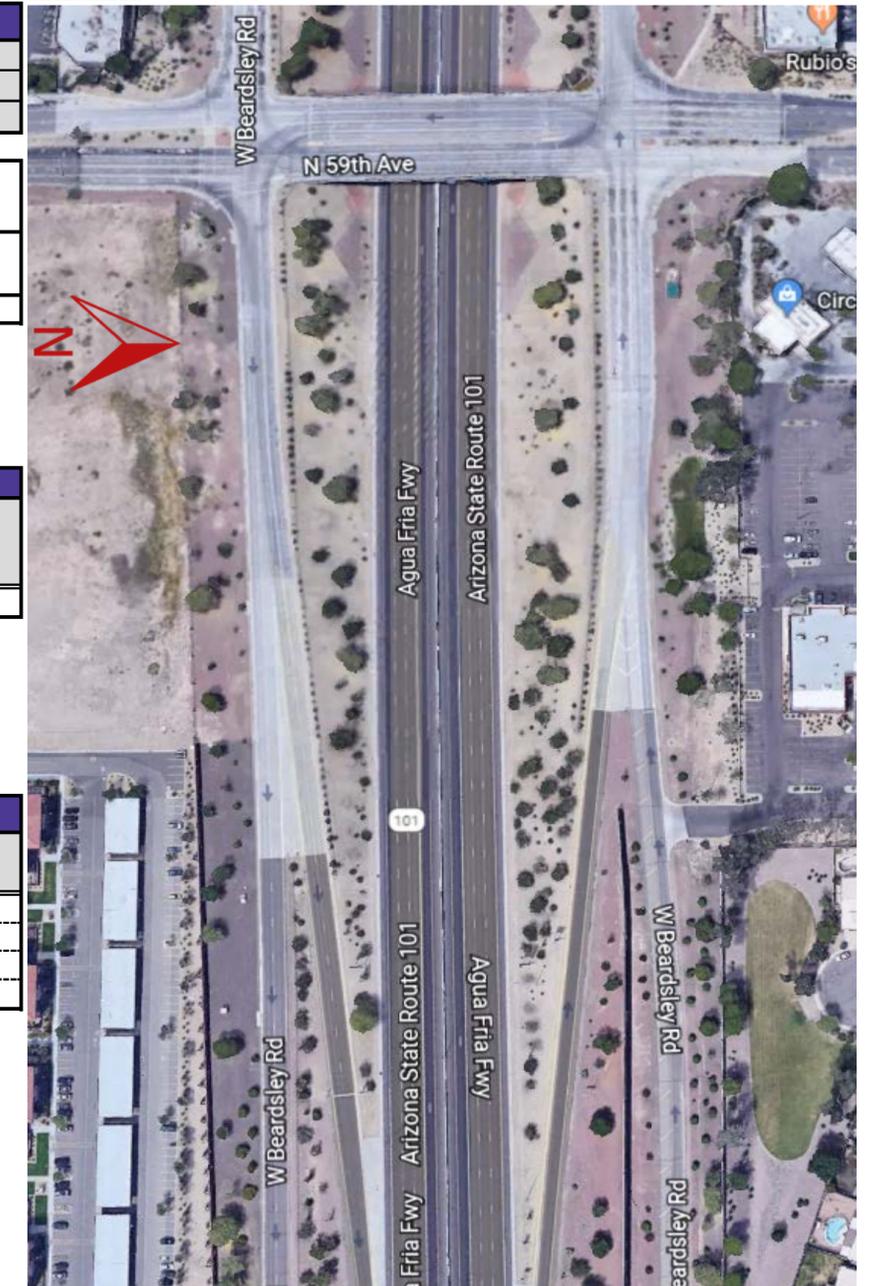
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
710	-110	300	190	250	250

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2, R1-2rP	Left	Lane Configuration
W3-2	Left	R1-2, R1-2rP	Right	
TOTAL # of Warning Signs: 2		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	YES



**Location: 101 & 51st EB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 51st EB	
LINK: <a href="https://earth.google.com/web/@33.66813942,-112.17193417,398.65101542a,266.1080676d,35v,-0h,0t,0r">https://earth.google.com/web/@33.66813942,-112.17193417,398.65101542a,266.1080676d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	30	380	330	190	190

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Left	Lane Configuration
		R1-2, R1-2rP	Right	
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & 51st WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 51st WB	
LINK: <a href="https://earth.google.com/web/@33.6693556,-112.16710211,396.07837101a,346.32798721d,35v,-0h,0t,0r">https://earth.google.com/web/@33.6693556,-112.16710211,396.07837101a,346.32798721d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	-10	450	460	200	200

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Left	Lane Configuration
		R1-2, R1-2rP	Right	
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	YES (faded)



**Location: 101 & 35th EB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 35th EB	
LINK: <a href="https://earth.google.com/web/@33.66928824,-112.13749853,412.25088867a,460.04665342d,35y,-0h,0t,0r">https://earth.google.com/web/@33.66928824,-112.13749853,412.25088867a,460.04665342d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	R1-2, R1-2rP on Right Blocked by Bushes
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	-10	300	330	160	160

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Left	
		R1-2, R1-2rP	Right	
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & 27th EB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 27th EB	
LINK: <a href="https://earth.google.com/web/@33.66788984,-112.11949337,418.6421404a,136.68257969d,35y,0h,0t,0r">https://earth.google.com/web/@33.66788984,-112.11949337,418.6421404a,136.68257969d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond at I-17 Interchange	

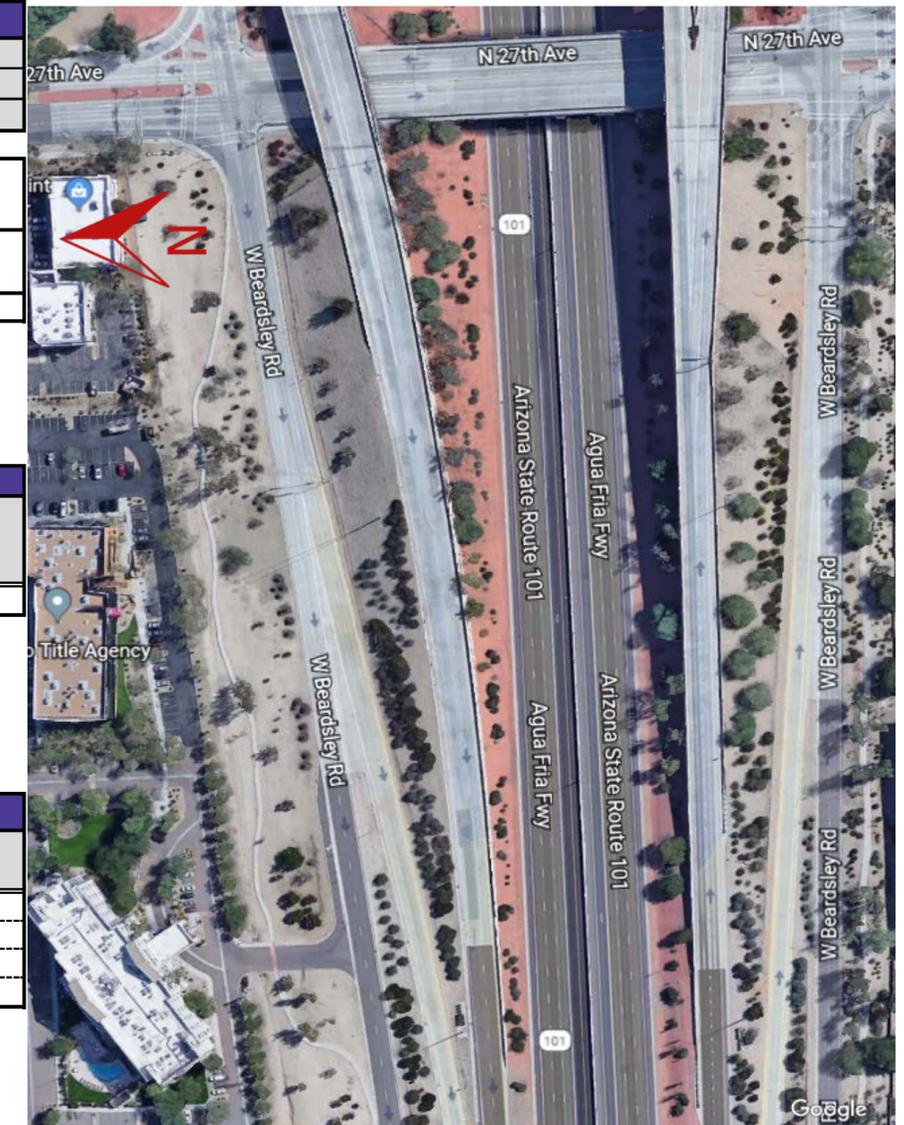
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
200	110	250	330	120	130

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2, R1-2rP	Right	Lane Configuration
W3-2	Left	R1-2, R1-2rP	Left	
TOTAL # of Warning Signs: 2		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & 27th WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 27th WB	
LINK: <a href="https://earth.google.com/web/@33.66974827,-112.11184045,417.44245533a,309.27372734d,35y,0h,0t,0r">https://earth.google.com/web/@33.66974827,-112.11184045,417.44245533a,309.27372734d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond at I-17 Interchange	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	200	190	1,240	120	110

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2	Right	Lane Configuration
		R1-2	Left	
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	YES



**Location: 101 & 19th WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 19th WB	
LINK: <a href="https://earth.google.com/web/@33.67008634,-112.09758361,429.72573484a,147.73487589d,35y,-0h,0t,0r">https://earth.google.com/web/@33.67008634,-112.09758361,429.72573484a,147.73487589d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	Left R1-2, R1-2rP Blocked by Tree
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	0	130	350	160	150

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
		R1-2, R1-2rP	Left	
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	YES



**Location: 101 & 7th Ave EB**

[Back to Index](#)

**EXISTING INVENTORY**

LOCATION: 101 & 7th Ave EB	
LINK: <a href="https://earth.google.com/web/@33.66836879,-112.08516346,433.25717018a,264.2553662d,35v,-0h,0t,0r">https://earth.google.com/web/@33.66836879,-112.08516346,433.25717018a,264.2553662d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	R1-2, R1-2rP on Right Blocked by Tree
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

**DISTANCES (NEAREST 10 FEET)**

Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	270	220	300	240	240

**Lanes**

Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

**Advance Warning Signs**

Sign Code	Side of Road
TOTAL # of Warning Signs:	0

**Traffic Control Signs**

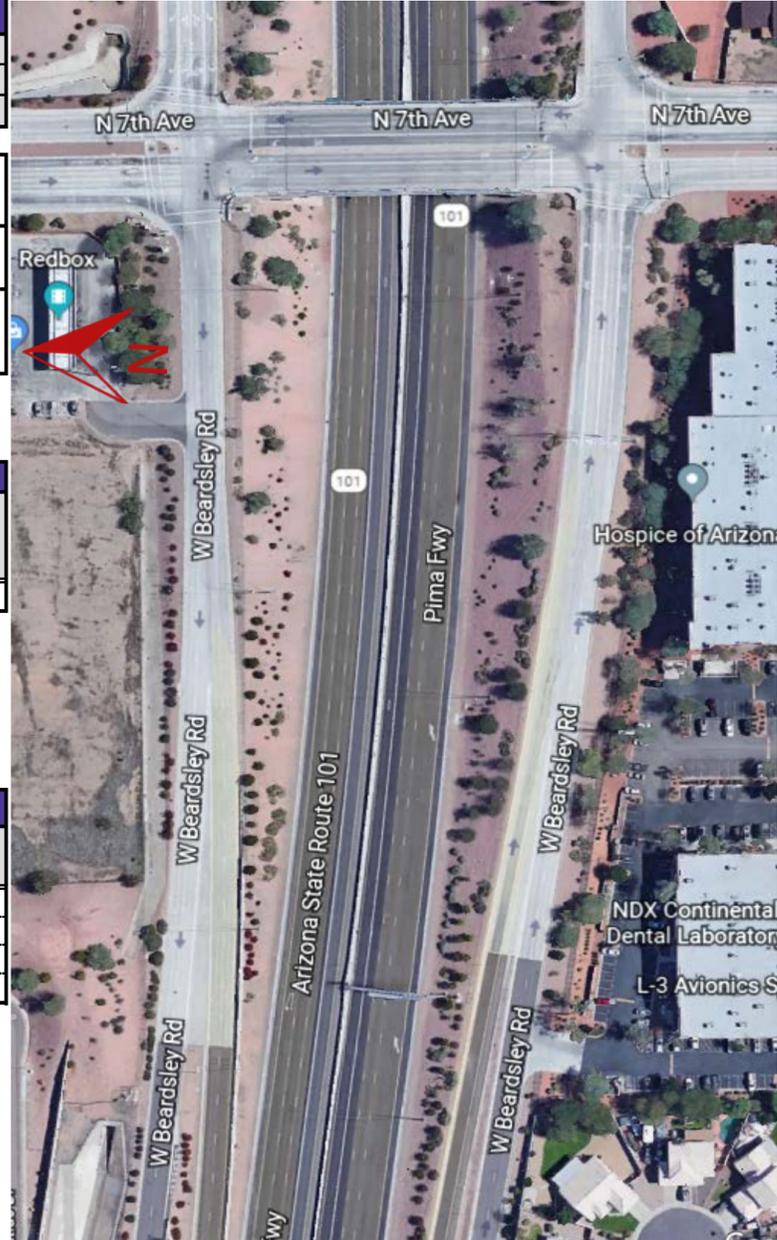
Sign Code	Side of Road
R1-2, R1-2rP	Right
R1-2, R1-2rP	Left
TOTAL # of Traffic Control Signs:	2

**Overhead Signs**

Description (Guide, Lane Configuration)
Lane Configuration

**Pavement Markings at Frontage/Ramp**

Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & 7th Ave WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 7th Ave WB	
LINK: <a href="https://earth.google.com/web/@33.66922601,-112.0801733,434.73502537a,284.33027304d,35v,-0h,0t,0r">https://earth.google.com/web/@33.66922601,-112.0801733,434.73502537a,284.33027304d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	70	350	380	240	250

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
		R1-2, R1-2rP	Left	
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	2	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & 7th St EB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 7th St EB	
LINK: <a href="https://earth.google.com/web/@33.66851464,-112.06804997,438.4300194a,194.78044258d,35v,-0h,0t,0r">https://earth.google.com/web/@33.66851464,-112.06804997,438.4300194a,194.78044258d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	R1-2, R1-2rP on Right Blocked by Tree
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	60	290	380	180	180

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
		R1-2, R1-2rP	Left	
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & 7th St WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & 7th St WB	
LINK: <a href="https://earth.google.com/web/@33.66933918,-112.06243195,440.36679235a,244.01935186d,35y,0h,0t,0r">https://earth.google.com/web/@33.66933918,-112.06243195,440.36679235a,244.01935186d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

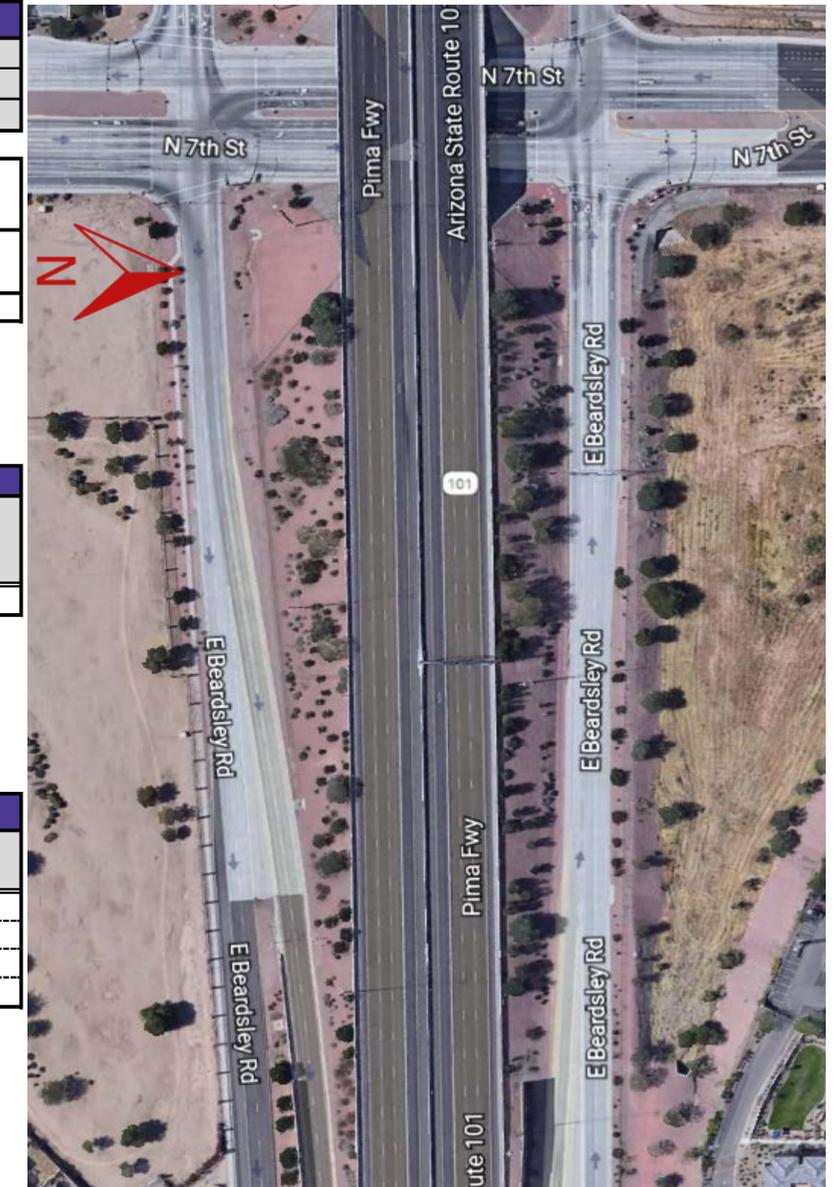
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	70	300	470	290	290

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & Cave Creek EB**

[Back to Index](#)

**EXISTING INVENTORY**

<b>LOCATION: 101 &amp; Cave Creek EB</b>	
<b>LINK:</b> <a href="https://earth.google.com/web/@33.67051742,-112.03618852,468.92542032a,245.43014916d,35y,0h,0t,0r">https://earth.google.com/web/@33.67051742,-112.03618852,468.92542032a,245.43014916d,35y,0h,0t,0r</a>	
<b>ARTERIAL/FREEWAY INTERCHANGE TYPE:</b> SPU	

<b>Posted Speed Limit on Frontage Road (mph):</b>	45	<b>AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :</b>	930
<b>Divider Between Frontage Road and Exit Ramp:</b>	Fence	<b>AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):</b>	800
<b>Downgrade or Upgrade?</b>	Downgrade	<b>Physical Obstruction to Sight Distance?</b>	NO
<b>Sidewalk Along Frontage?</b>	NO		
<b>Bicycle Lane Along Frontage?</b>	NO		
<b>Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?</b>	NO		

**DISTANCES (NEAREST 10 FEET)**

Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	R1-2 on Physical Gore	140	290	510	270

**Lanes**

<b>Number of Lanes on Frontage Road Approach:</b>	2
<b>Number of Lanes on Ramp at Merge:</b>	1
<b>Number of Lanes on Frontage Road Departure:</b>	3

**Advance Warning Signs**

Sign Code	Side of Road
<b>TOTAL # of Warning Signs:</b>	0

**Traffic Control Signs**

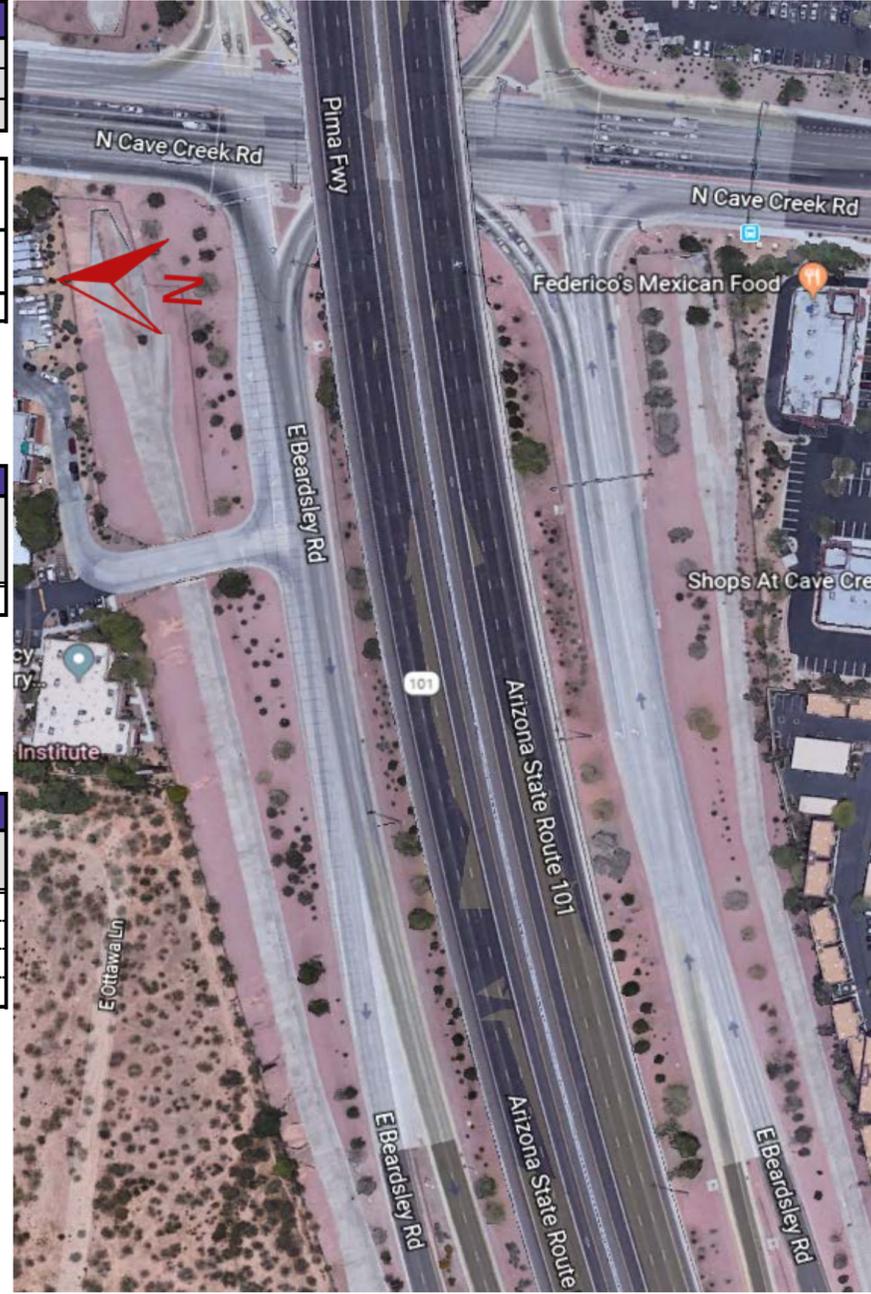
Sign Code	Side of Road
R1-2, R1-2rP	Right
R1-2, R1-2rP	Left
<b>TOTAL # of Traffic Control Signs:</b>	2

**Overhead Signs**

Description (Guide, Lane Configuration)
Lane Configuration

**Pavement Markings at Frontage/Ramp**

<b>Stop Bar for Frontage:</b>	NO
<b>Yield Ahead:</b>	NO
<b>Stop Ahead:</b>	NO
<b>Wrong-way Arrows with RPMs (M-12):</b>	NO
<b>Yield Lines:</b>	NO



**Location: 101 & Scottsdale WB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Scottsdale WB	
LINK: <a href="https://earth.google.com/web/@33.65814749,-111.92266124,491.18468938a,169.37940453d,35y,0h,0t,0r">https://earth.google.com/web/@33.65814749,-111.92266124,491.18468938a,169.37940453d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	YES		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	-220	270	350	310	300

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & Pima NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Pima NB	
LINK: <a href="https://earth.google.com/web/@33.64496247,-111.89111709,484.20459867a,276.64031642d,35y,-0h,0t,0r">https://earth.google.com/web/@33.64496247,-111.89111709,484.20459867a,276.64031642d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
500	30	140	440	280	290

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	2
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Left	R1-2, R1-2rP	Right	Lane Configuration
W3-2	Right			
TOTAL # of Warning Signs:	2	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	YES



**Location: 101 & Frank Lloyd Wright NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Frank Lloyd Wright NB	
LINK: <a href="https://earth.google.com/web/@33.62178337,-111.88963707,450.54505737a,459.08672997d,35y,0h,0t,0r">https://earth.google.com/web/@33.62178337,-111.88963707,450.54505737a,459.08672997d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPU	

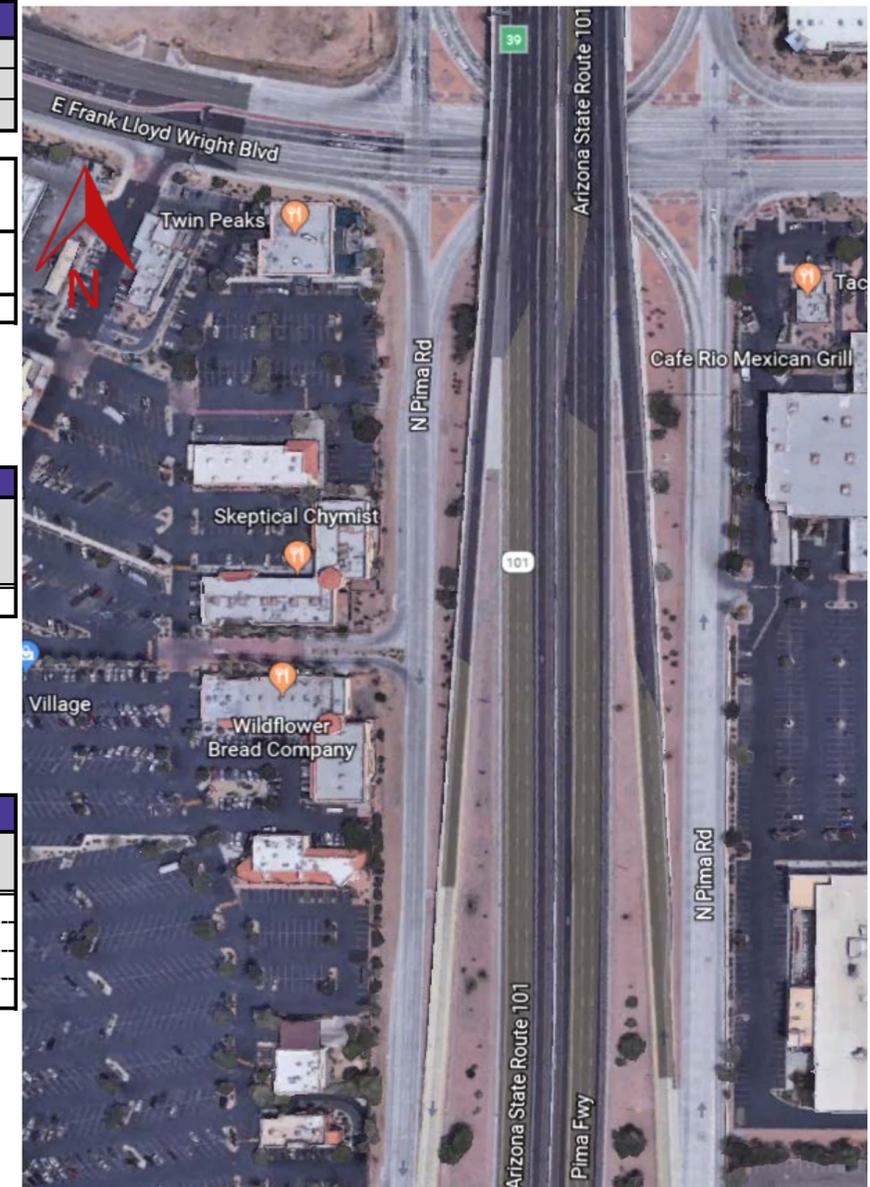
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
250	50	240	2,420	250	250

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2, R1-2rP	Left	Lane Configuration
		R1-2, R1-2rP	Right	
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 2		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 101 & Frank Lloyd Wright SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Frank Lloyd Wright SB	
LINK: <a href="https://earth.google.com/web/@33.63292875,-111.89069143,467.08435341a,189.88898407d,35y,0h,0t,0r">https://earth.google.com/web/@33.63292875,-111.89069143,467.08435341a,189.88898407d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPU	

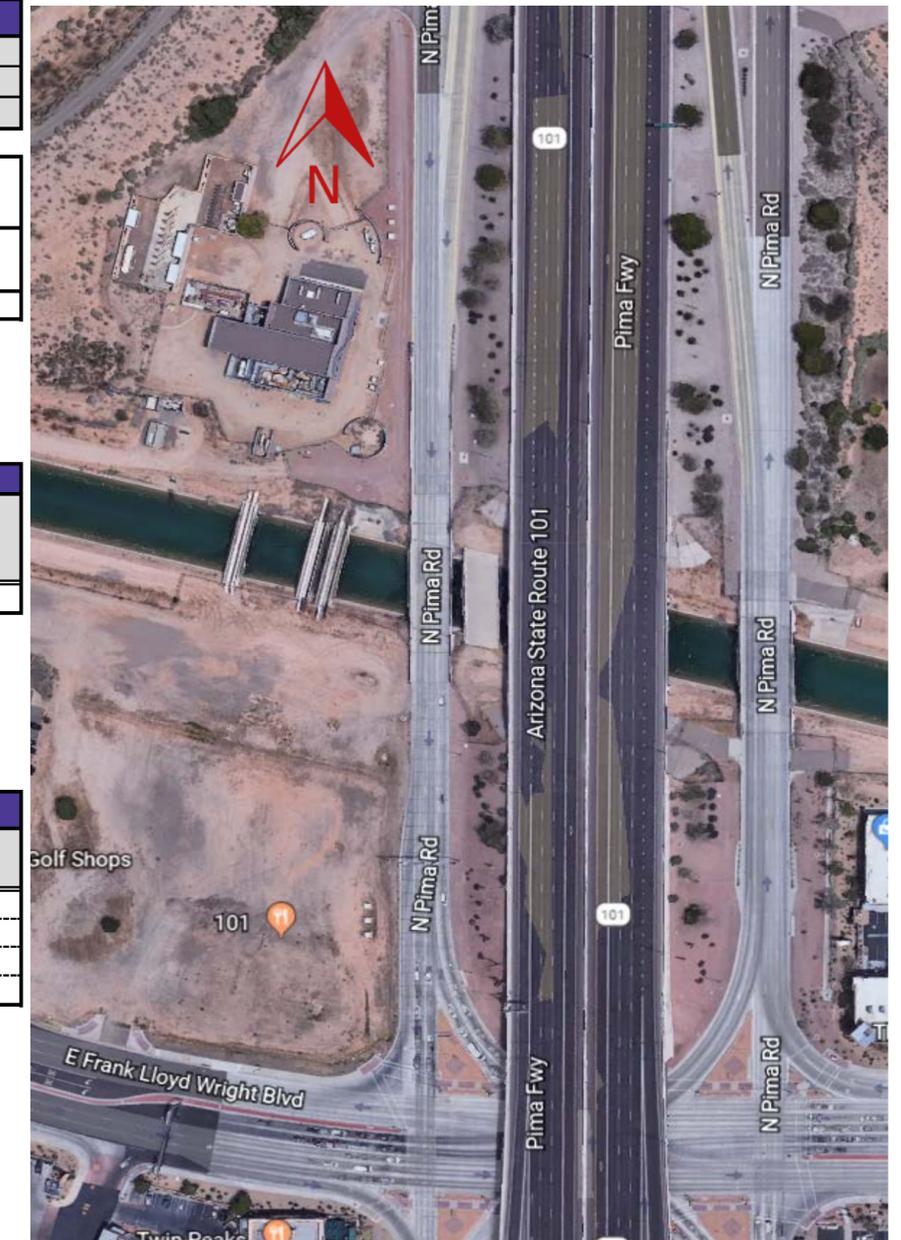
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
250	60	200	650	230	230

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2, R1-2rP	Right	Lane Configuration
		R1-2, R1-2rP	Left	
TOTAL # of Warning Signs:	1	TOTAL # of Traffic Control Signs:	2	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	YES



**Location: 101 & Raintree SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Raintree SB	
LINK: <a href="https://earth.google.com/web/@33.62633311,-111.89093542,456.82797687a,285.26460843d,35y,-0h,0t,0r">https://earth.google.com/web/@33.62633311,-111.89093542,456.82797687a,285.26460843d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPU	

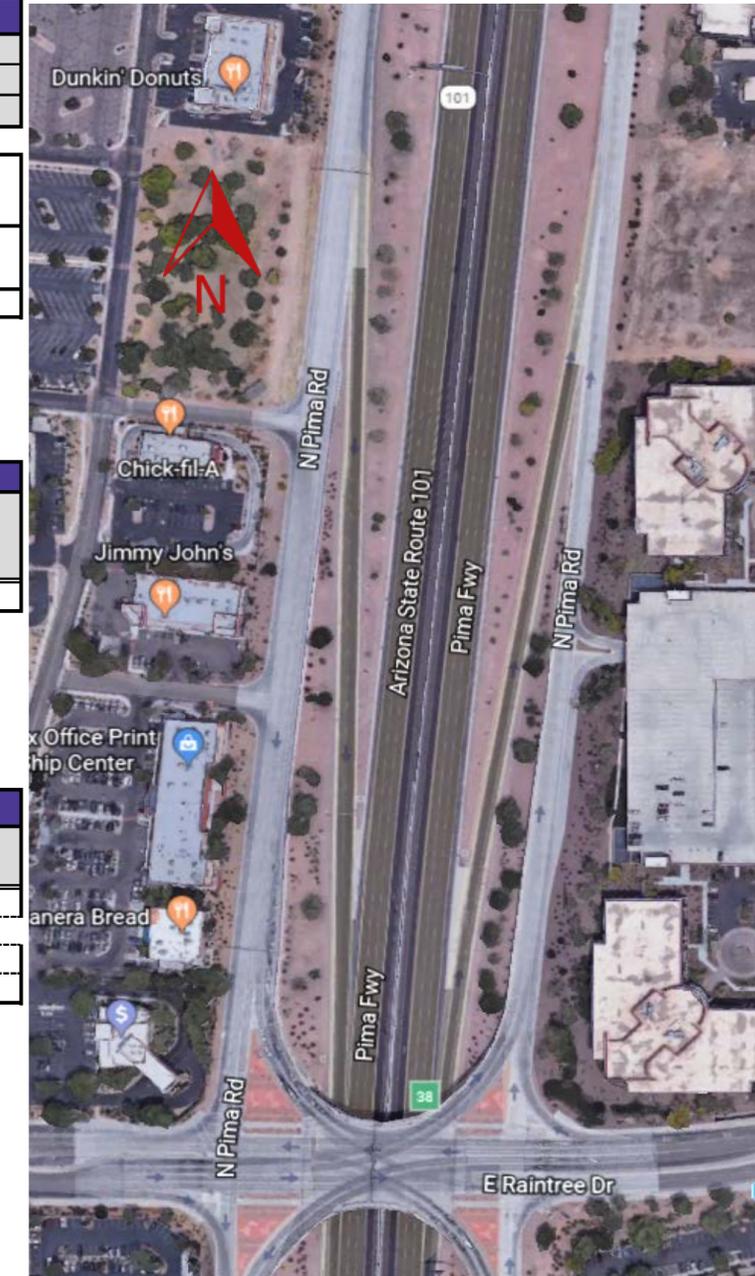
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
250	110	540	2,000	200	240

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2, R1-2rP	Left	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	YES (very faded)



**Location: 101 & Chandler SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Chandler SB	
LINK: <a href="https://earth.google.com/web/@33.30897622,-111.89445344,365.88975927a,492.2895218d,35v,-0h,0t,0r">https://earth.google.com/web/@33.30897622,-111.89445344,365.88975927a,492.2895218d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

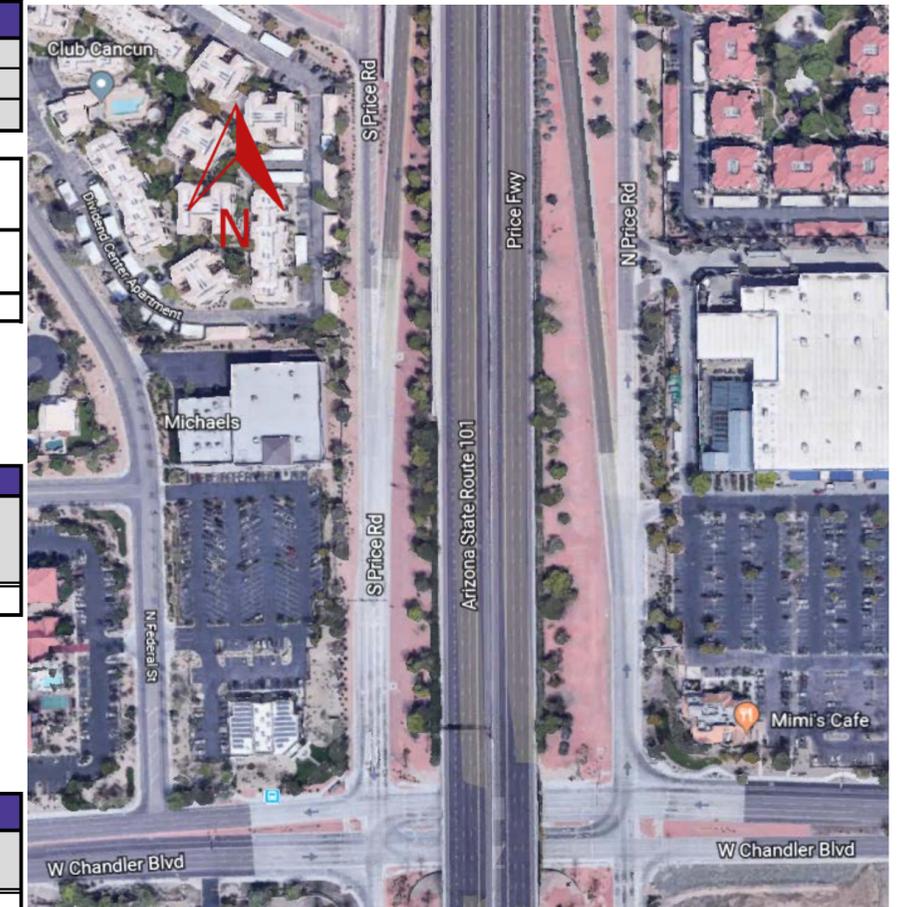
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	YES		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
550	-70	190	420	260	290

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	2
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Left	R1-2, R1-2rP	Right	Lane Configuration
W3-2	Right			
<b>TOTAL # of Warning Signs:</b>	2	<b>TOTAL # of Traffic Control Signs:</b>	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	NO



**Location: 101 & Ray NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Ray NB	
LINK: <a href="https://earth.google.com/web/@33.31855142,-111.89339563,359.66413087a,171.24493474d,35y,0h,0t,0r">https://earth.google.com/web/@33.31855142,-111.89339563,359.66413087a,171.24493474d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

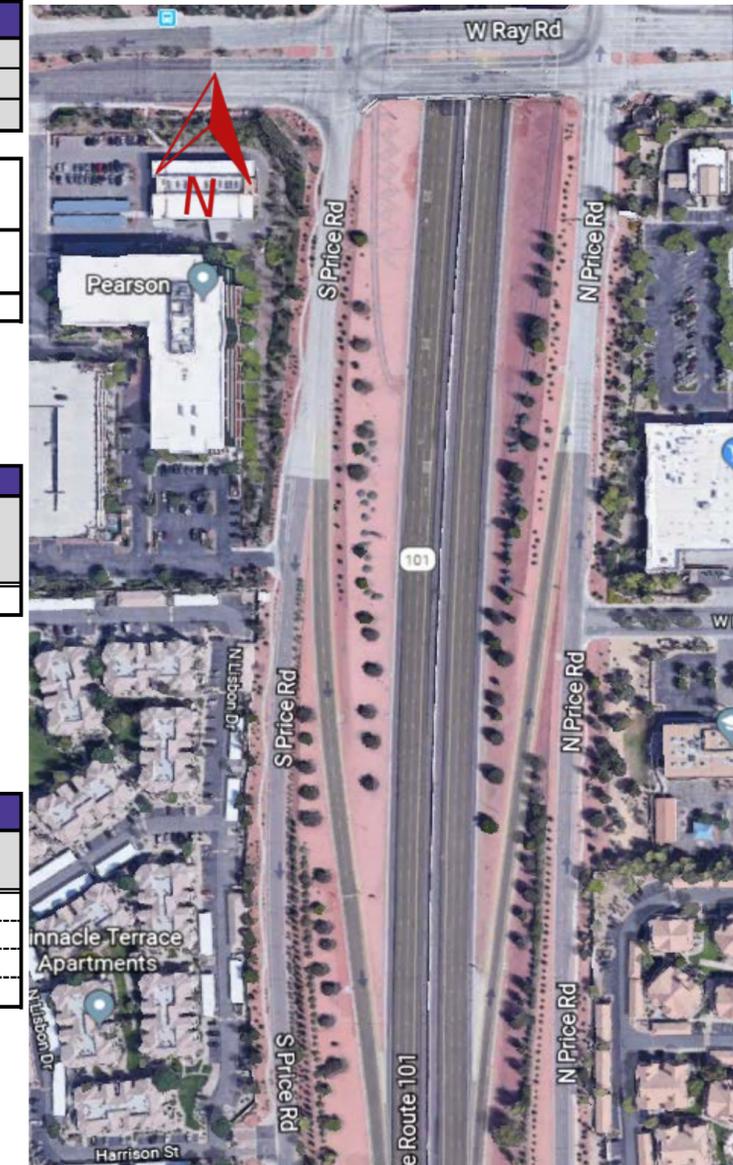
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	YES		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	-100	120	250	190	200

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Ray SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Ray SB	
LINK: <a href="https://earth.google.com/web/@33.32215304,-111.89431629,356.01350776a,228.69161139d,35y,0h,0t,0r">https://earth.google.com/web/@33.32215304,-111.89431629,356.01350776a,228.69161139d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	YES		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	110	130	280	210	210

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	2

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 0		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Warner NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Warner NB	
LINK: <a href="https://earth.google.com/web/@33.33344672,-111.89219385,358.94161811a,226.67787202d,35y,359.99999914h,0t,0r">https://earth.google.com/web/@33.33344672,-111.89219385,358.94161811a,226.67787202d,35y,359.99999914h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

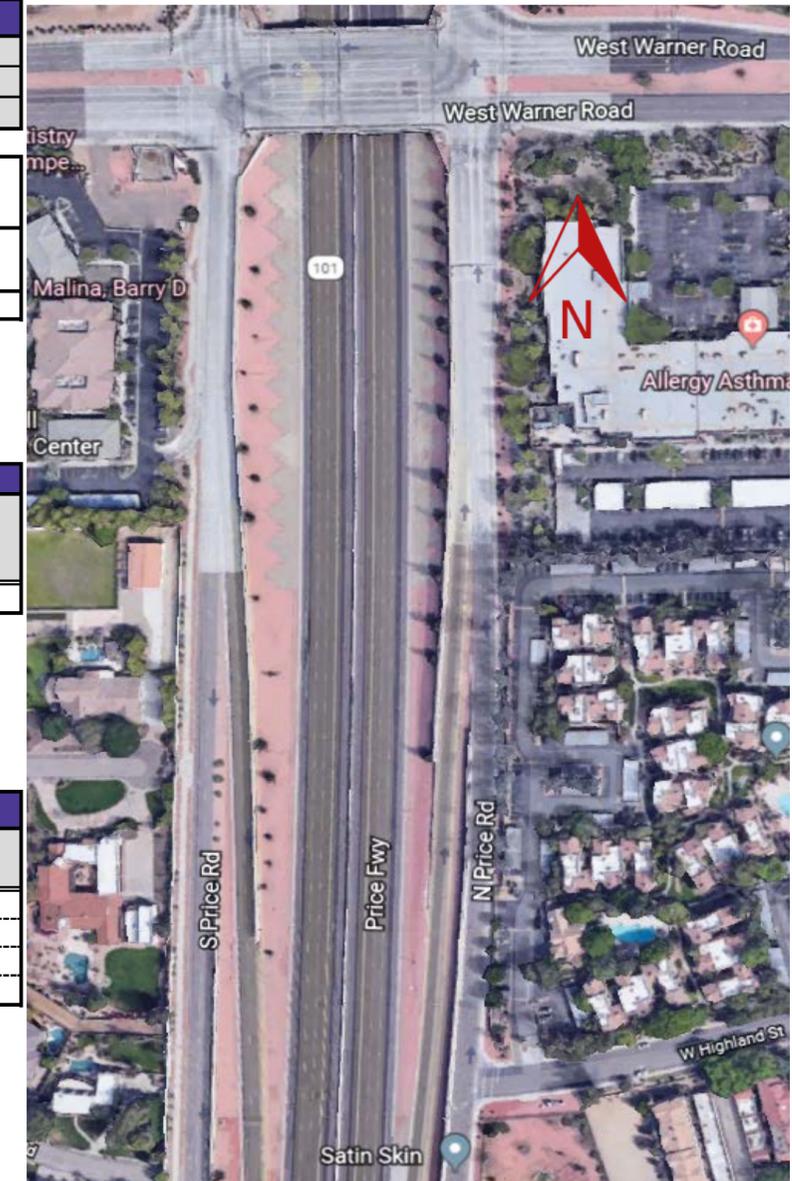
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	80	100	250	180	170

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Warner SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Warner SB	
LINK: <a href="https://earth.google.com/web/@33.33642888,-111.89343471,359.70956158a,153.30436031d,35y,-0h,0t,0r">https://earth.google.com/web/@33.33642888,-111.89343471,359.70956158a,153.30436031d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	YES		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Signs	-90	100	140	270	290

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
		R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs:	0	TOTAL # of Traffic Control Signs:	1	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Elliot NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Elliot NB	
LINK: <a href="https://earth.google.com/web/@33.34786829,-111.89300739,360.79132962a,171.7373776d,35v,-0h,0t,0r">https://earth.google.com/web/@33.34786829,-111.89300739,360.79132962a,171.7373776d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

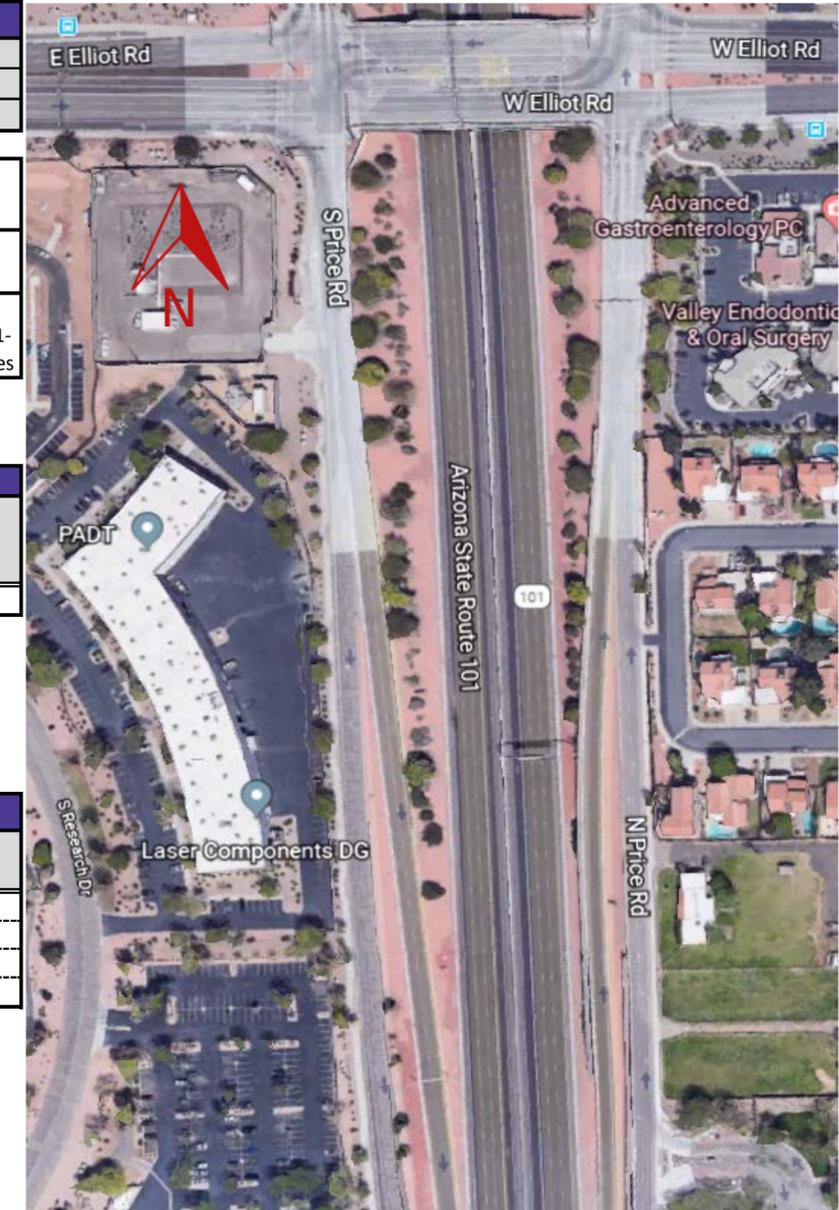
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	W3-2 and R1-2, R1-2rP Hidden by Trees
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	YES		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
300	30	100	230	180	210

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Elliot SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Elliot SB	
LINK: <a href="https://earth.google.com/web/@33.350808,-111.89431106,360.83825945a,131.99364704d,35v,0h,0t,0r">https://earth.google.com/web/@33.350808,-111.89431106,360.83825945a,131.99364704d,35v,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	YES		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
290	-80	130	110	270	280

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W3-2	Right	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Guadalupe NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Guadalupe NB	
LINK: <a href="https://earth.google.com/web/@33.36215981,-111.89346258,366.87920269a,162.9771142d,35y,0h,0t,0r">https://earth.google.com/web/@33.36215981,-111.89346258,366.87920269a,162.9771142d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPUI	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	R1-2, R1-2rP
Sidewalk Along Frontage?	YES		Blocked by Trees
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
50	20	130	330	170	170

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Guadalupe SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Guadalupe SB	
LINK: <a href="https://earth.google.com/web/@33.36550339,-111.89423427,367.67182959a,164.74089475d,35y,0h,0t,0r">https://earth.google.com/web/@33.36550339,-111.89423427,367.67182959a,164.74089475d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: SPUI	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
100	-30	160	220	260	340

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	2
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2,R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Baseline NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Baseline NB	
LINK: <a href="https://earth.google.com/web/@33.37648197,-111.89259087,366.35274044a,184.15344375d,35y,-0h,0t,0r">https://earth.google.com/web/@33.37648197,-111.89259087,366.35274044a,184.15344375d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	R1-2, R1-2rP
Sidewalk Along Frontage?	YES		Blocked by Tree
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
310	-50	90	310	250	330

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Southern SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Southern SB	
LINK: <a href="https://earth.google.com/web/@33.39480872,-111.89193941,361.61415456a,247.04055194d,35y,0h,0t,0r">https://earth.google.com/web/@33.39480872,-111.89193941,361.61415456a,247.04055194d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	R1-2, R1-2rP Blocked by Tree
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
510	-160	180	300	150	170

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Broadway NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Broadway NB	
LINK: <a href="https://earth.google.com/web/@33.40583175,-111.89019043,362.95957308a,225.49396024d,35y,-0h,0t,0r">https://earth.google.com/web/@33.40583175,-111.89019043,362.95957308a,225.49396024d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
560	-240	280	130	230	210

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & Broadway SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & Broadway SB	
LINK: <a href="https://earth.google.com/web/@33.40945478,-111.8917017,364.99905342a,243.24651799d,35v,-0h,0t,0r">https://earth.google.com/web/@33.40945478,-111.8917017,364.99905342a,243.24651799d,35v,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	YES		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
420	230	300	290	200	190

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



**Location: 101 & University NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 101 & University NB	
LINK: <a href="https://earth.google.com/web/@33.42052667,-111.890343,367.34338246a,212.29044675d,35y,-0h,0t,0r">https://earth.google.com/web/@33.42052667,-111.890343,367.34338246a,212.29044675d,35y,-0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

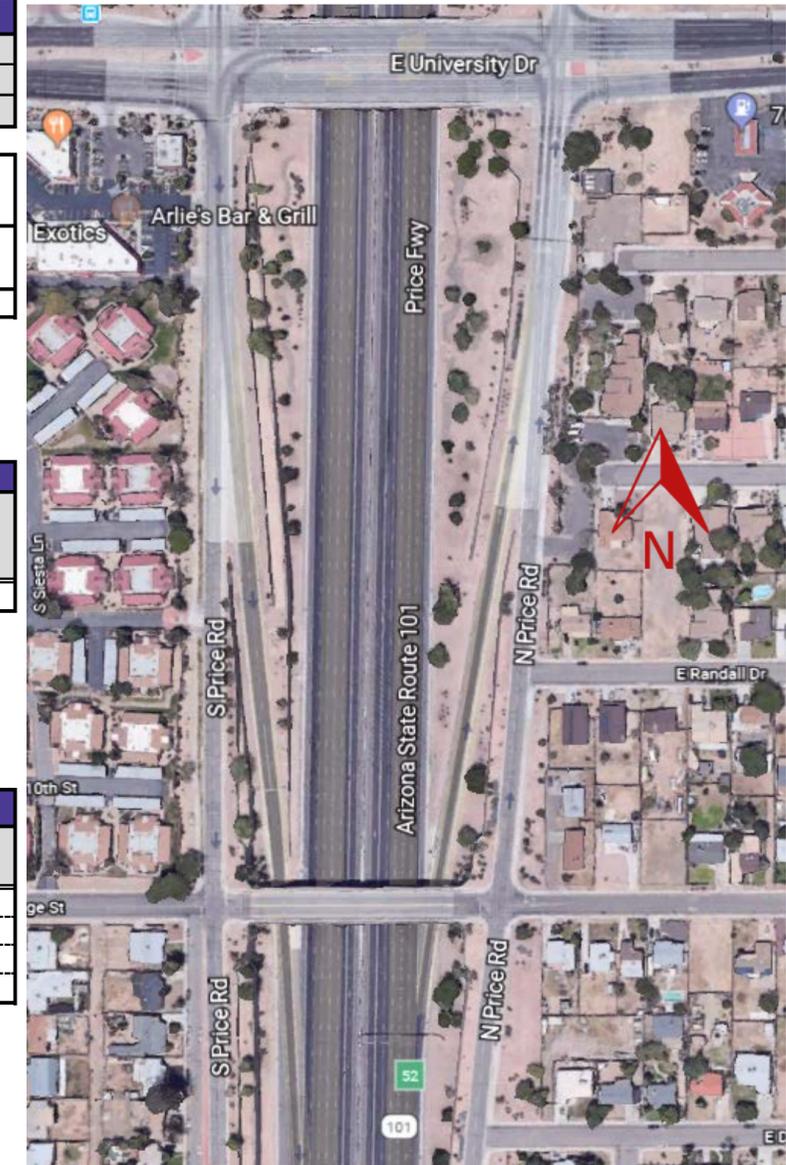
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	NO
Sidewalk Along Frontage?	YES		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
350	-20	290	110	200	190

Lanes	
Number of Lanes on Frontage Road Approach:	2
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2, R1-2rP	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	YES
Yield Lines:	YES



# **STATE ROUTE 202**

**Location: 202 & Broadway SB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 202 & Broadway SB	
LINK: <a href="https://earth.google.com/web/@33.40950239,-111.64108335,453.0404596a,184.68015469d,35y,0h,0t,0r">https://earth.google.com/web/@33.40950239,-111.64108335,453.0404596a,184.68015469d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	None
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
110	-40	210	190	220	230

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	1
Number of Lanes on Frontage Road Departure:	4

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left	R1-2	Right	Lane Configuration
TOTAL # of Warning Signs: 1		TOTAL # of Traffic Control Signs: 1		

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



**Location: 202 & University NB**

[Back to Index](#)

EXISTING INVENTORY	
LOCATION: 202 & University NB	
LINK: <a href="https://earth.google.com/web/@33.41975226,-111.63522551,468.17335633a,297.45041671d,35y,0h,0t,0r">https://earth.google.com/web/@33.41975226,-111.63522551,468.17335633a,297.45041671d,35y,0h,0t,0r</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Upgrade	Physical Obstruction to Sight Distance?	None
Sidewalk Along Frontage?	NO		
Bicycle Lane Along Frontage?	NO		
Driveways Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection?	NO		

DISTANCES (NEAREST 10 FEET)					
Advance Warning Signs to Regulatory	Traffic Control Sign to Physical Gore	Physical Gore to Tip of Striped Gore	Tip of Striped Gore to Start of Solid White lane Stripe Approaching the Intersection	Start of Solid White Striping to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Regulatory Signs	No Regulatory Signs	290	350	290	300

Lanes	
Number of Lanes on Frontage Road Approach:	1
Number of Lanes on Ramp at Merge:	2
Number of Lanes on Frontage Road Departure:	3

Advance Warning Signs		Traffic Control Signs		Overhead Signs
Sign Code	Side of Road	Sign Code	Side of Road	Description (Guide, Lane Configuration)
W4-3	Left			Lane Configuration
TOTAL # of Warning Signs:	1	TOTAL # of Traffic Control Signs:	0	

Pavement Markings at Frontage/Ramp	
Stop Bar for Frontage:	NO
Yield Ahead:	NO
Stop Ahead:	NO
Wrong-way Arrows with RPMs (M-12):	NO
Yield Lines:	NO



# **APPENDIX C**

## **SIGN CODES AND IMAGES**

Sign Codes



R1-2



R1-2rP



W3-2



W4-3



W4-1



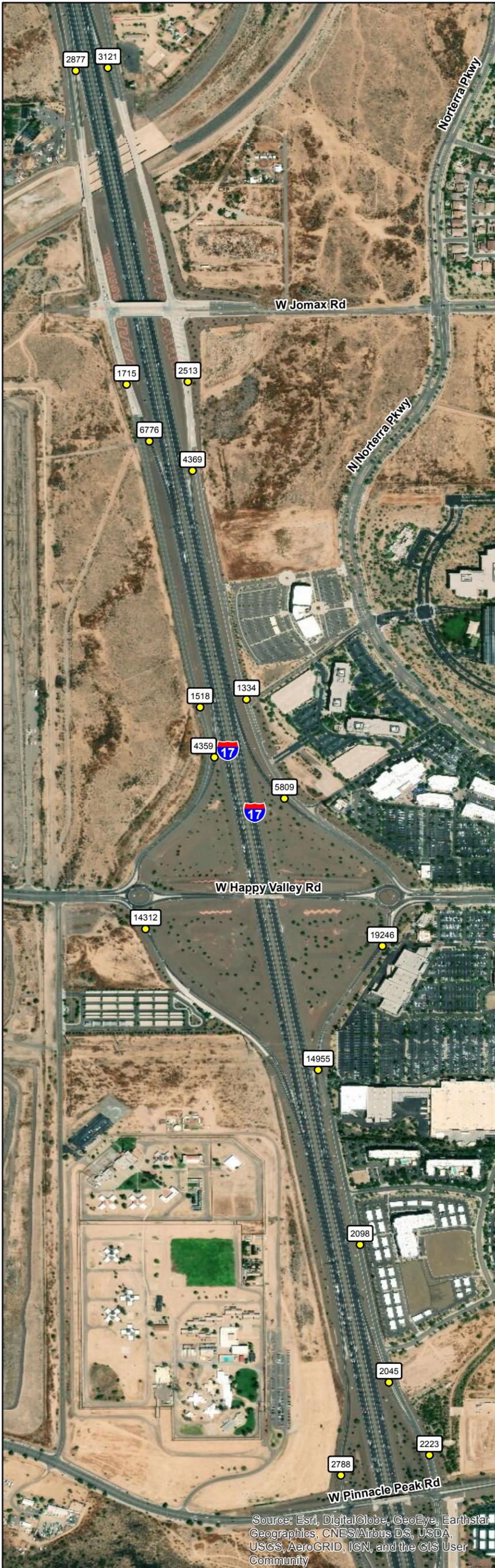
R1-1

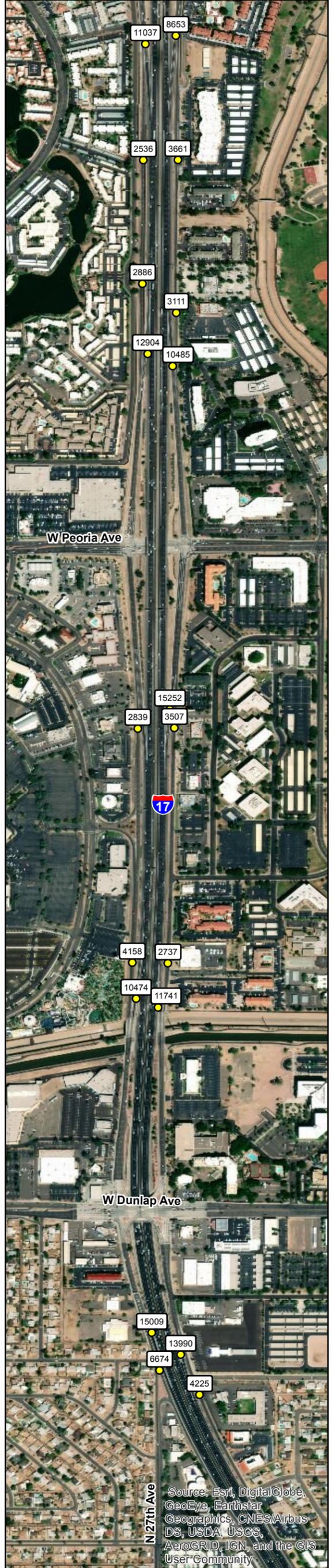
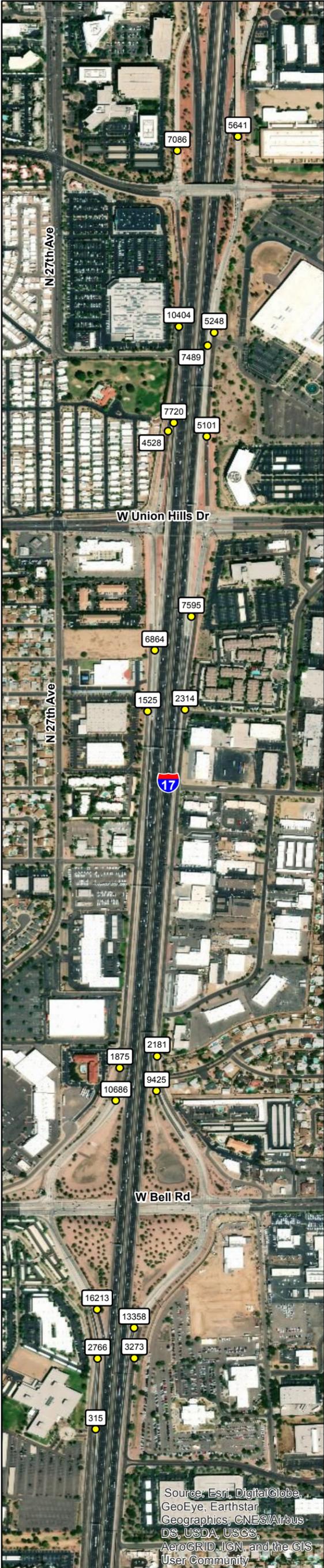


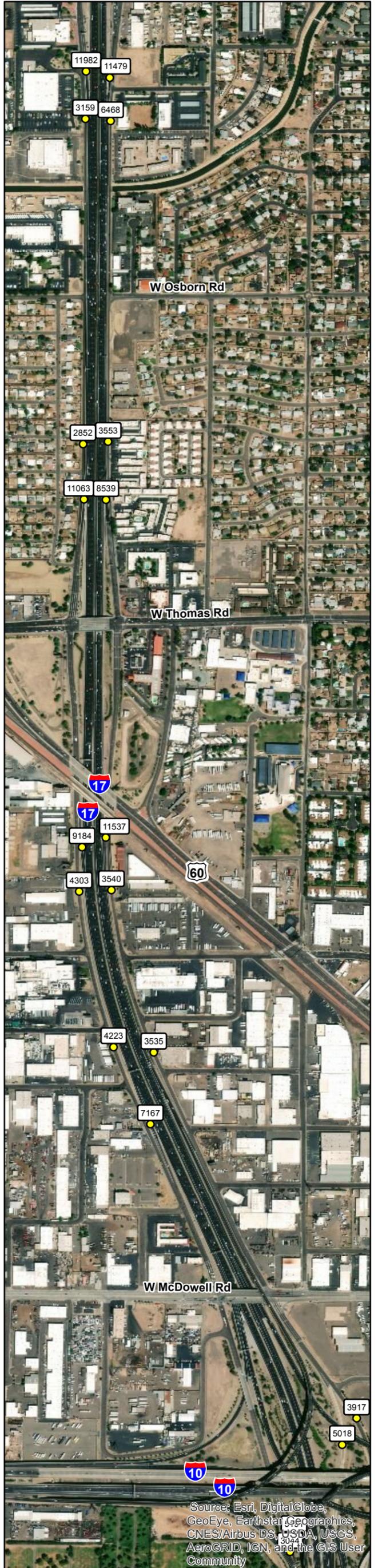
W3-1

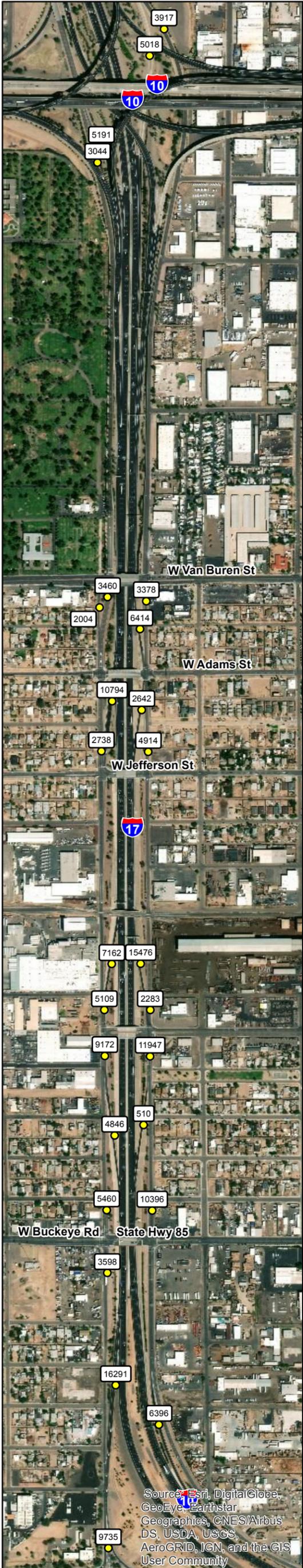
# **APPENDIX D**

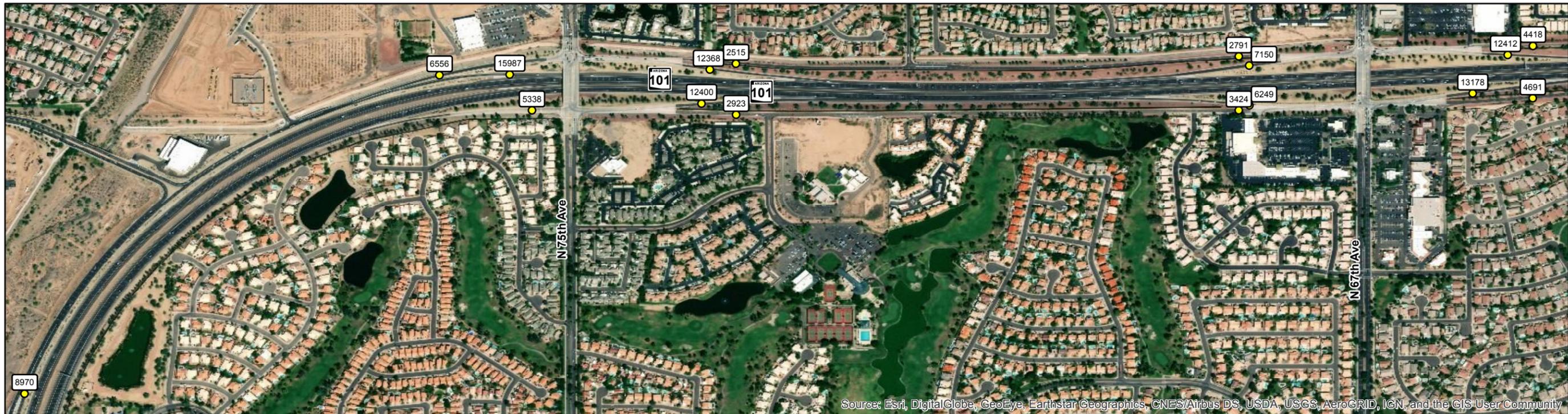
## **TRAFFIC VOLUMES**

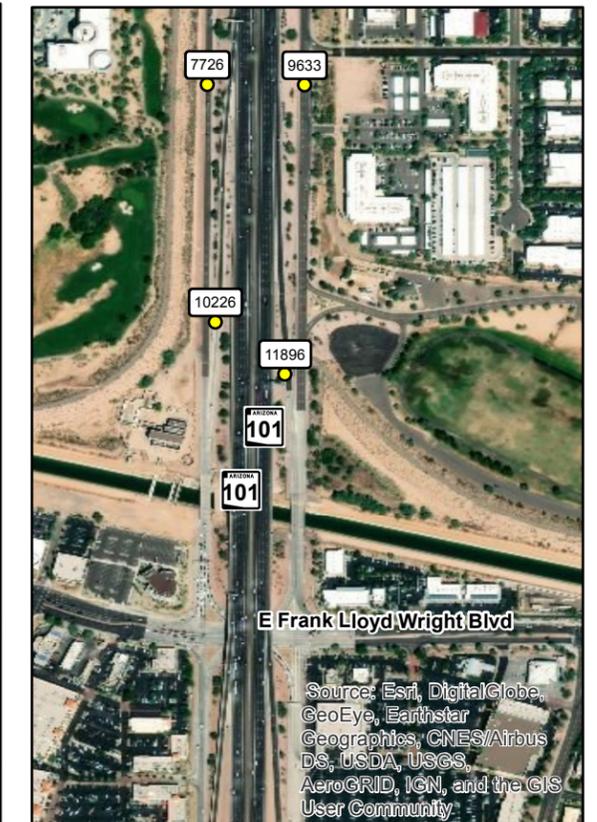
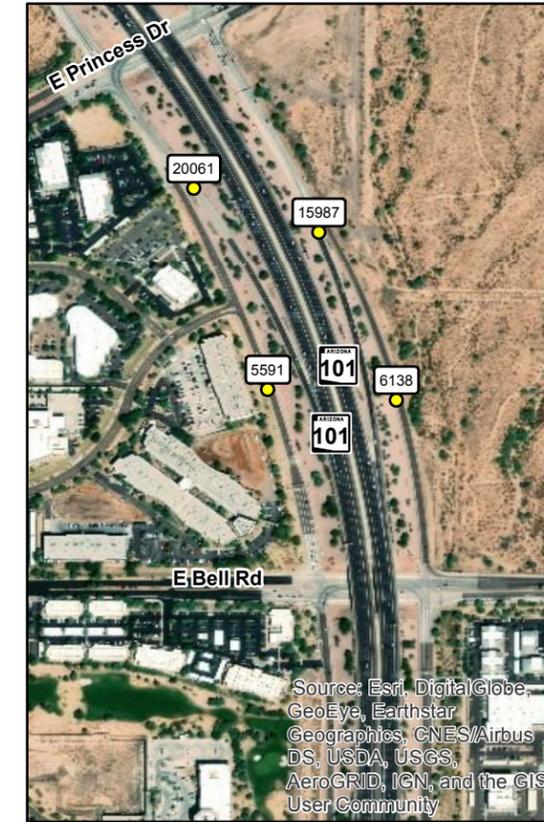
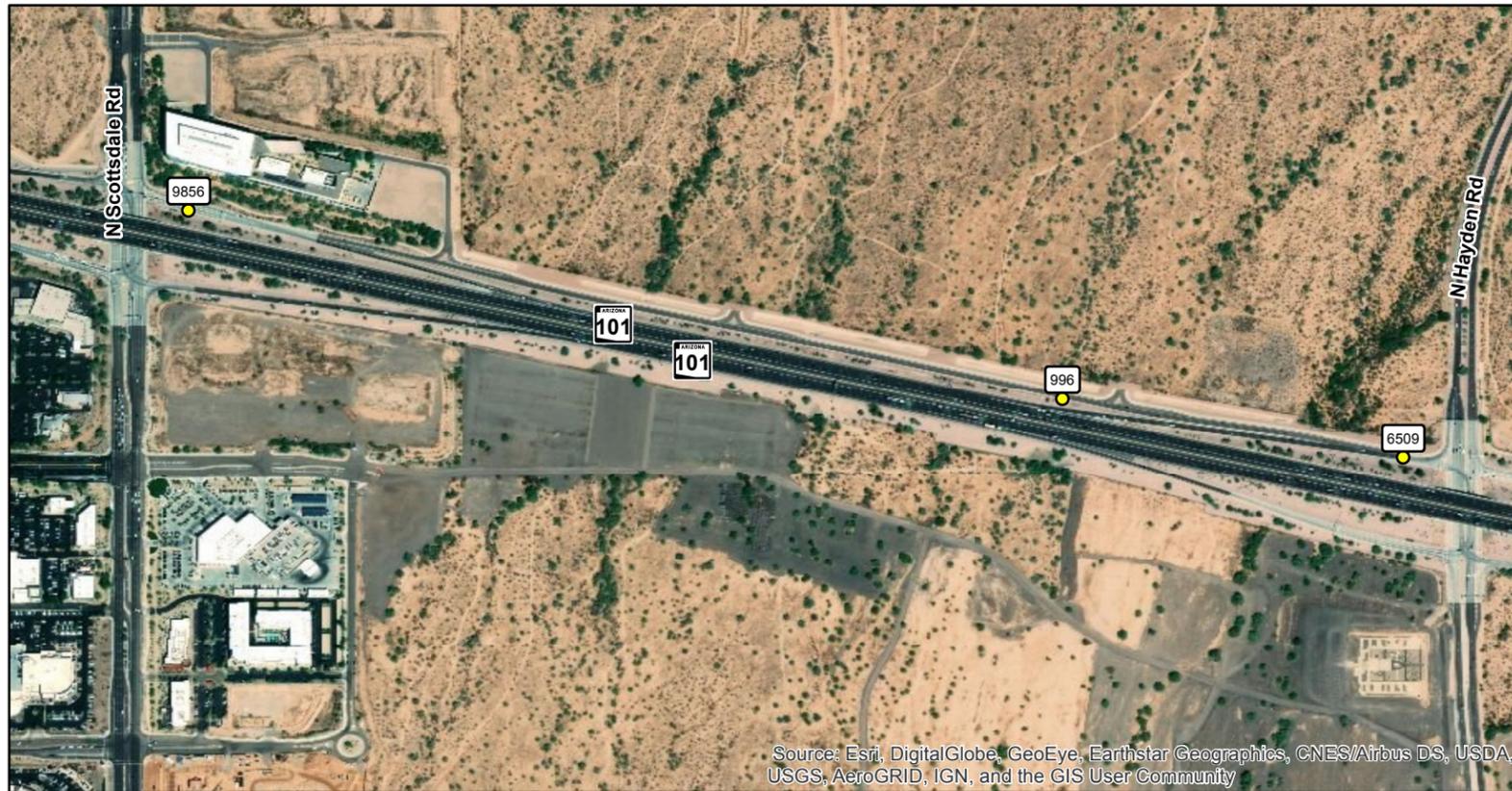


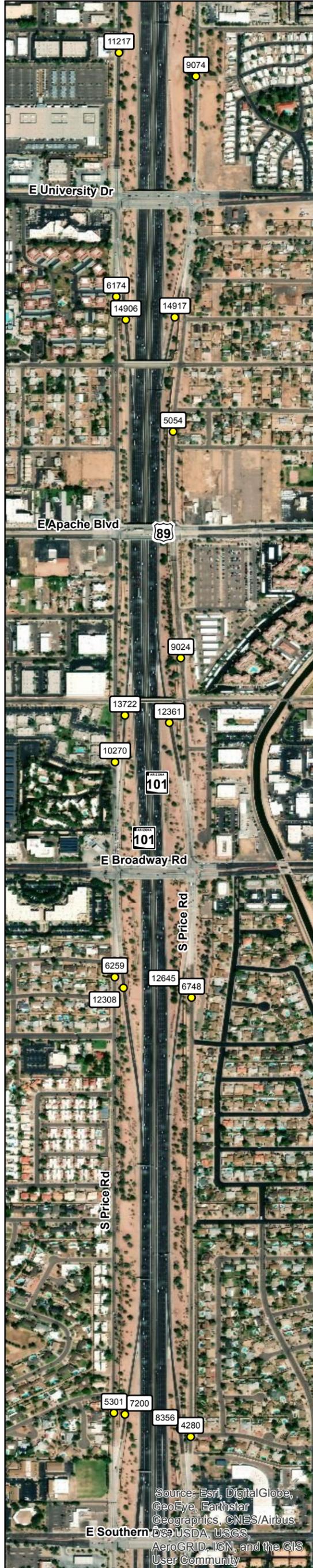
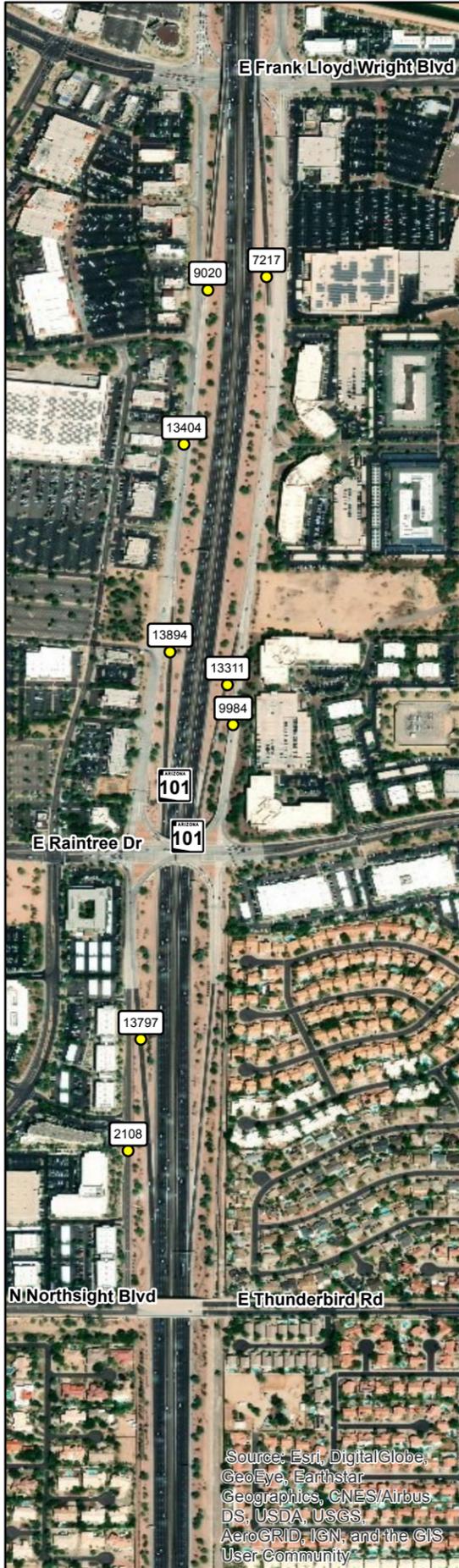














# **APPENDIX E**

## **COMPLAINTS LOG**

Date	Complaint #	Freeway	Cross Street	Complaint	Action	Action Result		Applicable to this project
						Disposition	Date	
3/23/2016		SR 101	Broadway Road	DPS and Tempe PD, with neither willing to enforce the "YIELD TO RAMP TRAFFIC" signage - concerned about the merging/gore area of SB Price and SB Loop 101 Frontage Rd at Broadway Rd in Tempe	Provided signing and striping improvements (Go to work order for details)	Completed	6/26/2016	Yes
11/15/2016		SR 101	Pima	As cars come fast down the north 101 off-ramp heading toward the traffic light at the intersection with Pima. Unfortunately, the traffic heading north on the Frontage Road (which crosses into the off-ramp) are often (may be even more often) not yielding until the last section, if at all (maybe because of bad sight lines). to avoid a big accident (if one hasn't happened already), Scottsdale and/or the State needs to do more! Should we be enlarging the yield sign or placing a blinking yellow light to warn the side-road's drivers of the need for caution as they head across/into the off-ramp?	Move the Yield sign close to the tip of the gore. We will also be moving the shark teeth to line up with the new Yield location.	Completed	12/13/2016	Yes
1/12/2017	1701281262	SR 101	Exit 36 - Pima Road NB	Every day I travel along the northbound 101 freeway, sometimes several times in one day, and exit at #36 to head north on Pima Road. As the time of the year gets busier, this exit ramp is so dangerous. The lower traffic is to YIELD to the exiting ramp traffic. THIS NEVER HAPPENS! Its's as if the YIELD sign does not exist. Any chance this is going to become at least a FLASHING yield sign or even a stop sign. We have a newer driver at our home and this intersection is terrifying!				Yes
1/12/2017	1701281262	SR 101	Frank Lloyd Wright NB	The second one in the area that is horrible also is as you are heading south on the 101 and exit Frank Lloyd Wright. If you want to head West on Frank Lloyd Wright, you need to cut over three lanes of traffic, which once again are supposed to YIELD to ramp traffic. Same problem here.				Yes
8/9/2017		SR 101	Warner Road NB	On NB 101 Warner Rd exit, there used to be a 'yield to ramp traffic' sign that was located on the left side of frontage road. Was it damaged and removed? Are there plans to reinstall it? How about merging the frontage road to one lane (similar to SB 202 at Elliott) to help prevent the off ramp traffic from getting backed up and having to cross to lanes of traffic to turn right?				Yes
10/27/2017	1730065877	SR 101	Ray Road SB	I have a concern as a driver. When exiting the 101 Loop South in Chandler, AZ to take Exit 59 at Ray Road, drivers that are approaching Ray Road from Price Road are supposed to yield to drivers taking the ramp off the 101. However, drivers on Price Road rarely do yield properly and often make a dangerous driving situation. I think putting a STOP sign instead of a YIELD sign for those traveling south on Price Road towards Ray Road would make for a better.	<a href="https://www.google.com/maps/@33.3221296,-111.8945761,3a,75y,191.31h,84.43t/data=!3m6!1e1!3m4!1svot-GyV8xF5lz1rReueqWg!2e0!7i13312!8i6656">https://www.google.com/maps/@33.3221296,-111.8945761,3a,75y,191.31h,84.43t/data=!3m6!1e1!3m4!1svot-GyV8xF5lz1rReueqWg!2e0!7i13312!8i6656</a>			Yes
11/14/2017	1731730208			Sure, that is what you and I would do if we were on the access road, yield to freeway traffic. But that becomes challenging for them too because both access road lanes get backed up from the light by 6-8 cars which is past the merge lines, so when the light turns green they would have to stay stationary in order to let anyone merge. However we have been driving this route for almost a year now, and unfortunately we have found that not many people will actually yield, and what seems to make it more difficult at this location is that the actual merge lines (where the solid white shoulder line changes to white dashed) are only a few short car lengths from the light, so when the access road traffic is full, as it often is around 8:10am, merging when you are almost at the light makes it extra challenging. I'm sure it's been this way forever, I just can't understand why the solid white shoulder line goes on for so long. Probably because it may be hard to see around the Great Wall if it was shorter. Some will even cut through the shoulder to try to ensure they will get over far enough to turn right which only further complicates things for those attempting to merge farther up at the dashed lines. Thanks for listening anyway. Have a good day.				Not sure of the location
11/17/2017	1732132524		Ray Road, Chandler Blvd	Yield Sign at Ray Road / Chandler Blvd is not visible for drivers to convey - heading EAST - and drivers coming from Ray rd are subject to collisions *** "Yield Sign" is NOT visible — It is posted on PASSENGER SIDE OF ROAD & POSTED TOO FAR AFTER THE TURN for vehicles to slow down and yield to oncoming traffic				Not sure of the location
1/19/2018	1801971588	SR 101	59th Avenue EB	The way this exit is designed makes it almost impossible for the freeway traffic to exit south. The gore point funnels all highway traffic into the left turn only lane. It directs traffic from the access road to the 3 right lanes. Many people live just south of the freeway. Tonight, like most evenings, there was a 1/4 mile backup onto the freeway because of this problem. People coming off the access road DO NOT yield. Freeway traffic is forced to drive across the gore point in order to get to any of the right 3 lanes. I see near misses every day. Very poor design, very unsafe. Please look at the design here.				Yes