

# Central District Freeway Frontage Road Traffic Control Study

## Working Paper #1: Current Conditions



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## EXECUTIVE SUMMARY

To be provided with future Work Task 9: Draft Final Report.

## 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 but 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. A formalized study is warranted to establish additional 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 will establish 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 will also include 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 take into account current practices that are deployed nationwide in similar locations. In order to properly consider the practices of others across the country, a 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 has 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 study area for this project 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, these locations identified for this study include:

**Interstate 10 (I-10):** There is a limited use of frontage roads currently along Interstate 10. 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 roads in both directions are 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 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 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:

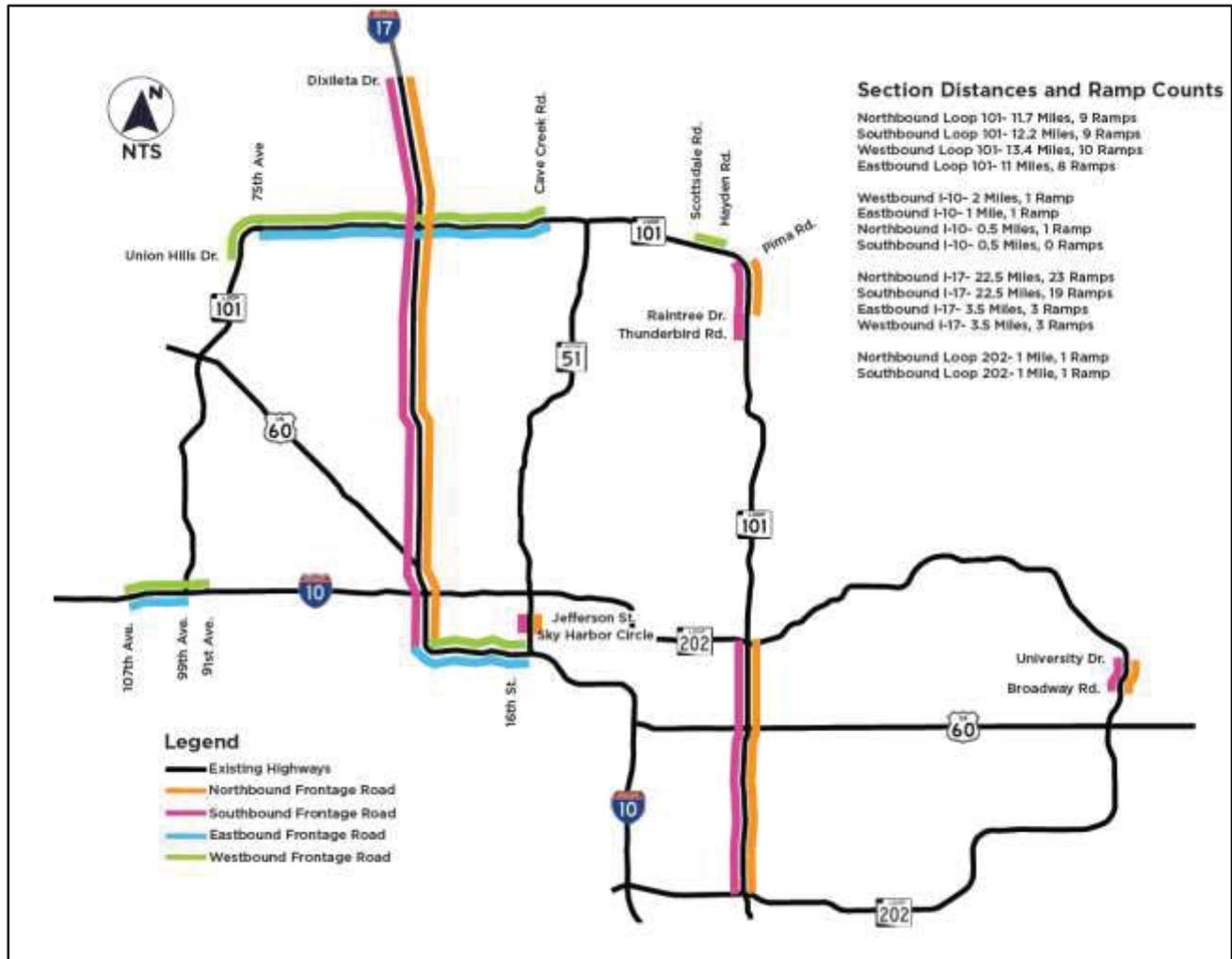
- Between Union Hills and Cave Creek Road,
- Between Scottsdale Road and Hayden Road,
- Between Pima Road and Thunderbird Road, and
- Between SR 202 (Red Mountain Freeway) and SR 202 (Santan Freeway)

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

Collectively, the ADOT Central District currently has (and this study is therefore evaluating) 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 desires 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 will also develop 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 will be identified and prioritized by the TAC and will reflect 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. It was then determined that the following states would be contacted/surveyed to identify and better understand their perspective. 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 has also 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 would like this project to 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

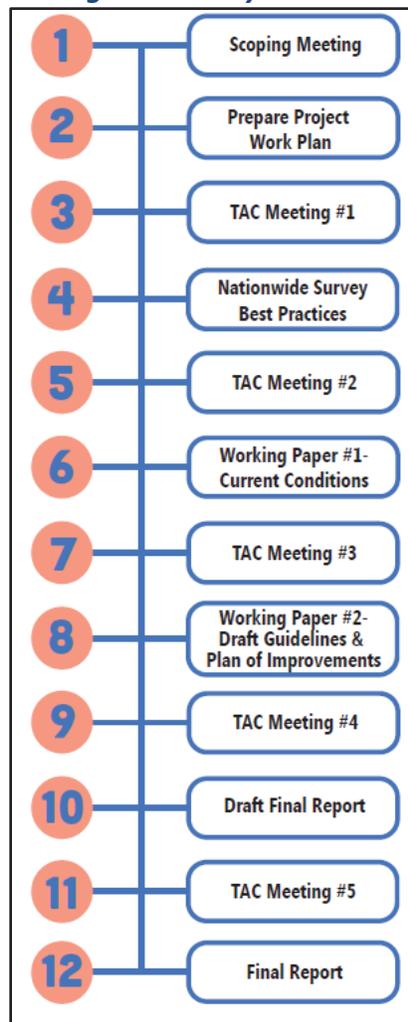
**Figure 2** below depicts the milestone tasks and work products for this project. The entire project is anticipated to last approximately 12 months.

**Figure 2** identifies the major milestones over the course of this process. The study process began with a scoping meeting with a diverse cross section of ADOT and other agency staff on November 27, 2017. 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 exercise. Some of the key takeaways from the 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 PUBLIC AND 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 will be informed and educated on the results of this study (access control guidelines/manual and suggested spot improvement locations) subsequent to the conclusion of this study. At the conclusion of the study, a fact sheet will be prepared and utilized to educate and inform agency stakeholders and the general public on the results and key recommendations of the Central District Ramp Traffic Control Study.

A Technical Advisory Committee (TAC) has been 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 will be instrumental to developing a plan that achieves desired objectives. TAC consists of personnel 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 are included in the TAC for the Central District Freeway Frontage Road Traffic Control Study.

AGENCY	CONTACT
AZ Dept. of Transportation	Jason Bottjen, Multimodal Planning Division, Project Manager
AZ Dept. of Transportation	Tony Abbo, ADOT TSMO
AZ Dept. of Transportation	Vahid Gofar, ADOT TSMO
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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

## Chapter 3 NATIONWIDE SURVEY OF BEST PRACTICES

This Nationwide Survey and Best Practices section has been 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.

### Purpose of the Nationwide Survey of Best Practices

The goals and objectives of this study are to establish traffic control guidelines on the appropriate type of traffic control to be used at the exit ramp/frontage road junctions. ADOT does not currently have traffic control guidelines for the exit ramp/frontage road junctions. The guidelines shall take into account current practices that are deployed nationwide in similar locations. In order to properly consider the practices of others across the country, a survey was conducted with states that have one-way frontage roads incorporated into the freeway system. An initial listing/identification of those states were reviewed and discussed with the TAC.

### States Identified for this Best Practices Survey

Guidance from the TAC and consultant research together identified states that have 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 are as follows:

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? Eg: One-way, right-turn only, wrong way, do not enter, no left-turns etc.

**Table 1** depicts the summary of responses obtained from the survey questions that were sent to various agencies. **Appendix A** includes the complete listing of responses to the surveys that were received from the state agencies.

As of the time Working Paper #1 was prepared, survey responses were not received from Wisconsin and Colorado. Survey results from these two states will be included as part of future Working Paper as they become available.

**Table 1: 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/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.	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 are 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 1: 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 has been researched and obtained through the survey questionnaire. The following sections document the standards and/or best practices of these states for the one-way frontage road traffic control.

### Arkansas Department of Transportation (ARDOT)

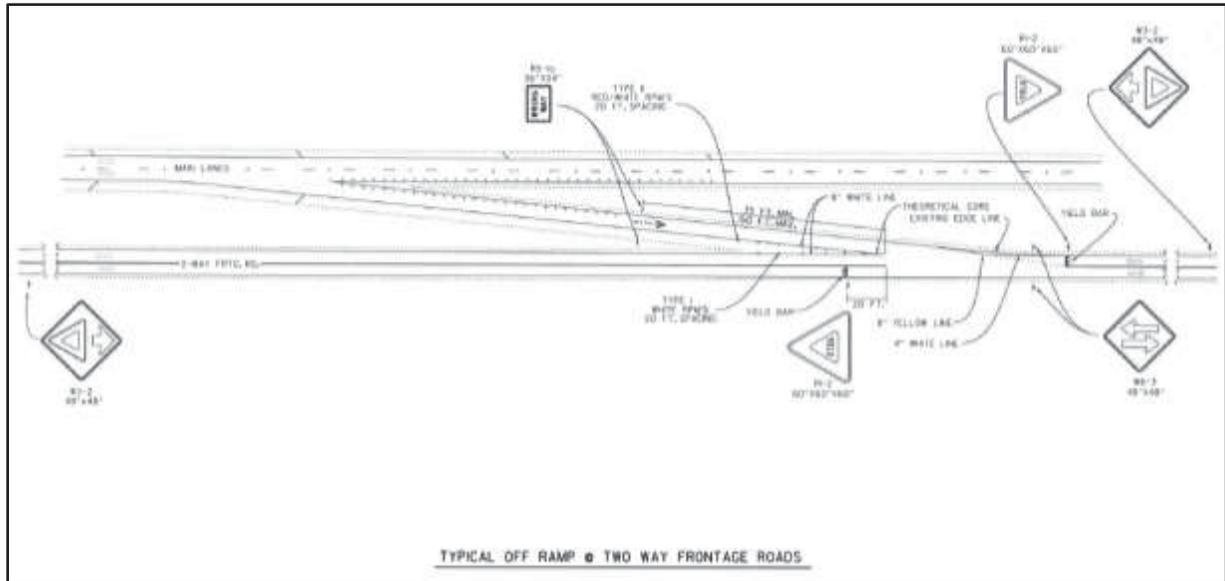
A summary of the traffic control regulations and/or policies utilized by ARDOT in locations where the frontage road converges with the exit ramps includes the following:

- 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.

#### **Wisconsin Department of Transportation (WisDOT)**

At the time this technical memorandum was prepared, it is not known if traffic control standards for frontage roads where they merge with the exit ramps exist. Based on discussions with WisDOT, traffic control varies depending on lanes dedicated to off and on traffic, traffic volumes of roads they are crossing and, in some cases, depends on the right-of-way from frontage road and also exit ramp.

Traffic control standards for various states that are 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 summarizes 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.

Figure 5: Sample Data Collection Sheet

Location: I-17 & McDowell NB					
<b>EXISTING INVENTORY</b>					
ID:ADOTM: I-17 & McDowell NB					
URL: <a href="#">Input Data Form</a>					
ARTERIAL/FREEWAY INTERCHANGE TYPE: <b>Elwood</b>					
Posted Speed Limit on Frontage Road (mph)	45	AADOT Avianth's Measure 2 (Speed/Path/Direction Change on Urban Road) Decision Light Distance for Urban Road (ft)		330	
Divider Between Frontage Road and Exit Ramp	Fence	AADOT Avianth's Measure 8 (Stop on Urban Road) Decision Light Distance for Urban Road (ft)		300	
Description of Sign side	Left side	Physical Obstruction to Sight Distance		No	
Signs Along Frontage	NO				
Signs Along Frontage	NO				
Downslopes Along the Frontage Road Between the Ramp/Frontage Physical Gore and Frontage/Arterial Intersection	NO				
<b>DISTANCES (IN FEET) TO FEET</b>					
Advance Warning Sign 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 Striped to Stop Bar at Intersection	Stop Bar to Overhead Sign
No Advance Warning Sign	30	100	200	300	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 (Grade, Lane Configuration)	
		W4-3	Left	Lane Configuration	
TOTAL # of Warning Signs: 0		of Traffic Control Signs: 1			
<b> pavement Markings at Frontage/Ramp</b>					
Stop Bar for Frontage	NO				
Yield Ahead	NO				
Stop Ahead	NO				
Wing-way Arrows with RPMs (M-52)	NO				
Yield Lines	NO				



## 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 frontage roads 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 is 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 sections describe the existing signs and pavement marking along the various frontage roads and along the exit ramps where 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 below. “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 that are included in **Appendix B**.

### Physical Obstruction to Sight Distance

A driver’s ability to see ahead is of utmost important 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. It is evident that there are many locations where it would be prudent to provide longer sight distances. In these circumstances, 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 2**.

**Table 2: 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 are listed below:

- I-17 and Bethany Home Road in the southbound direction – the existing added lane sign (W4-3) is being blocked by a bush,
- I-17 and Peoria Avenue in the northbound direction – the existing “Yield Ahead” sign (W3-2) is being blocked 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 blocked by a wall,
- I-17 and Cactus Road in the southbound direction – the existing “Yield” sign (R1-2) is being blocked 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 blocked 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 blocked 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 blocked 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 blocked 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 blocked by 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 blocked by curve and a wall,
- I-17 and Happy Valley Road in the northbound direction – the existing “Yield Ahead” sign (W3-2) is being blocked 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 blocked 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 blocked 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 blocked 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 blocked 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 blocked 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 blocked 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 blocked 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 blocked 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 blocked 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 blocked by trees.

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

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. Therefore, for the purposes of this analysis, it was assumed, all the locations where the distance between the gore point where the frontage road converges 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 at each study 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 the *Study Process* of this report, crash data, while useful, is not as imperative to evaluate for the nature of this study. However, this project will establish 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. Therefore, crash data analysis was 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** illustrates the various crash data elements within the study area.

Figure 6: Crashes by the Year

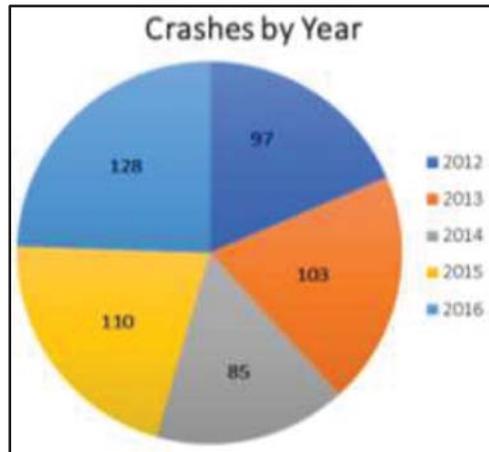


Figure 7: Crashes along Frontage Road adjacent to each Freeway Facility

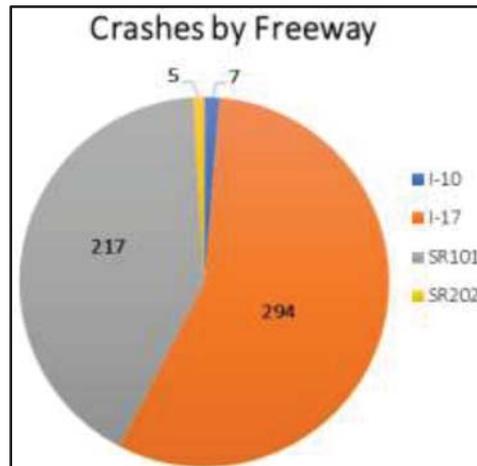


Figure 8: Crashes by Injury Severity

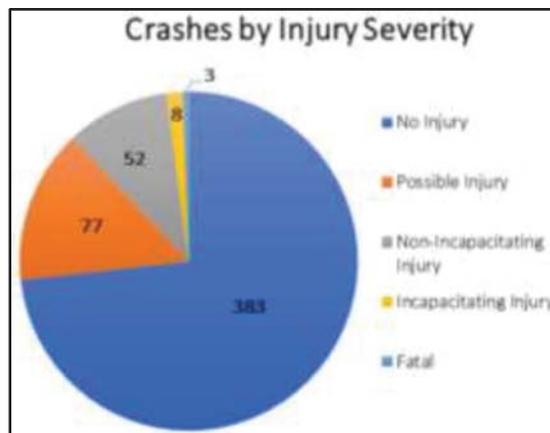


Figure 9: Crashes by Collision Manner

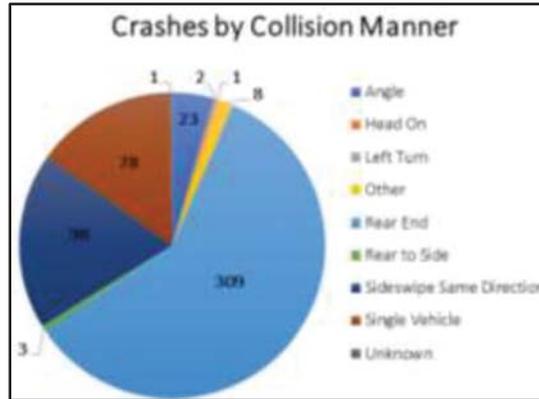
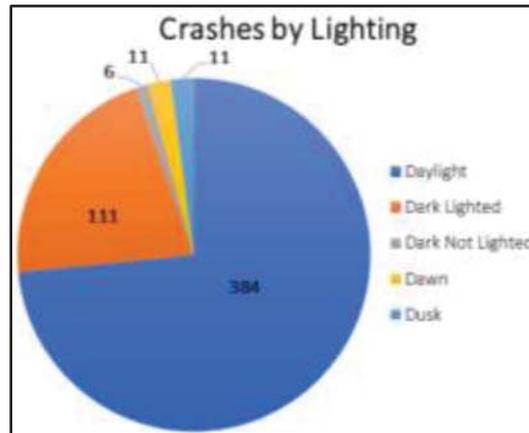


Figure 10: Crashes by Lighting



### 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**.

# **APPENDIX A**

## **AGENCY SURVEYS AND STANDARDS**

# TEXAS

**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, 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.

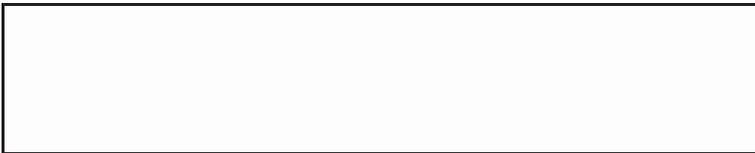
Attached with this email is a survey with a list of 10 questions relevant to the study. I would really appreciate it if you can please take the survey and provide me with the responses.

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  
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# MINNESOTA

**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?
  - 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

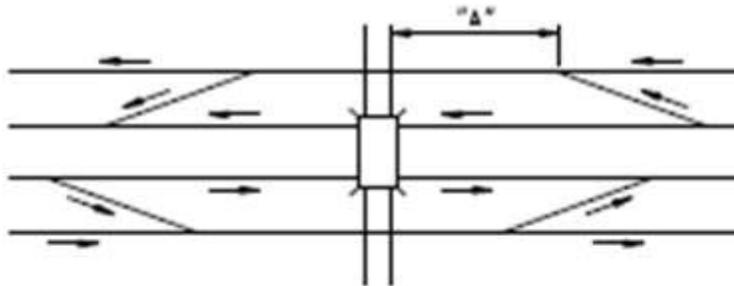
Figure 6-4.02A

#### FRONTAGE ROAD SCHEMATICS

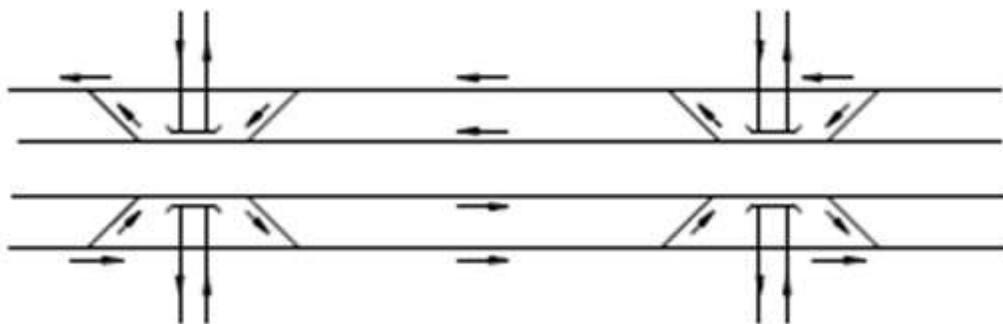
Figure 6-4.02B



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>1</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

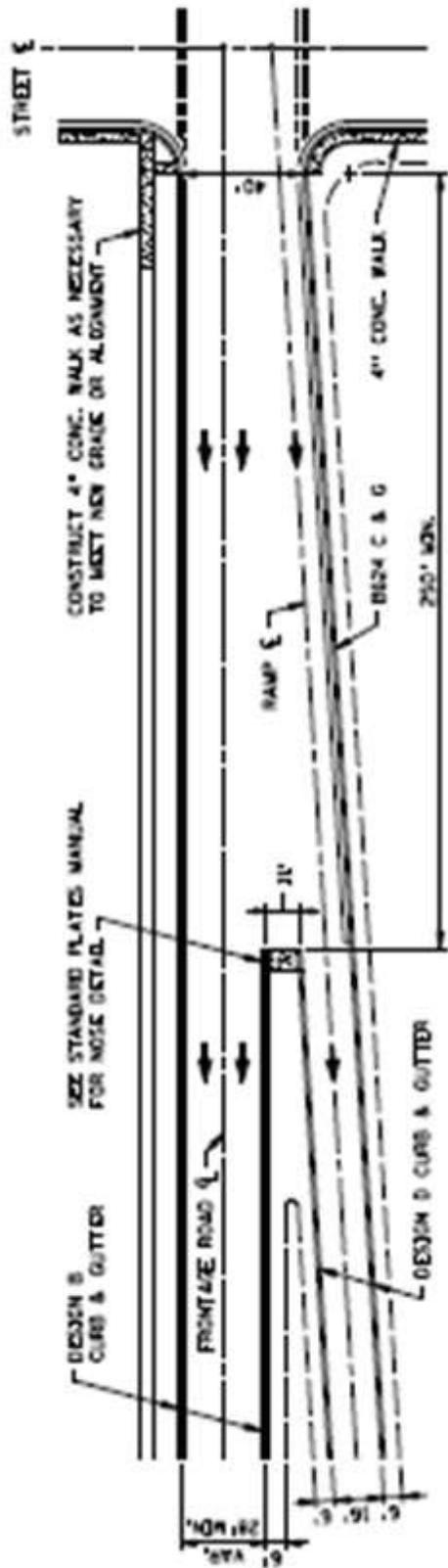
Distance A is shown on Figure 6-4.02B.

- 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.

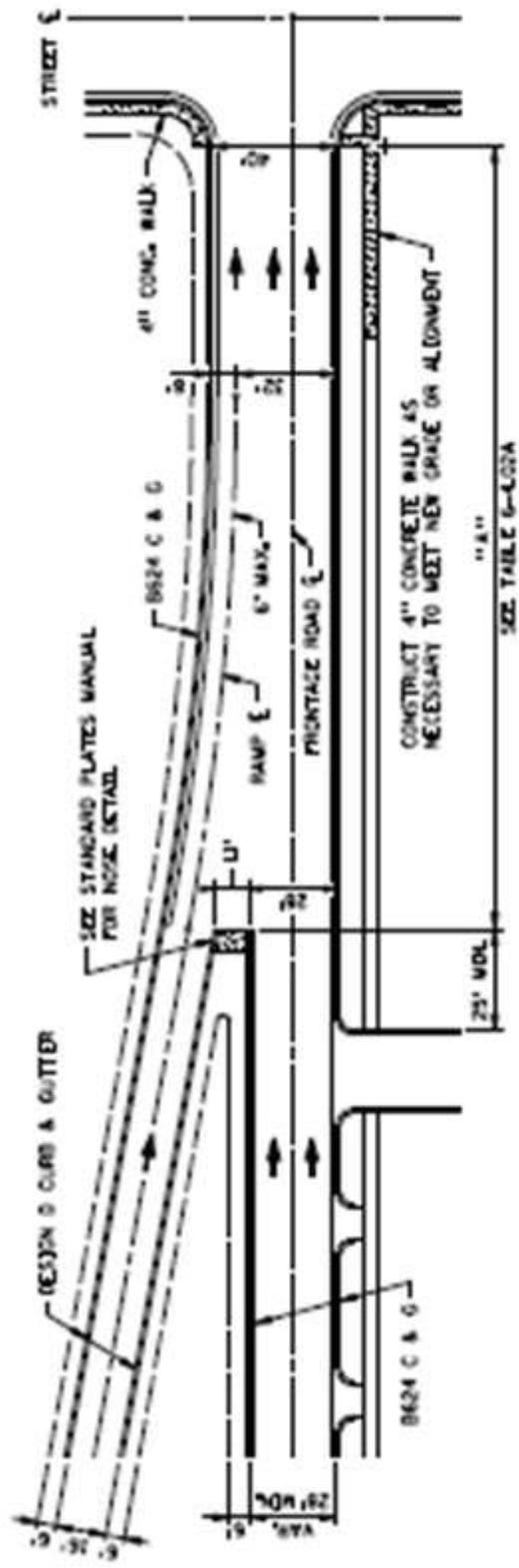
**REFERENCE:**

"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  
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 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

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**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.

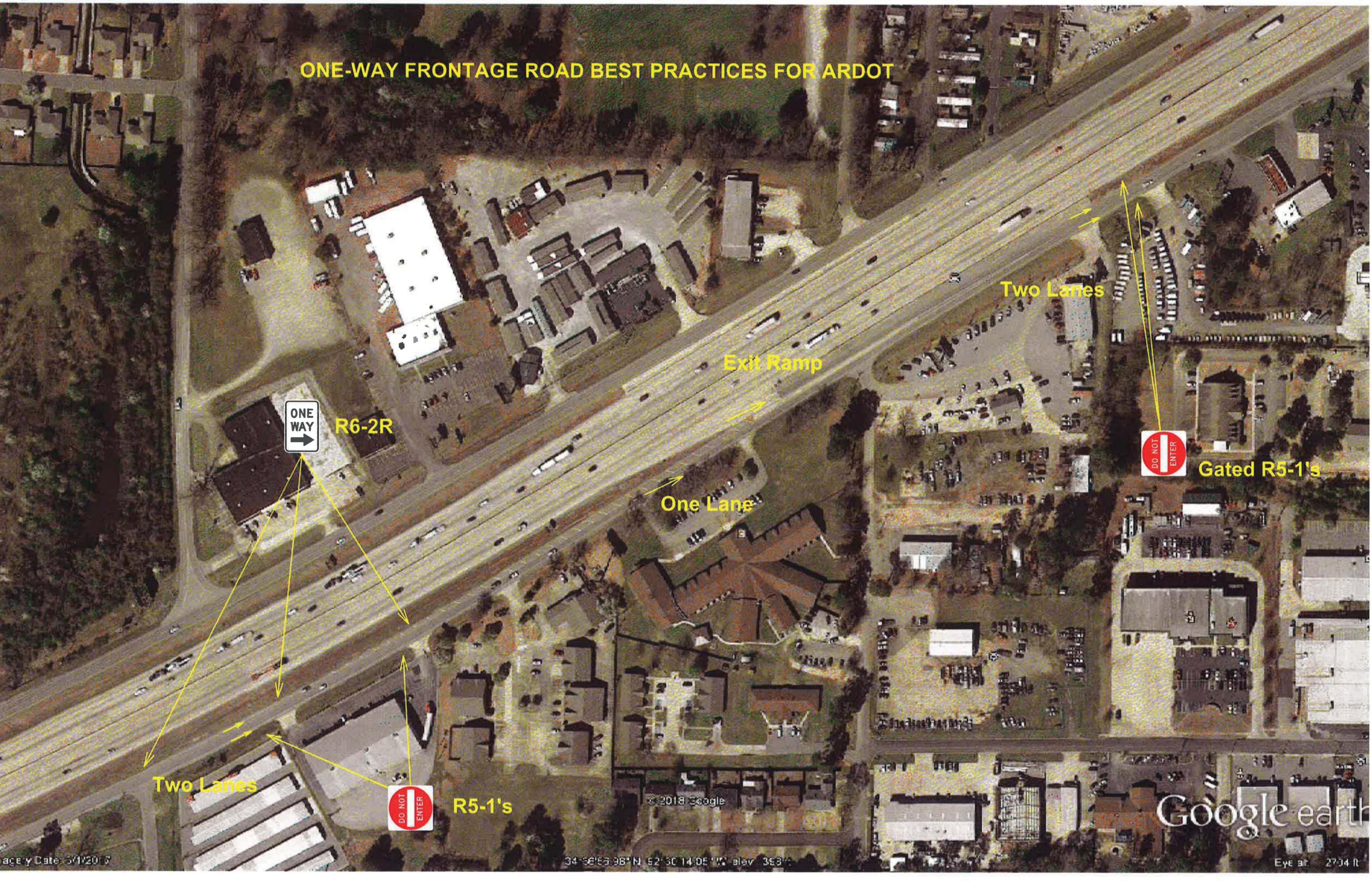
I really appreciate your input on this. Please call or email me if you have any questions.

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.mbakertnl.com](http://www.mbakertnl.com)



ONE-WAY FRONTAGE ROAD BEST PRACTICES FOR ARDOT



R6-2R

Exit Ramp

Two Lanes

One Lane



Gated R5-1's

Two Lanes

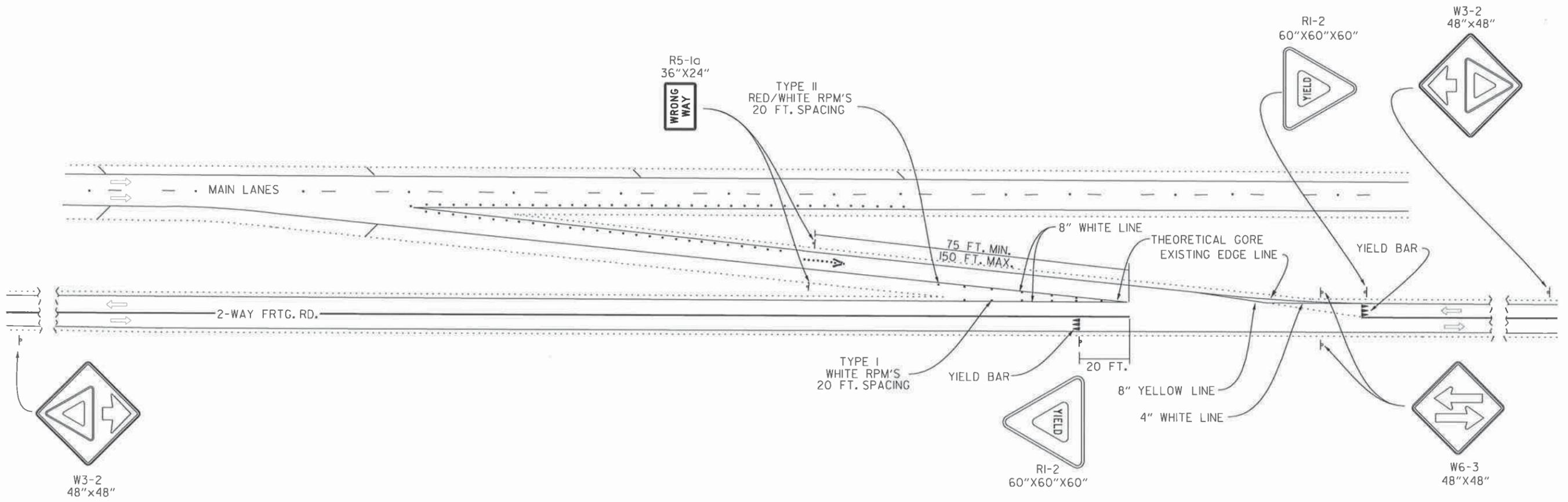


R5-1's

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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

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**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

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**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  
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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**
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

---

**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

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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**

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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,Or">https://earth.google.com/web/@33.46404126,-112.10768362,326.07768116a,396.4104684d,35y,0h,0t,Or</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

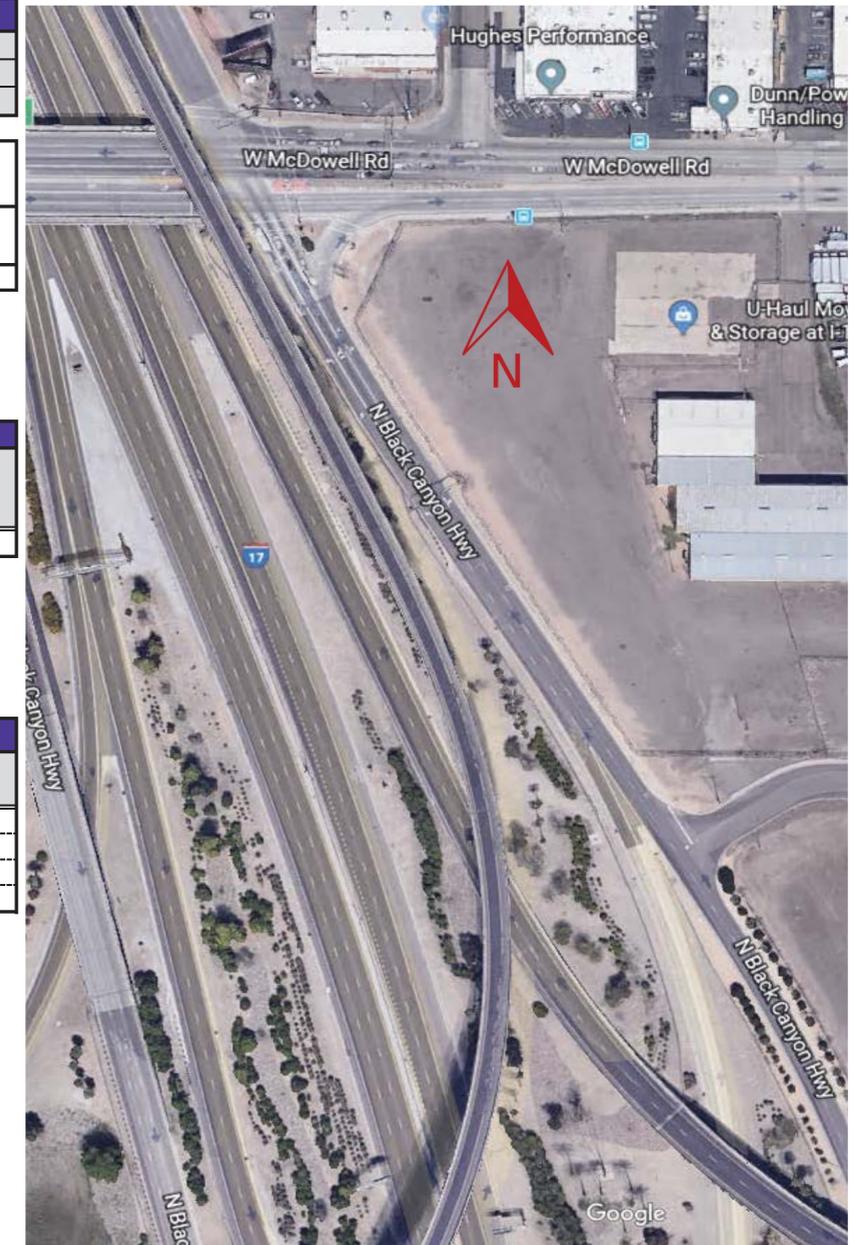
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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

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

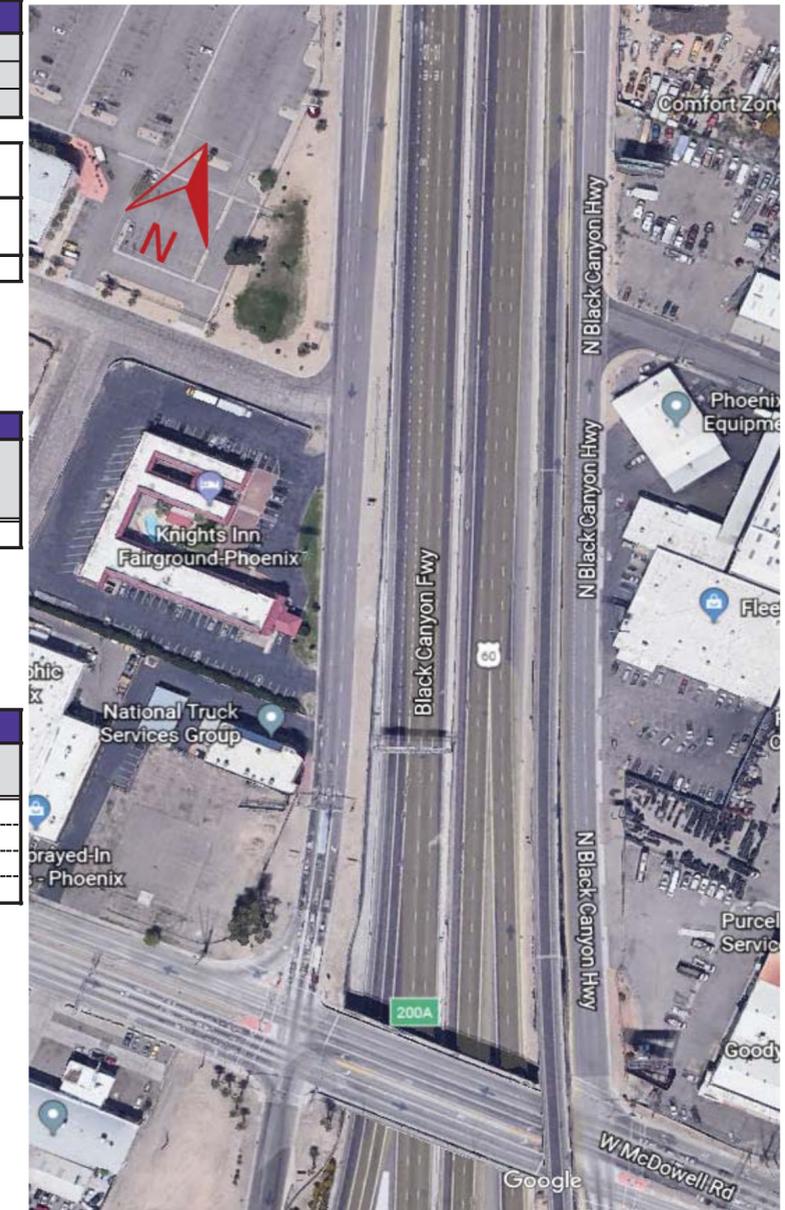
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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**

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EXISTING INVENTORY	
LOCATION: I-17 & Thomas NB	
LINK: <a href="https://earth.google.com/web/@33.47598241,-112.11259092,331.61364754a,422.7614056d,35y,-0h,0t,0r">https://earth.google.com/web/@33.47598241,-112.11259092,331.61364754a,422.7614056d,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?	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:		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 SB**

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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	

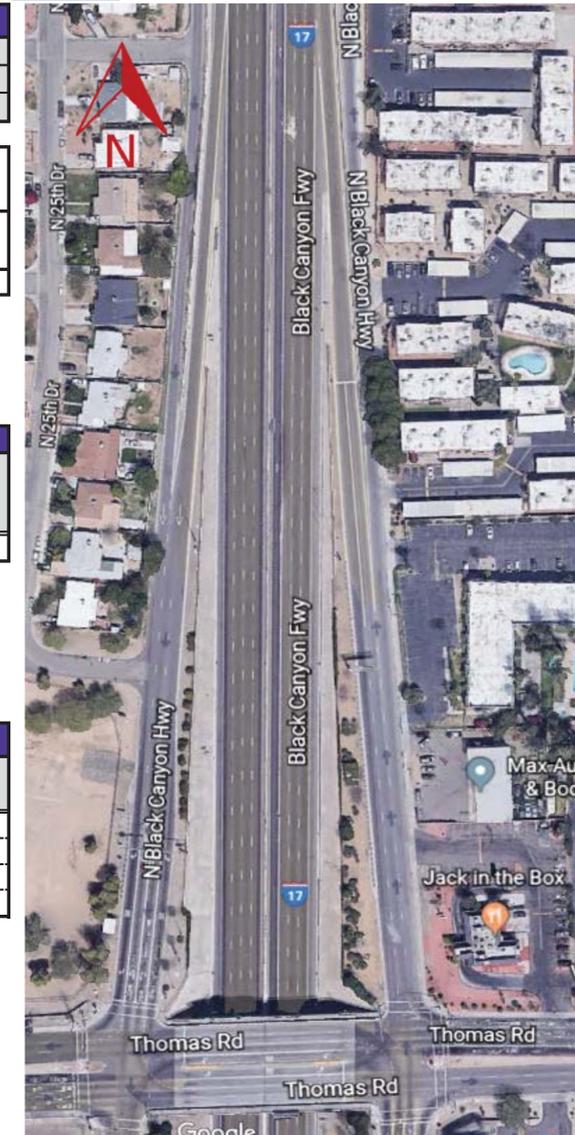
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for 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:		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 & Indian School NB**

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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:		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 & Indian School SB**

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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,Or">https://earth.google.com/web/@33.49713208,-112.11334696,340.39463377a,316.11937038d,35y,0.00000001h,44.3112617t,Or</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

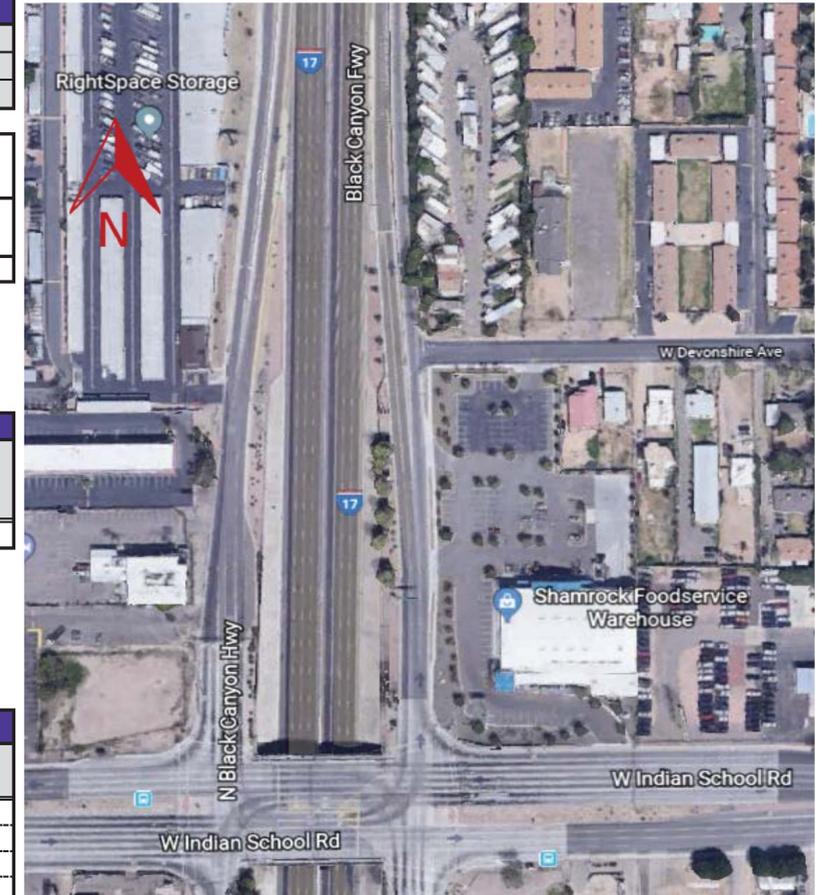
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight 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:		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 & Camelback NB

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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	

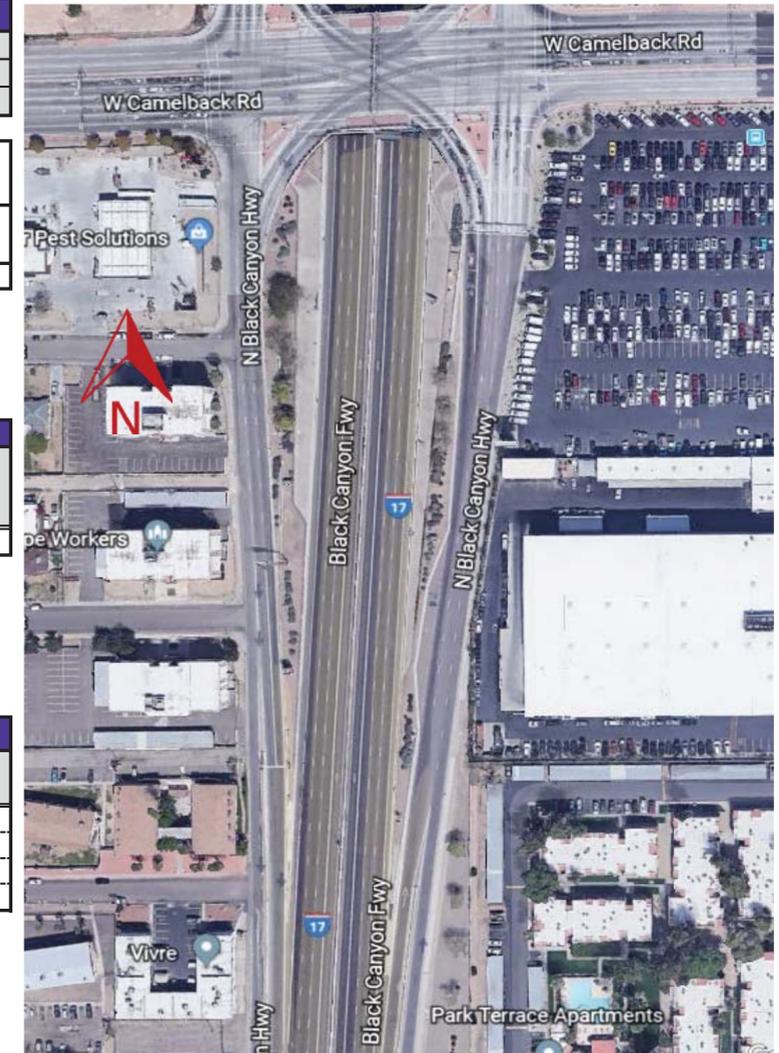
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight 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:		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 & Camelback SB

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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: SPUI	

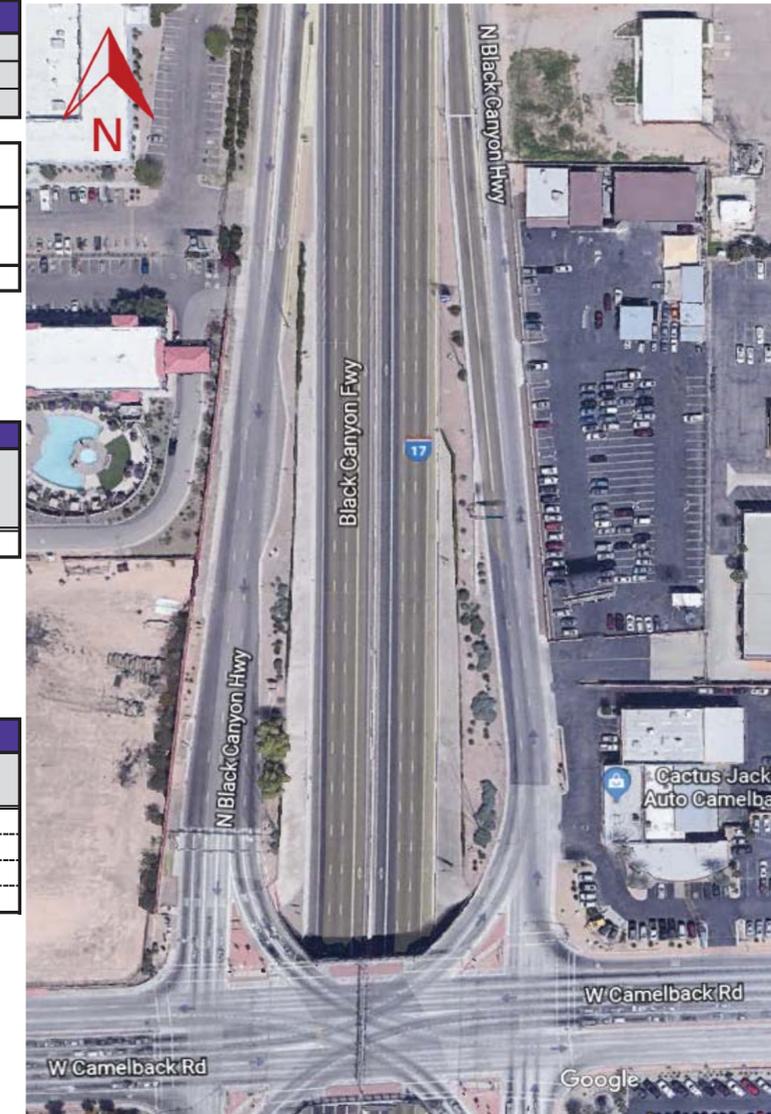
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight 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 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:		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 and Bethany Home NB**

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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,Or">https://earth.google.com/web/@33.52201421,-112.1119078,350.51757512a,236.00303146d,35y,-0h,0t,Or</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 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**

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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:		TOTAL # of Traffic Control Signs:		
1		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**

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**EXISTING INVENTORY**

LOCATION: I-17 & Glendale NB

LINK: <https://earth.google.com/web/@33.53688892,-112.1114781,360.09387324a,302.98200575d,35y,-0h,0t,0r>

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	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**

Sign Code	Side of Road
W4-3	Left
W4-3	Right
TOTAL # of Warning Signs:	2

**Traffic Control Signs**

Sign Code	Side of Road
TOTAL # of Traffic Control Signs:	0

**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:	NO



Location: I-17 & Glendale SB

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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:		TOTAL # of Traffic Control Signs:		
1		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

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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
TOTAL # of Warning Signs:		TOTAL # of Traffic Control Signs:		
1		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

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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: 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	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:		TOTAL # of Traffic Control Signs:		
1		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

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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	

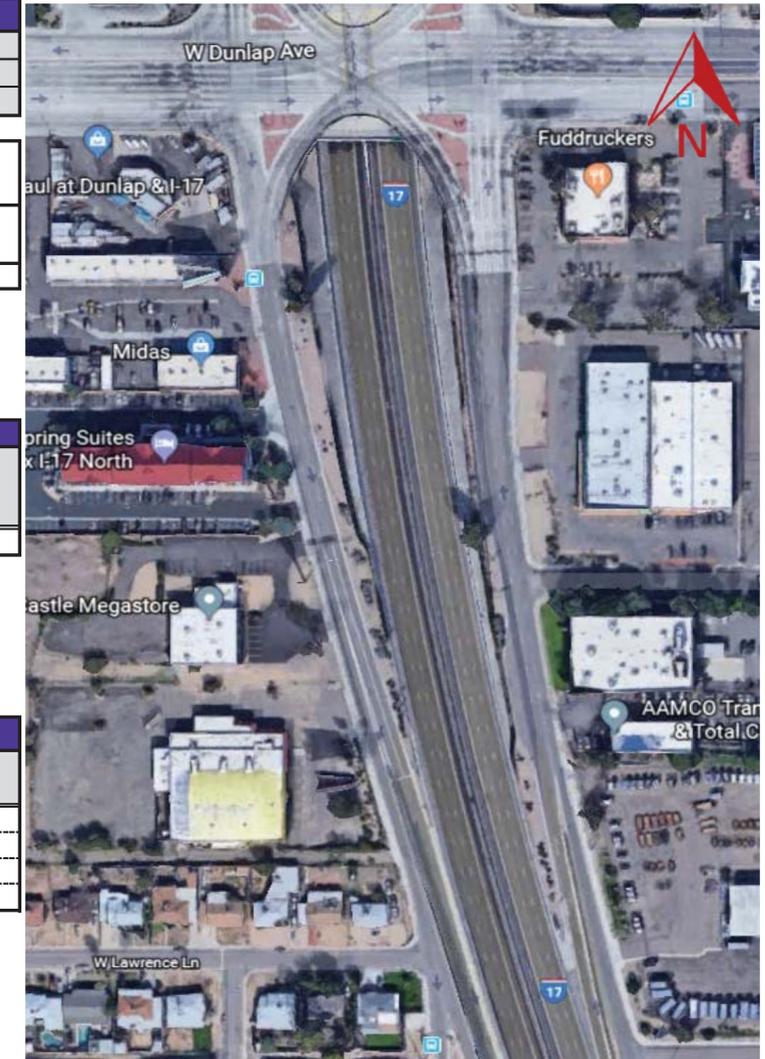
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier w/ Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight 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:		TOTAL # of Traffic Control Signs:		
1		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**

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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	

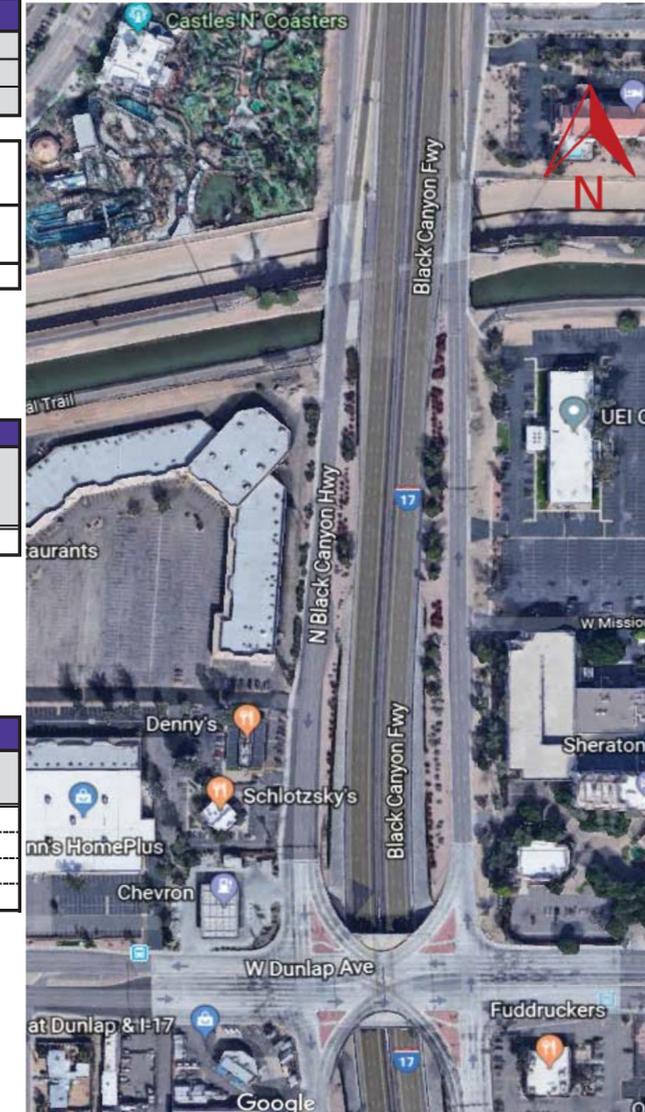
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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:		TOTAL # of Traffic Control Signs:		
1		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

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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	

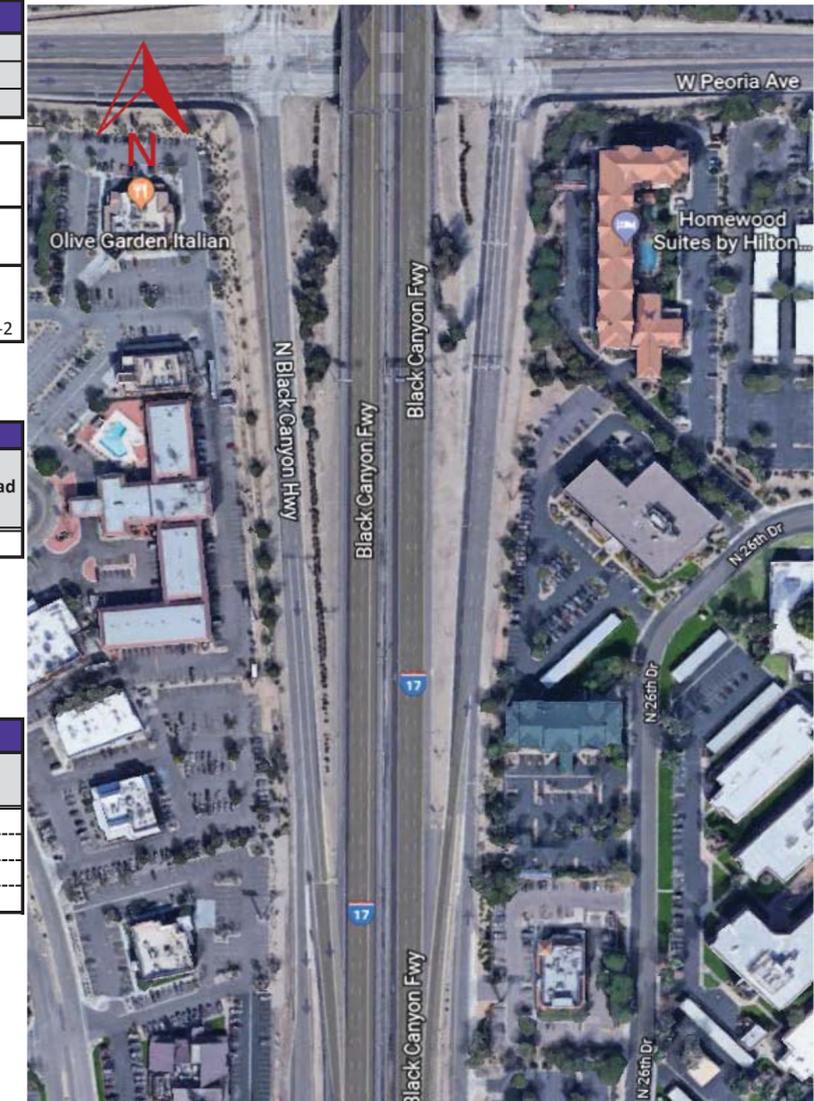
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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

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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:		TOTAL # of Traffic Control Signs:		
1		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

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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	

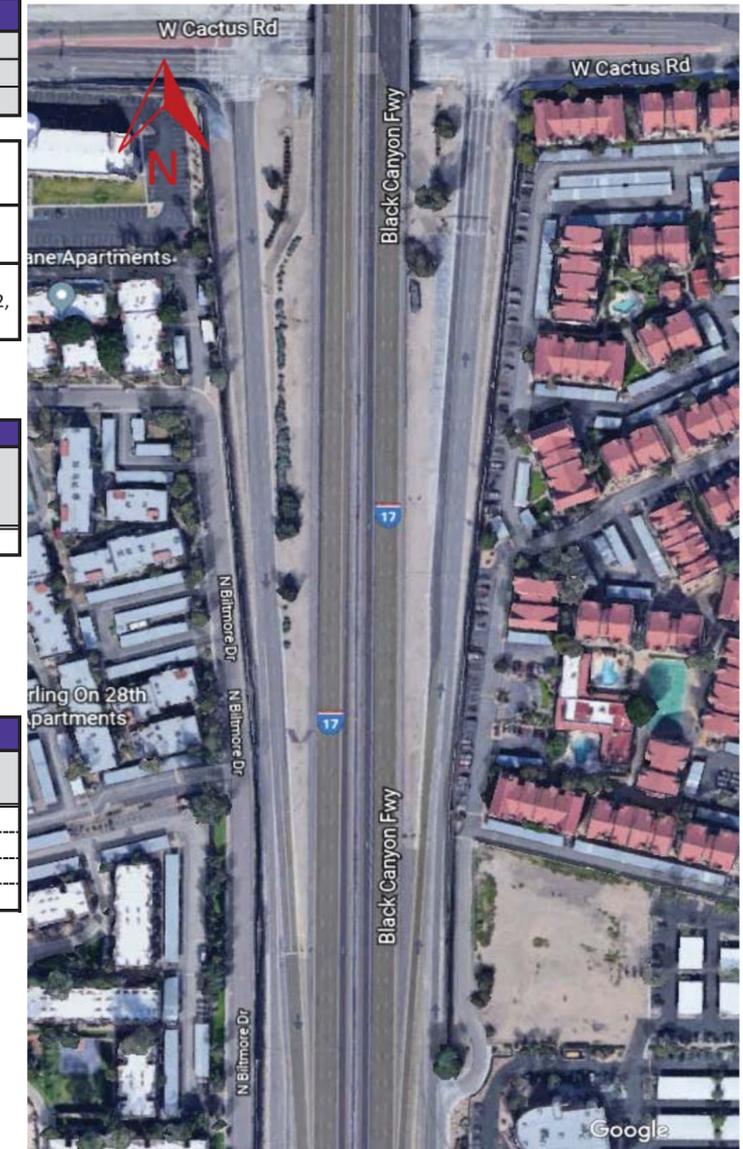
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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:		TOTAL # of Traffic Control Signs:		
1		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

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EXISTING INVENTORY	
LOCATION: I-17 & Cactus SB	
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>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

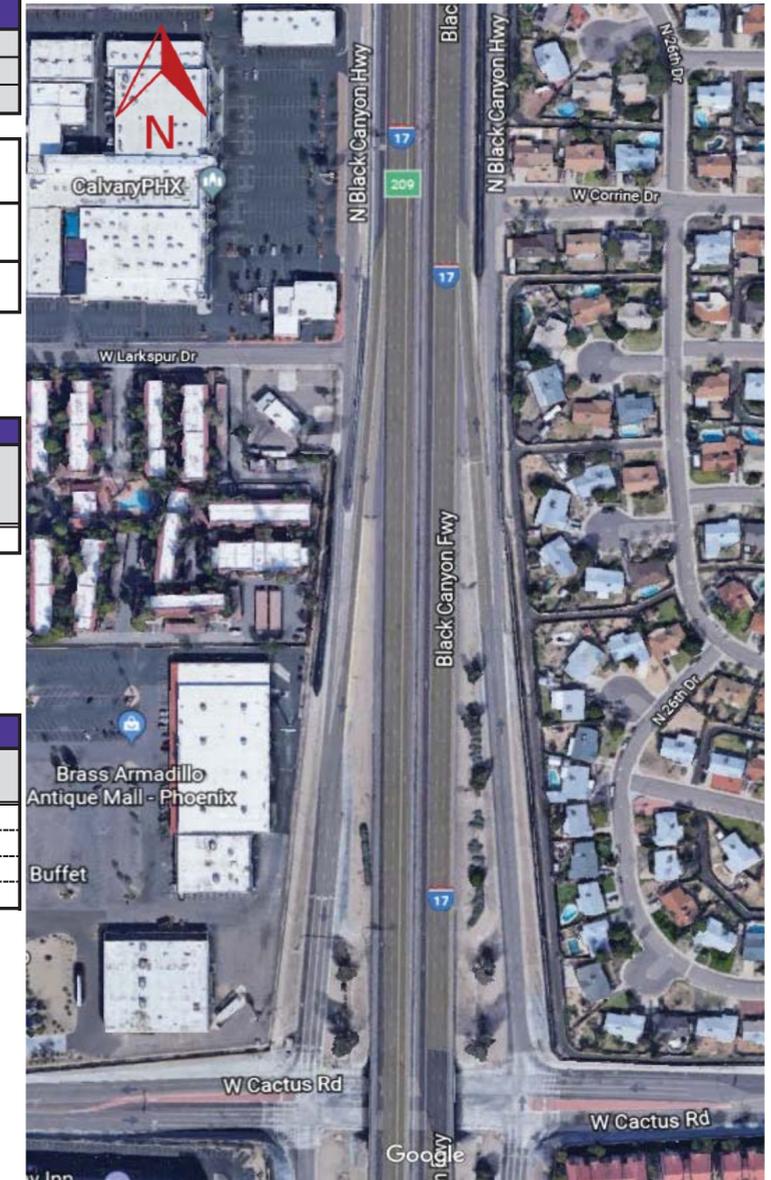
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	800
Downgrade or Upgrade?	Downgrade	Physical Obstruction to Sight Distance?	R1-2 Blocked by
Sidewalk Along Frontage?	NO		Wall
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	-360	400	290	300	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:	4

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
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 & Thunderbird NB**

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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			

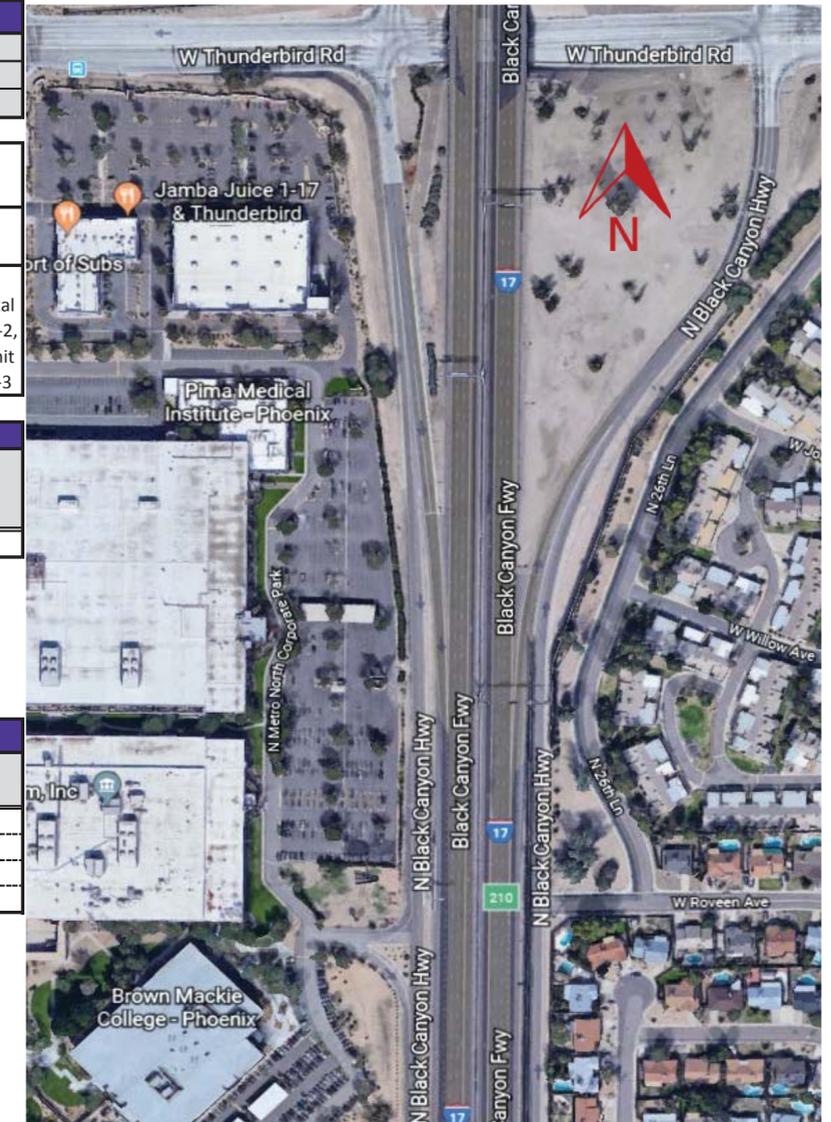
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance 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**

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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	

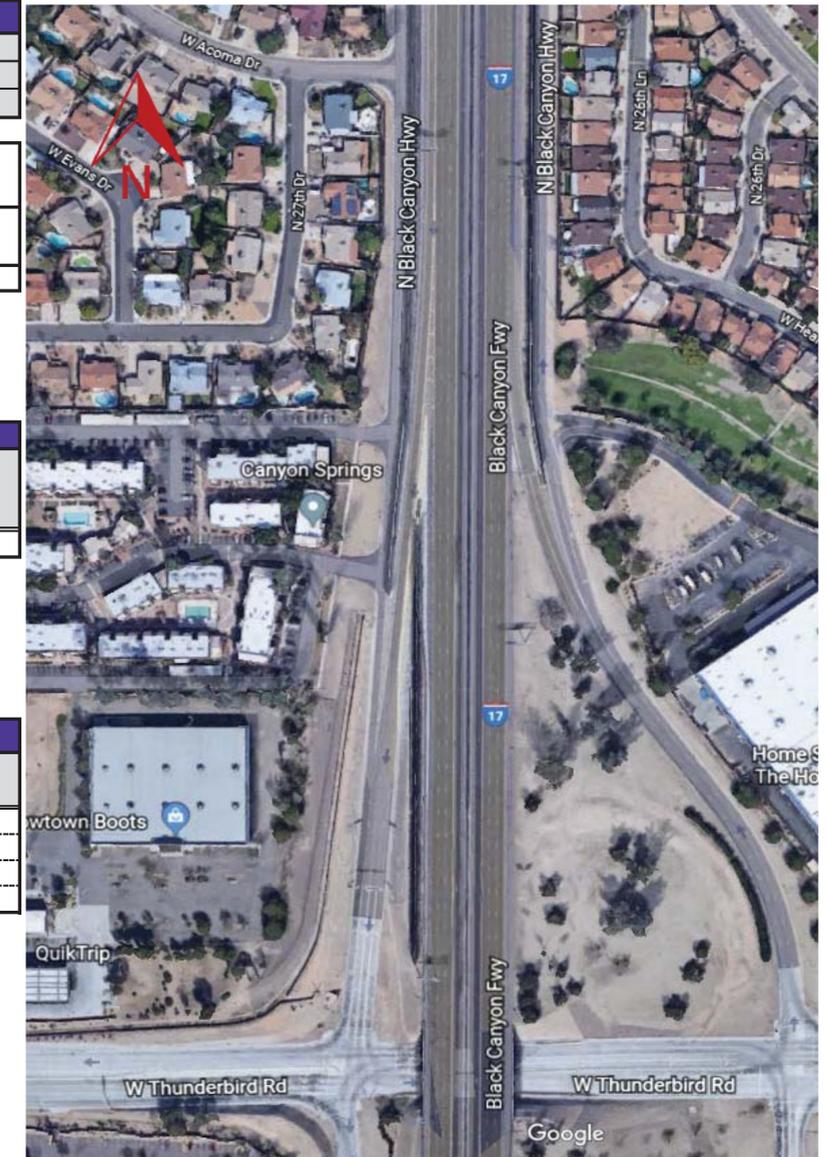
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for 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**

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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

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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	

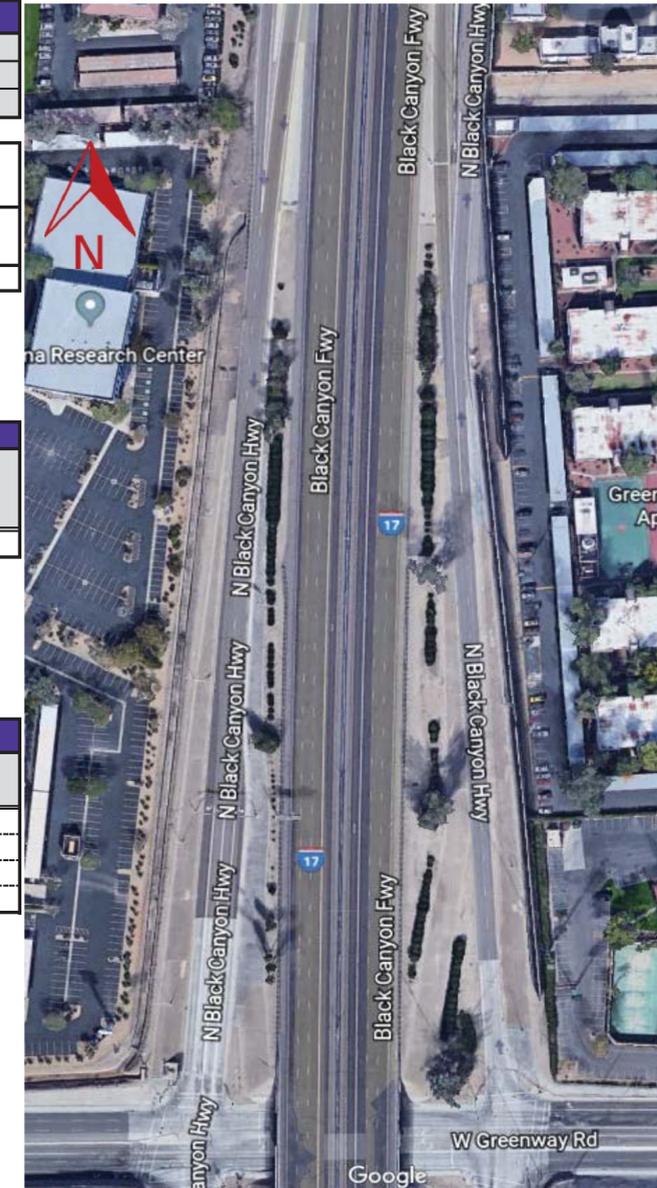
Posted Speed Limit on Frontage Road (mph):	50	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	1030
Divider Between Frontage Road and Exit Ramp:	Guard Rail	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for 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:		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):	NO
Yield Lines:	NO



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

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**EXISTING INVENTORY**

LOCATION: I-17 & Bell NB

LINK: <https://earth.google.com/web/@33.63787911,-112.11499413,404.41920202a,253.54228575d,35y,-0h,0t,0r>

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**

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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:		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):	NO
Yield Lines:	NO



Location: I-17 & Union Hills NB

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EXISTING INVENTORY

LOCATION: I-17 & Union Hills NB

LINK: <https://earth.google.com/web/@33.65316201,-112.11403016,413.59792272a,214.92817345d,35y,0.00000085h,0t,0r>

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

Sign Code	Side of Road
W3-2	Right
TOTAL # of Warning Signs: 1	

Traffic Control Signs

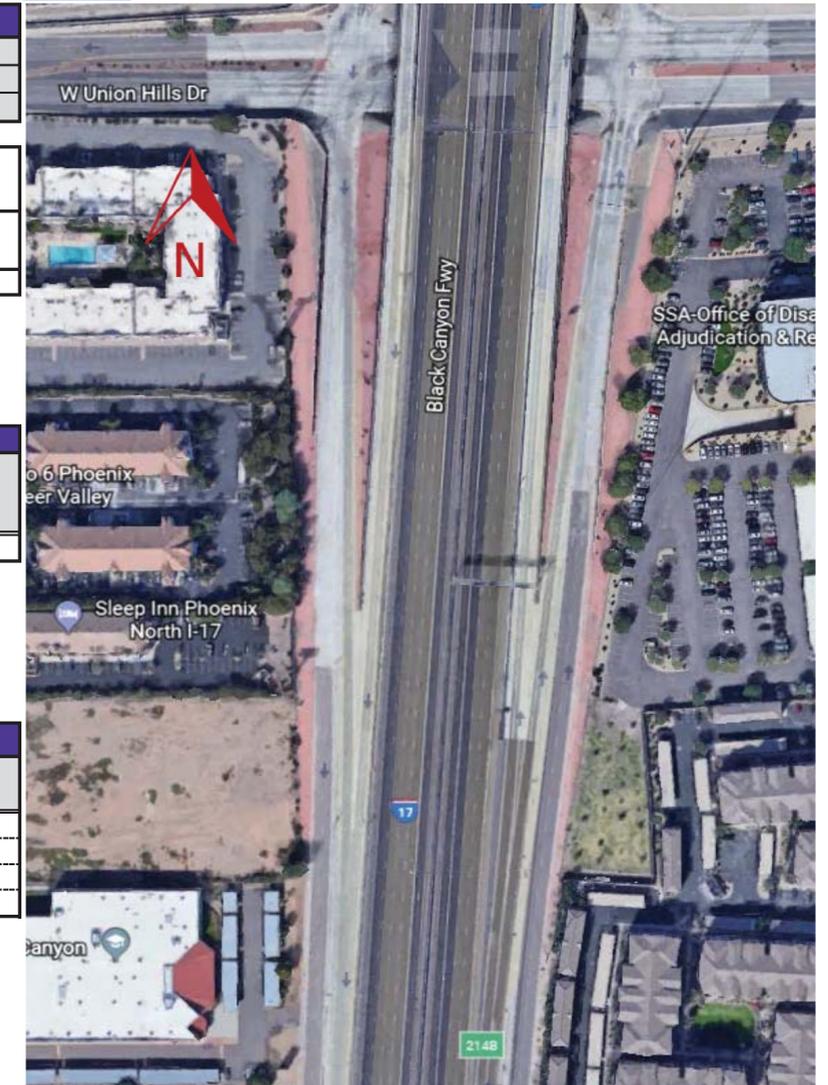
Sign Code	Side of Road
R1-2, R1-2rP	Right
TOTAL # of Traffic Control Signs: 1	

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:	NO



Location: I-17 & Utopia NB

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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			

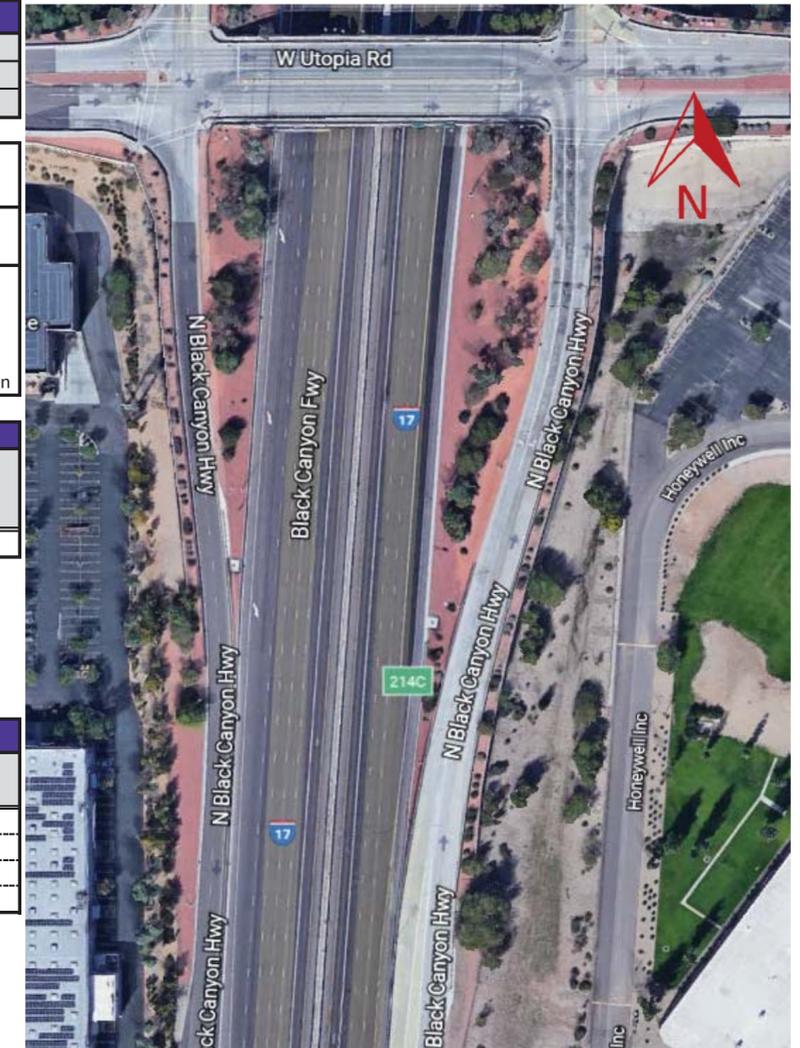
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance 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:		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):	NO
Yield Lines:	NO



Location: I-17 & Deer Valley NB

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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:		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):	NO
Yield Lines:	YES



Location: I-17 & Deer Valley SB

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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:		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):	NO
Yield Lines:	YES



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

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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,Or">https://earth.google.com/web/@33.69859819,-112.11336096,428.01022702a,167.4927943d,35y,0.07595487h,0t,Or</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

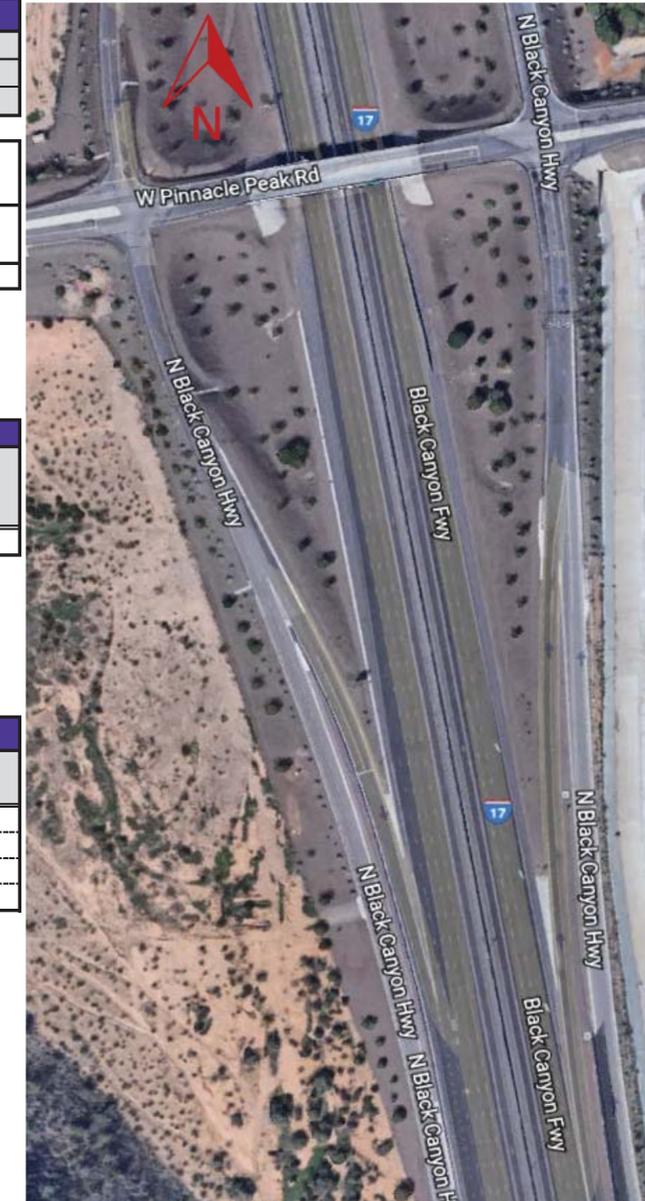
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Median	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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**

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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:		TOTAL # of Traffic Control Signs:		
1		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**

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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:		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 & Jomax NB

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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	

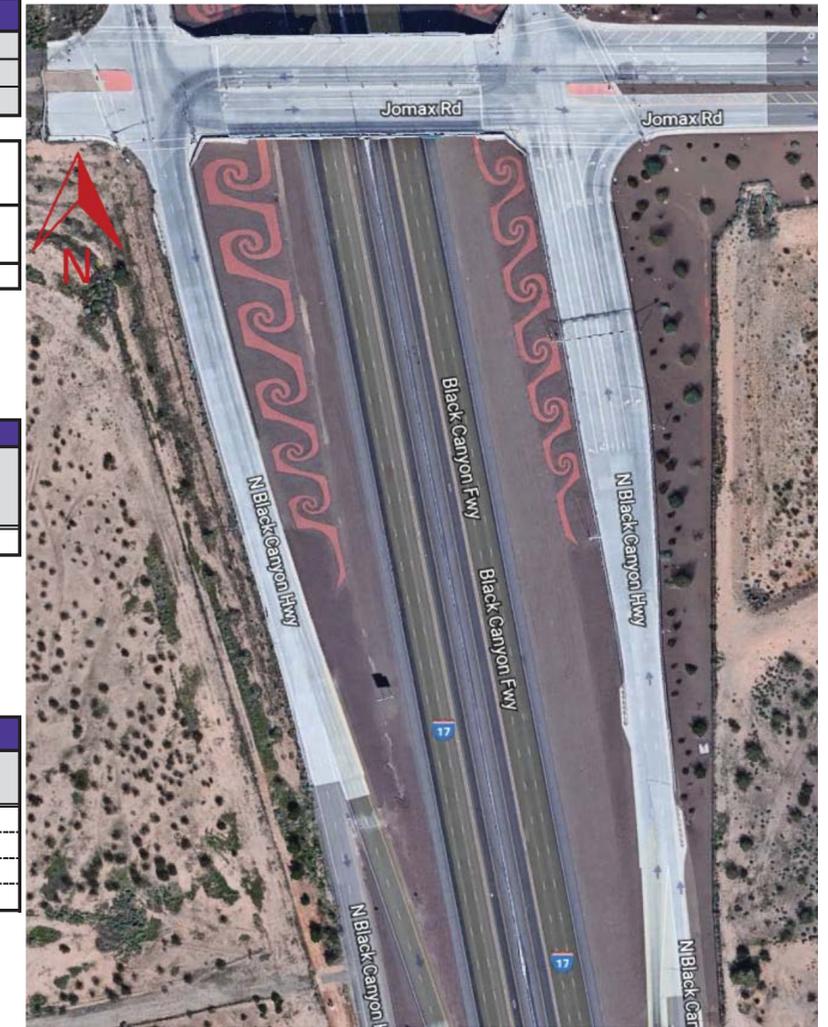
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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
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**

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

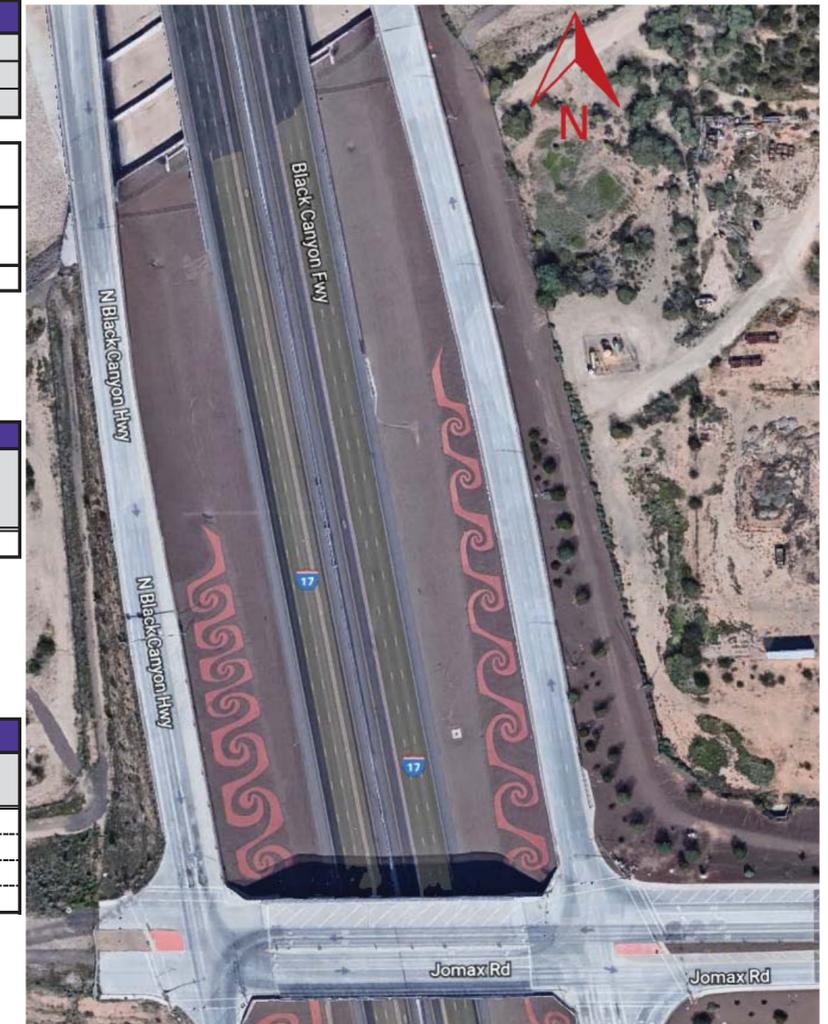
Posted Speed Limit on Frontage Road (mph):	45	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	930
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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:		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):	NO
Yield Lines:	NO



Location: I-17 & Dixileta NB

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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	

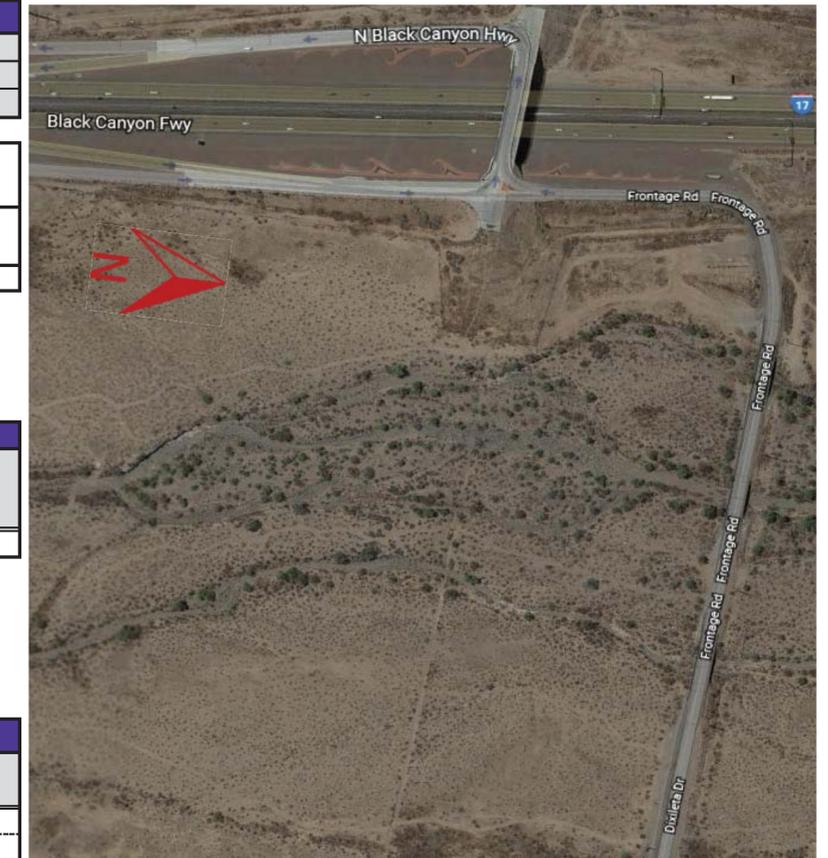
Posted Speed Limit on Frontage Road (mph):	35	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	720
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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:		TOTAL # of Traffic Control Signs:		
1		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**

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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,-Or">https://earth.google.com/web/@33.44877308,-112.10762278,322.95706971a,74.89985514d,60y,0h,1.45583719t,-Or</a>	
ARTERIAL/FREEWAY INTERCHANGE TYPE: Diamond	

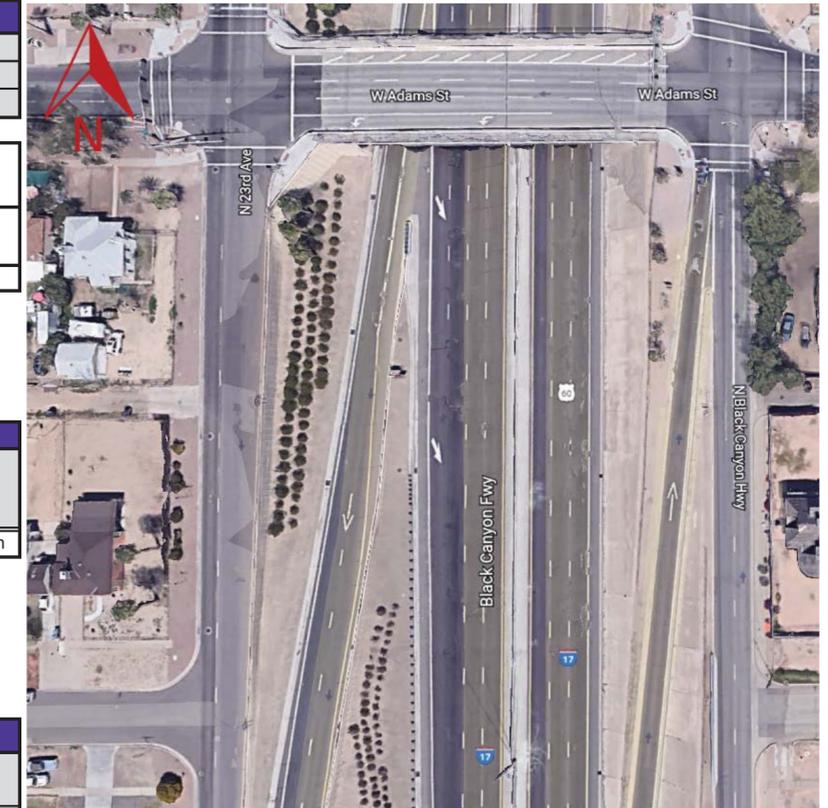
Posted Speed Limit on Frontage Road (mph):	35	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	720
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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:		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 & Jefferson SB

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

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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	

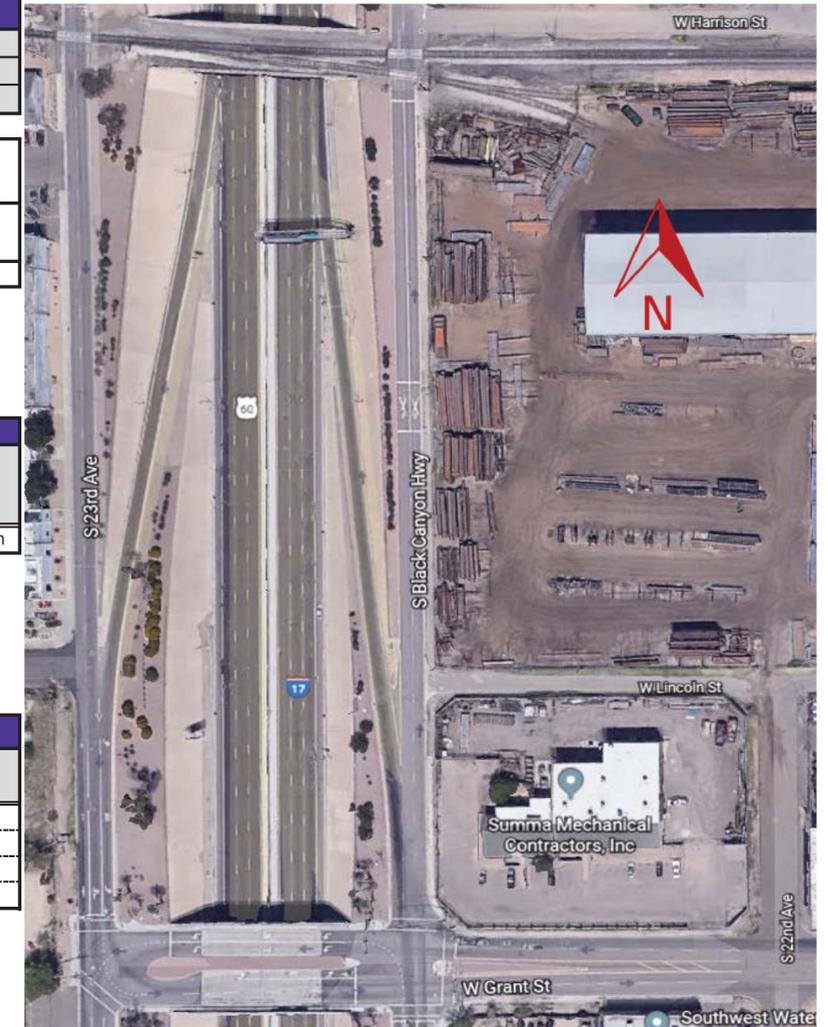
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Fence	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban 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

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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**

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**EXISTING INVENTORY**

LOCATION: I-17 & Buckeye NB

LINK: <https://earth.google.com/web/@33.43374134,-112.10743293,322.08694279a,155.50619748d,35y,-0h,0t,0r>

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

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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			
TOTAL # of Warning Signs:	3	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 & 19th WB

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

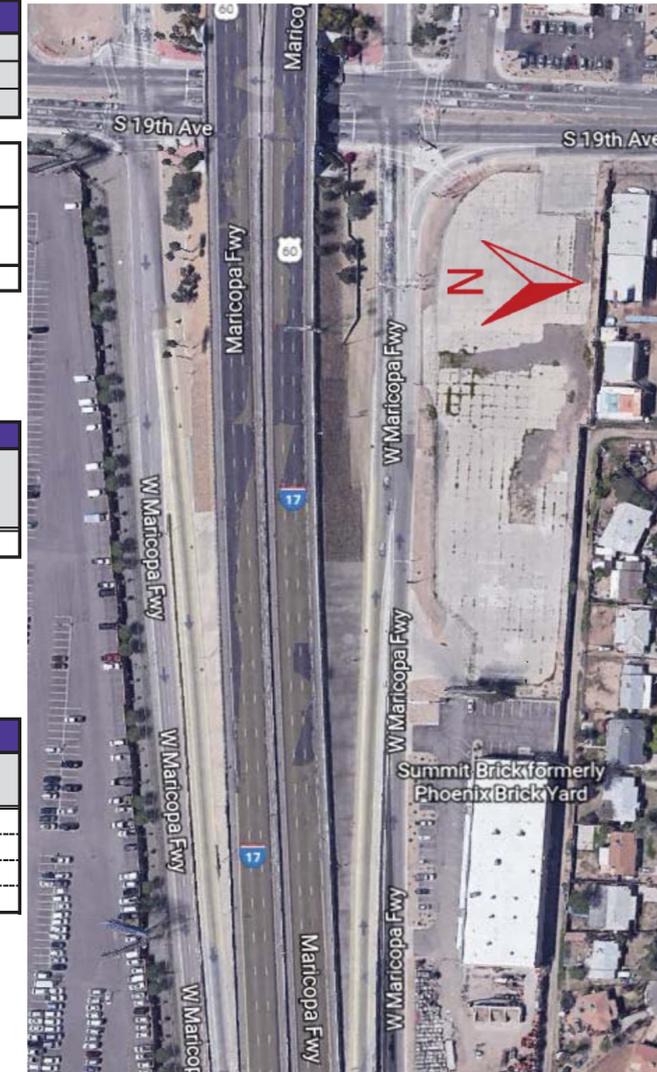
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Sound Wall	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance for Urban Roads (ft):	690
Downgrade or Upgrade?	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

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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:		TOTAL # of Traffic Control Signs:		
1		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

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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,Or">https://earth.google.com/web/@33.42963058,-112.08126495,323.79523801a,180.11912762d,35y,357.69621997h,0t,Or</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**

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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	

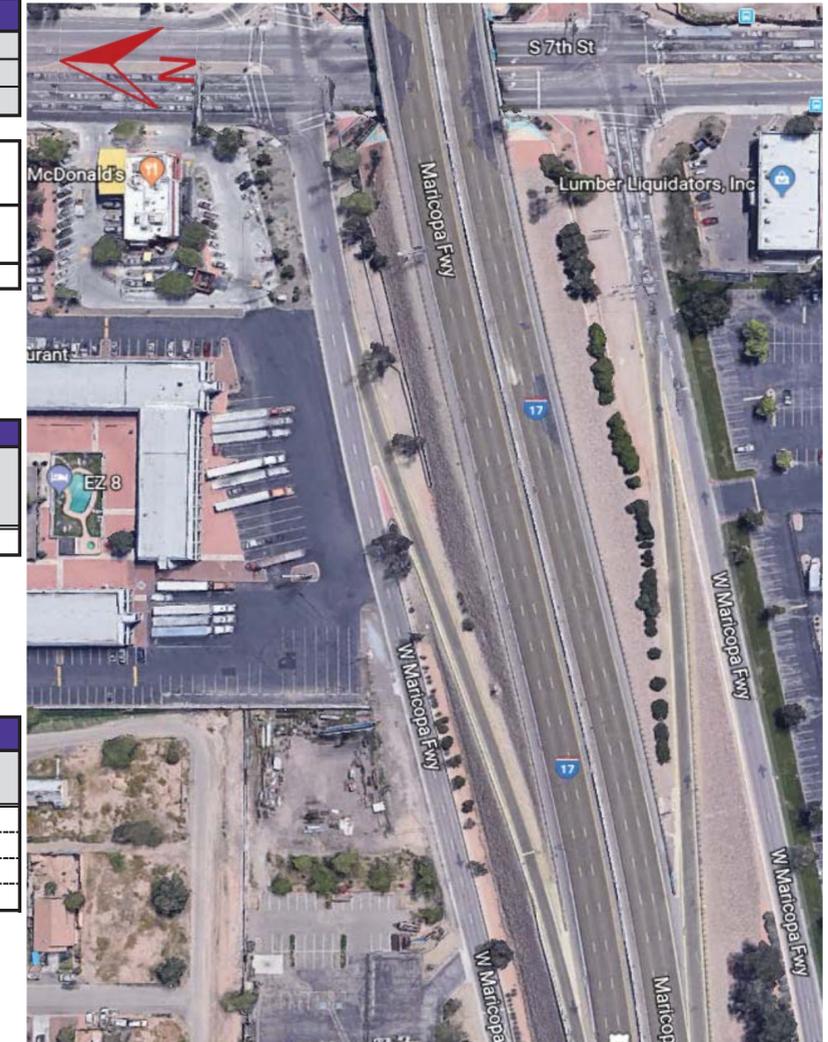
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance 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**

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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

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

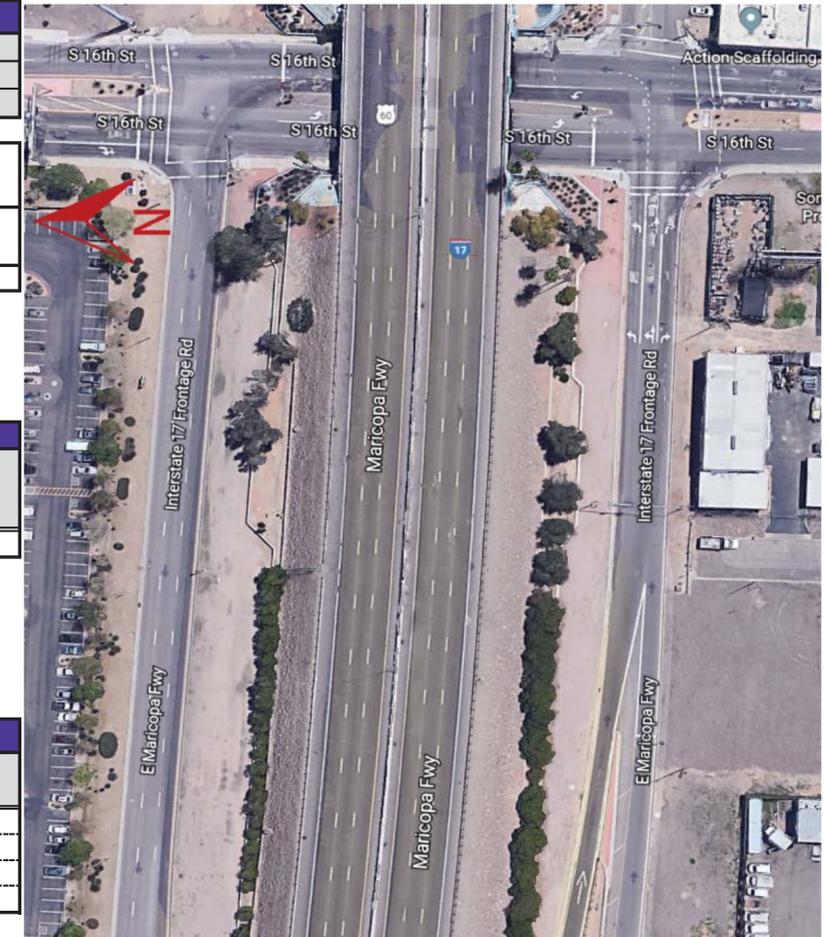
Posted Speed Limit on Frontage Road (mph):	40	AASHTO Avoidance Maneuver E (Speed/Path/Direction Change on Urban Road) Decision Sight Distance for Urban Roads (ft) :	825
Divider Between Frontage Road and Exit Ramp:	Concrete Barrier	AASHTO Avoidance Maneuver B (Stop on Urban Road) Decision Sight Distance 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**