



Arizona Department of Transportation- Multimodal Planning Division

Central District Freeway Frontage Road Traffic Control Study

ADOT MPD Task Assignment MPD0024-18

DRAFT

Working Paper #1

Nationwide Survey of Best Practices

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Prepared for:

Arizona Department of Transportation

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Introduction

Purpose of the Study

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. A formalized study is warranted to establish some guidance for current conditions and future needs.

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. By establishing a set of 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, ADOT will have a more consistent application which will not be as dependent on staff changes as is currently the case. The study shall include specific/detailed recommendations for spot implementation projects as to the type of control, traffic signing recommendations (type of sign, location, size etc.), and pavement marking recommendations.

Purpose of Working Paper #1

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 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.

Working Paper #1 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.

States Identified for this Best Practices Survey

Based on consultant research and input from the TAC to identify states have the existence 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

Based on the input received from TAC to assist in identifying the most beneficial information to obtain best practices information, ten questions were developed and electronically distributed to the states listed above. These questions 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 to 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 Working Paper #1** section, the adopted regulations, policies and/or best practices for frontage road traffic control in various states was been researched and obtained from various states through a survey of questionnaire. The following sections document the standards and/or best practices of various 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 1 and **Figure 2** depict examples of traffic control along frontage roads in the State of Arkansas.



Figure 1: Example of One-Way Frontage Road Best Practices for ARDOT

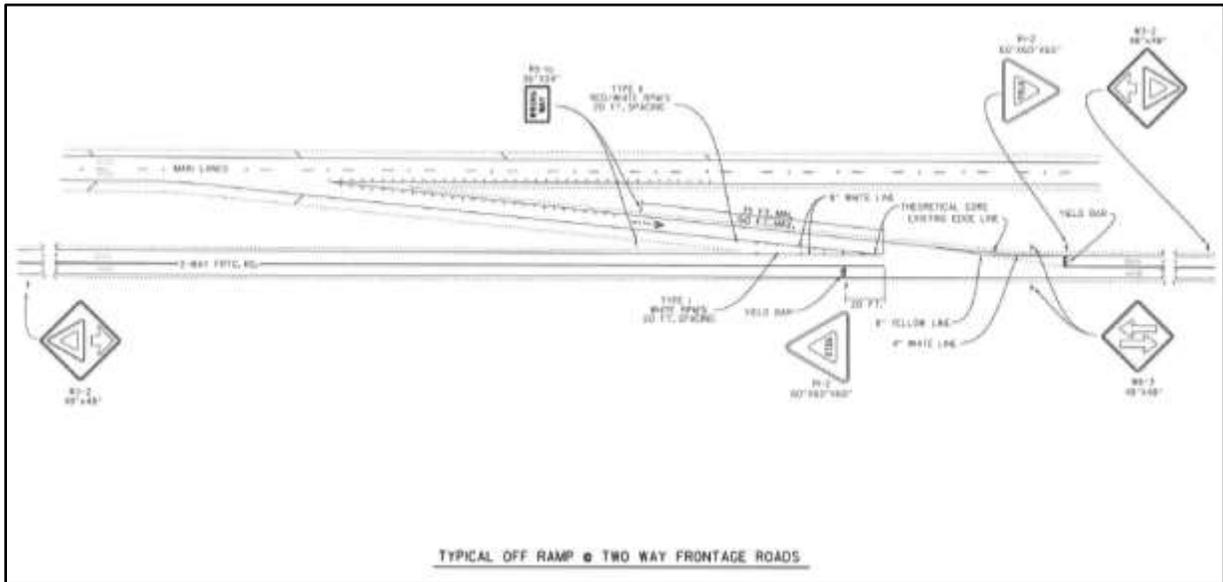


Figure 2: Yield Signs along Frontage Road in Arkansas 712015

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 adapted 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**.

APPENDIX A

SURVEY RESULTS AND STANDARDS/BEST PRACTICES

Michael Baker

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TEXAS

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**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 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.

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

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

Sign Crew Field Book: http://onlinemanuals.txdot.gov/txdotmanuals/sfb/interchange_applications.htm

Freeway Signing Handbook: 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

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Cell: (512) 221-8993

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.

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MINNESOTA

Michael Baker

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Phoenix, Arizona

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

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

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

Barrientes, Vivianna

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

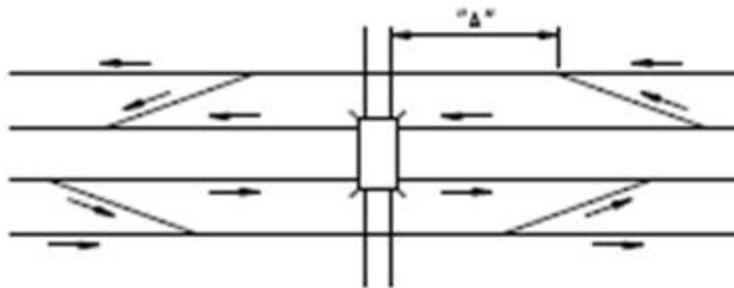
Figure 6-4.02A

FRONTAGE ROAD SCHEMATICS

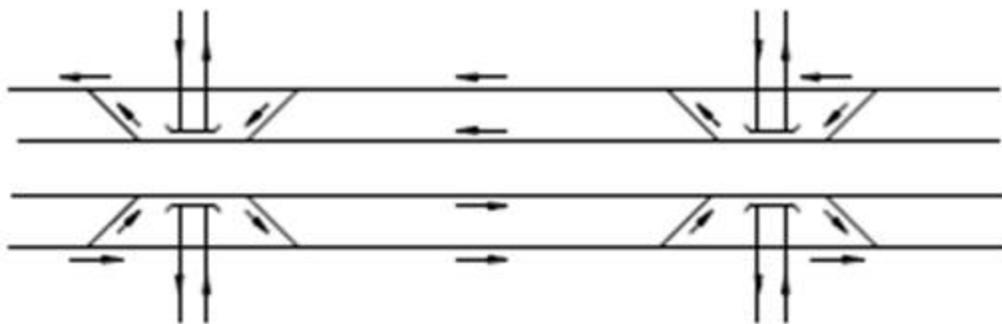
Figure 6-4.02B



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) ¹	Exit Ramp Volume (VPH) ²	"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

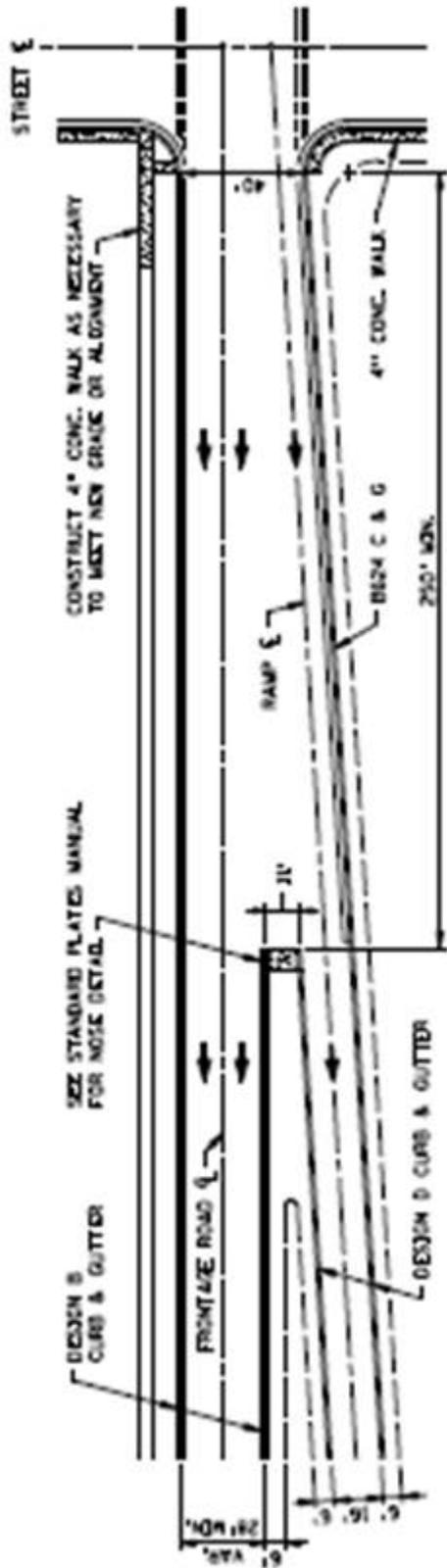
Distance A is shown on Figure 6-4.02B.

- 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.

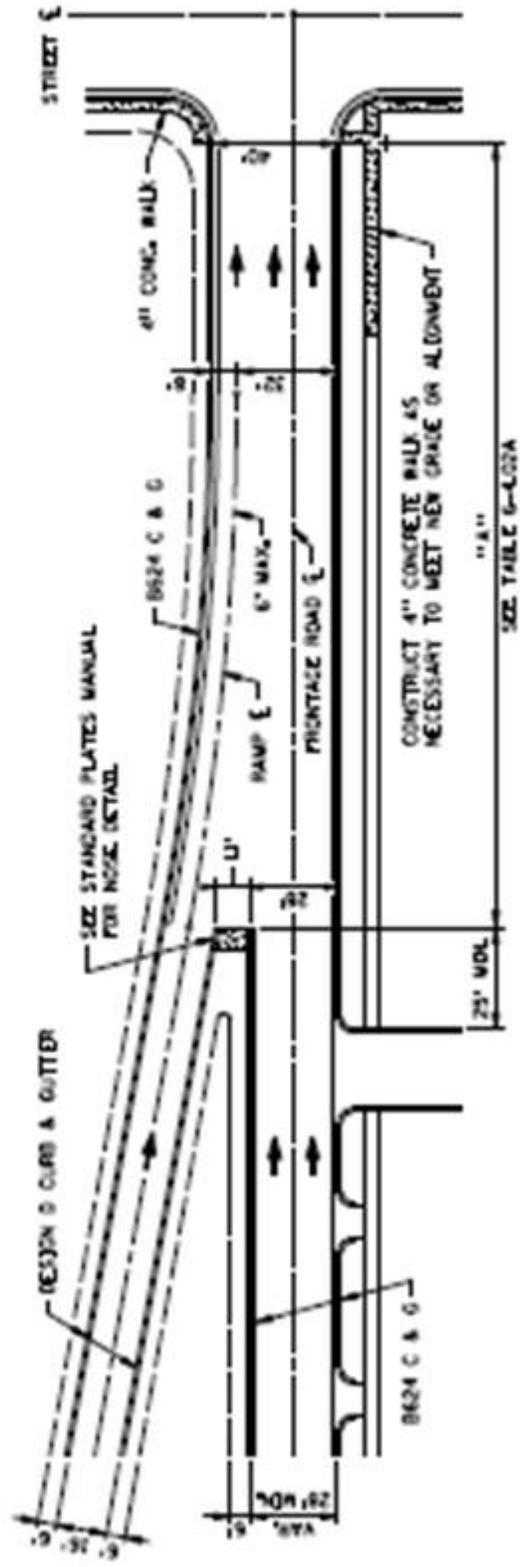
REFERENCE:

"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

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**Michael Baker
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Phoenix, Arizona

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

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

Barrientes, Vivianna

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

Good Morning,

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

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

Hope this helps a little.

Have a great day,

David Weston

Sign Designer

ARDOT – Maintenance Division

501-569-2565

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

Hello David,

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

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

Thanks.

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

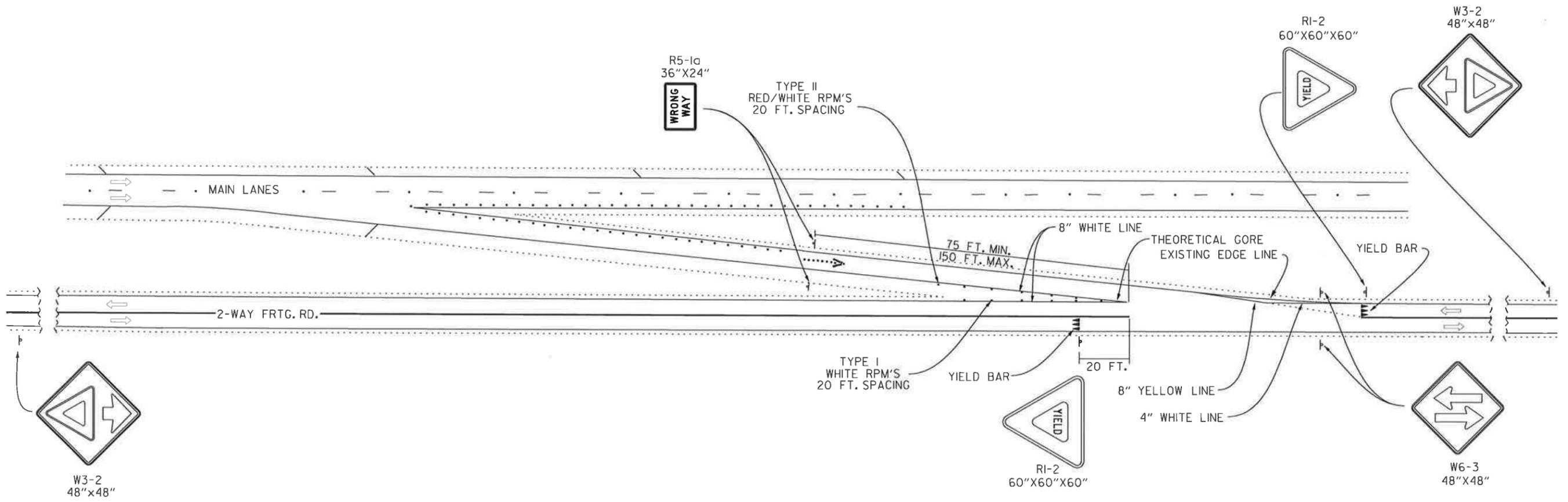


R5-1's

© 2018 Google

Google earth

TOP



TYPICAL OFF RAMP @ TWO WAY FRONTAGE ROADS

OKLAHOMA

Michael Baker

INTERNATIONAL

**Michael Baker
International, Inc.**

Phoenix, Arizona

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

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

Barrientes, Vivianna

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

Smitha,

It was nice talking to you on the phone. Here is the link to our traffic control standards:
http://www.okladot.state.ok.us/traffic/traffic2009/trf_std_2009-control.php

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

Thanks,

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

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

Hello Herbert,

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

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

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

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

Jason Bottjen

Planning Program Manager
ADOT Multimodal Planning Division
206 S. 17th 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
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International, Inc.**

Phoenix, Arizona

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

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

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

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

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

Kundur, Smitha

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}

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.

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.

From: Ann Guarino2 (DOTD)
Sent: Friday, June 29, 2018 9:20 AM
To: Joshua Harrouch <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



From: Kunder, Smitha [<mailto:Smitha.Kunder@mbakerintl.com>]
Sent: Monday, June 25, 2018 10:15 AM
To: Ann Guarino2 (DOTD) <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.

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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**
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

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**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

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.