FDOT DDI Design Webinar Series
DDI Overview

June 15, 2021

FDOT DDI Design Webinar Series

- **Florida Department of Transportation (FDOT) will be hosting a webinar series focused on design and analysis of Diverging Diamond Interchanges (DDI). This series will present guidance on the major elements of DDI project development, including Geometric Design, Signing and Pavement Markings, Traffic Operations, Signalization, Plan Detailing, and Public Involvement.**
- **FDOT Developmental Design Criteria, D217 Diverging Diamond Interchanges, will be covered as well as national design guidance and industry best practices.**
- **Intended Audience: The intended audience for this training includes transportation professionals involved in the planning, design, and review of Diverging Diamond Interchanges.**
- **Schedule:**

DDI Overview	June 15, 2021	2p-5p
DDI Geometric Design	June 29, 2021	2p-3p
DDI Signing and Pavement Marking	July 16, 2021	2p-3p
DDI Traffic Operations	August 10, 2021	2p-3p
DDI Multimodal Accommodations	August 24, 2021	2p-3p
DDI Plans Detailing & Public Involvement	September 7, 2021	2p-3p

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DDI Overview – Webinar Instructors

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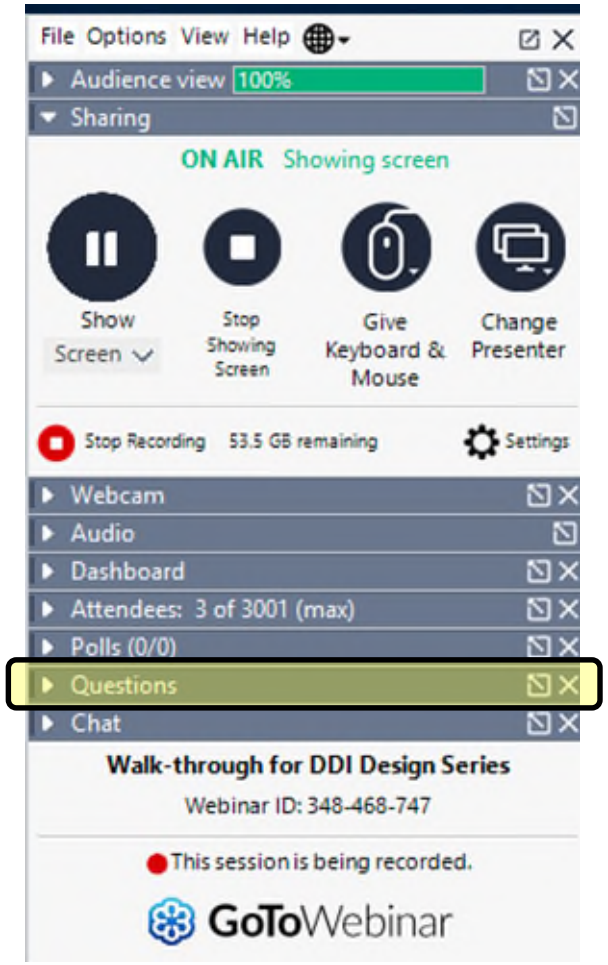
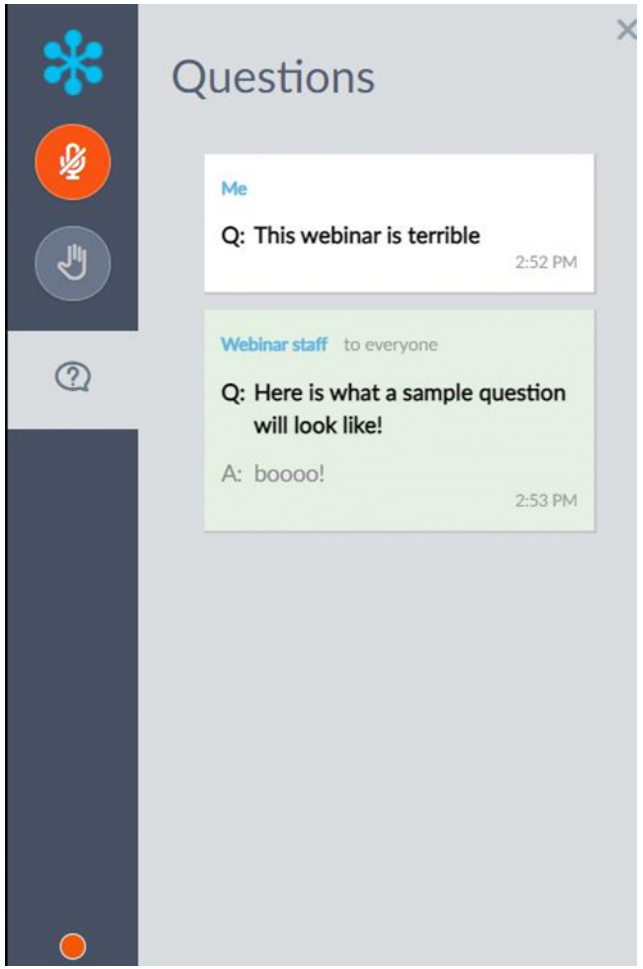
DDI Overview – Webinar Logistics

- You are MUTED upon entry
- Please ask questions via *Questions* dialogue box





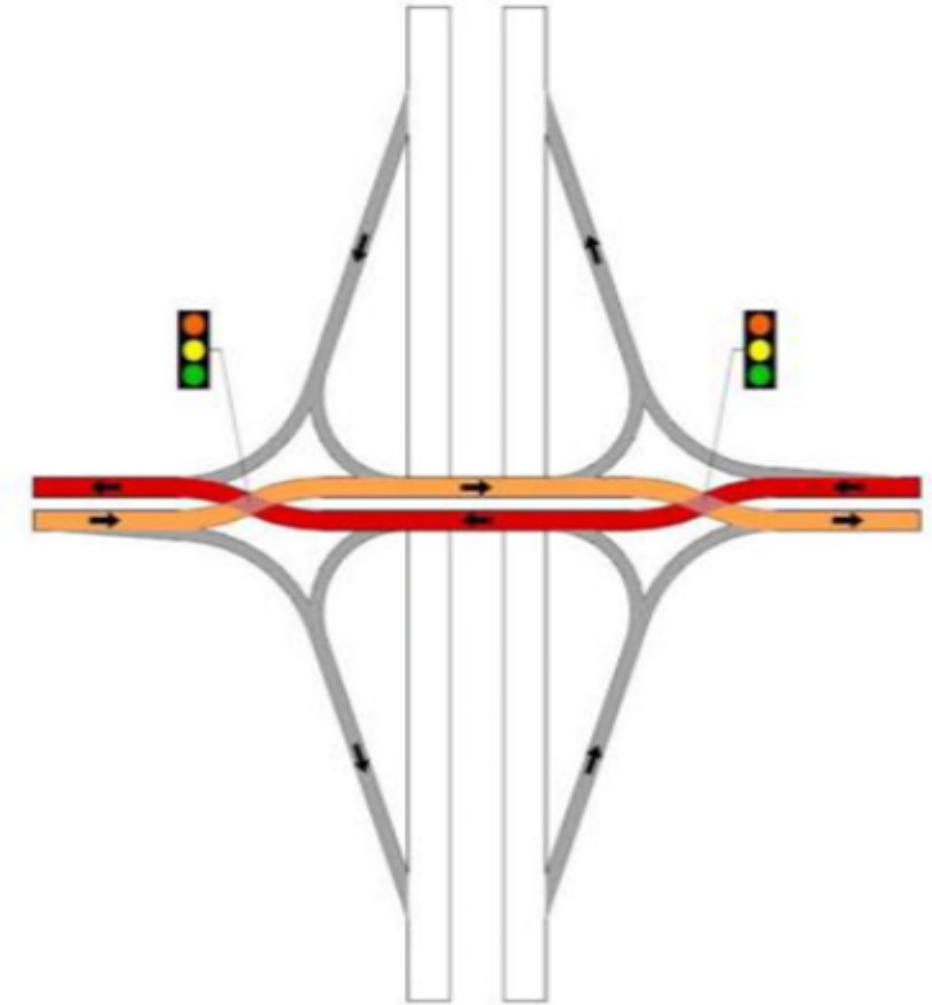
DDI Overview - AGENDA

- What is a DDI?
- Benefits of a DDI
- When Should a DDI be Considered?
- FDOT DDI Adoption
- Key DDI Development Features
- *BREAK*
- Key DDI Development Features (cont.)
- Additional DDI Resources

WHAT IS A DDI?

What is a DDI?

- A diamond interchange form that allows the two directions of traffic on the crossroad to temporarily divide and cross to the opposite side to gain access to and from the freeway more easily



What is a DDI?

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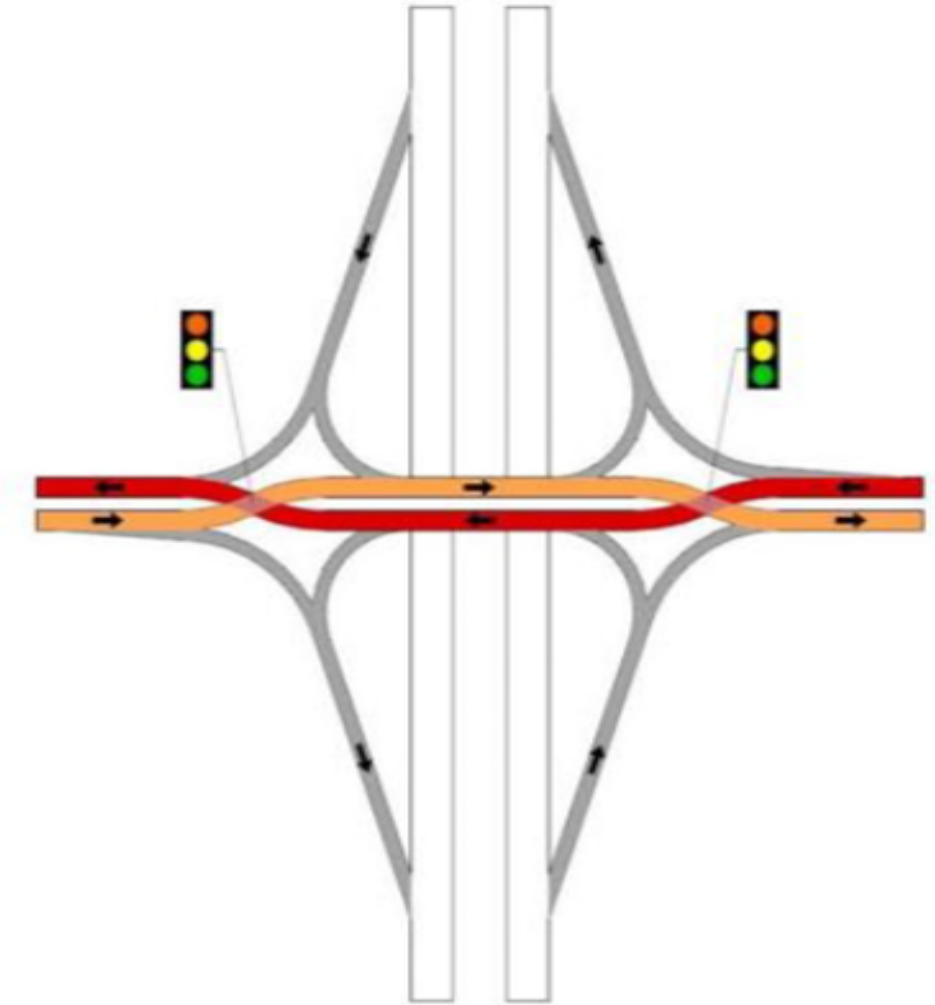
- Traffic crosses over to the left side of the roadway between the ramp nodes of the interchange



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- A diamond interchange form that allows the two directions of traffic on the crossroad to temporarily divide and cross to the opposite side to gain access to and from the freeway more easily
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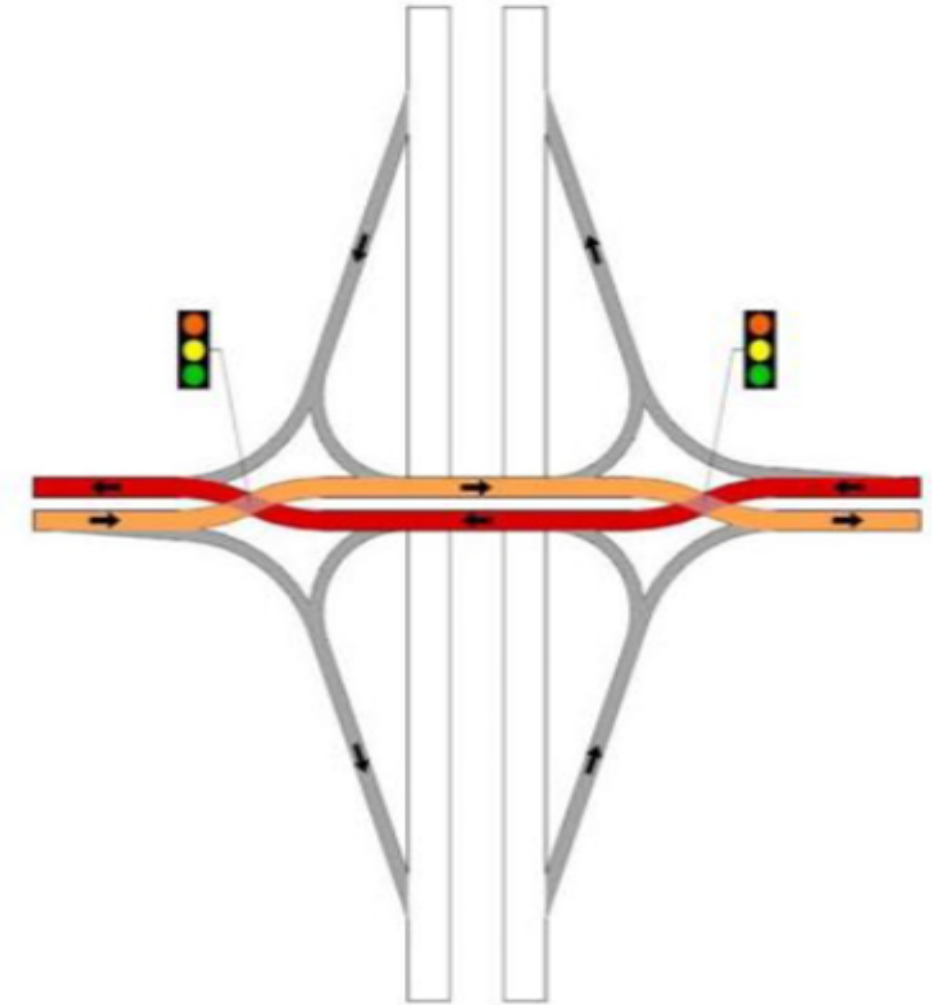
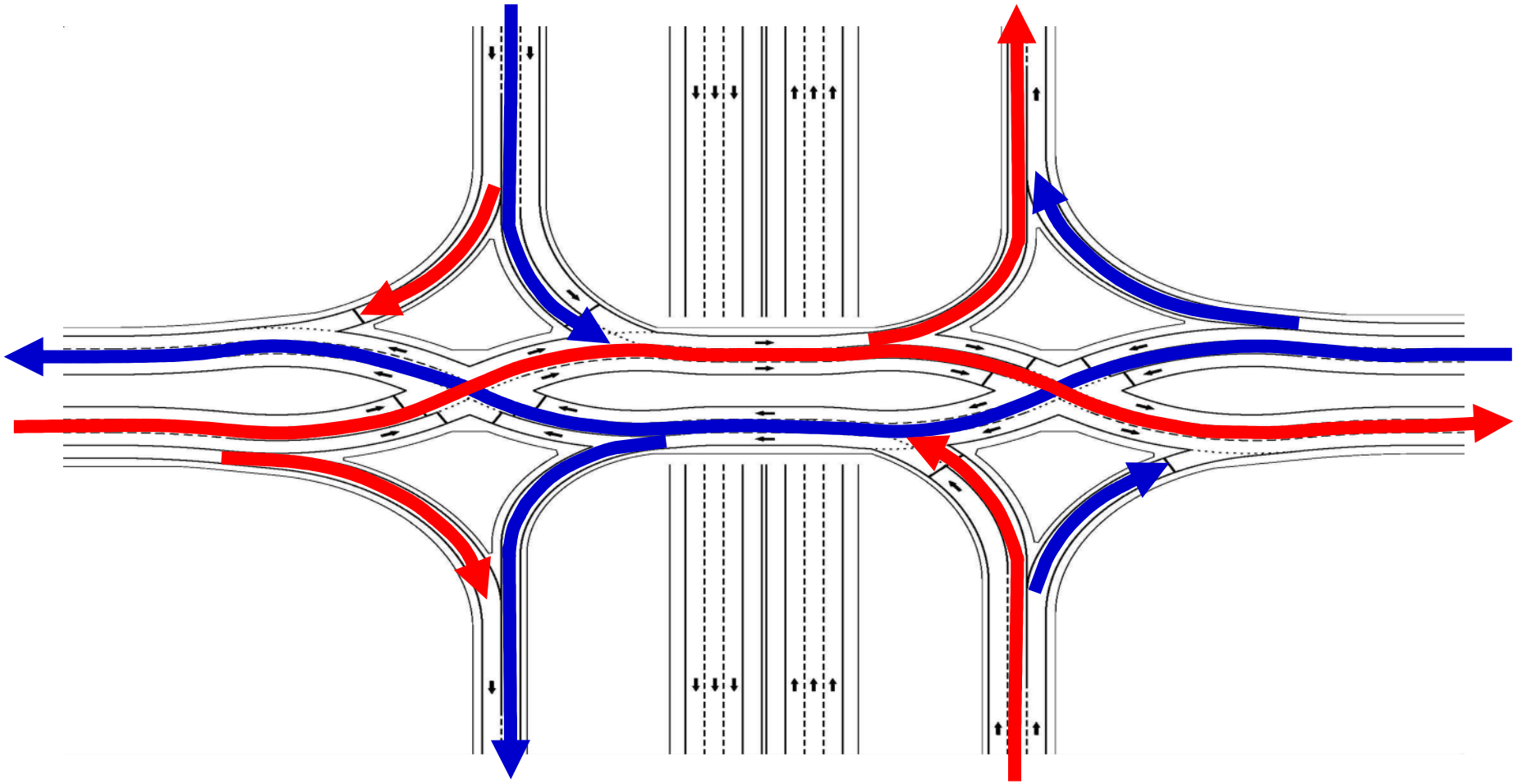
- Eliminates the need for left-turn signal phasing; no opposing traffic for left-turning movements made at the interchange

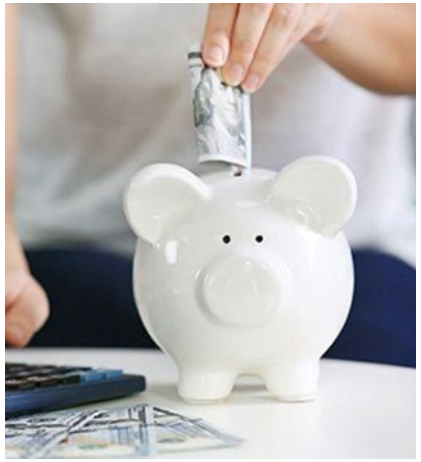


What is a DDI?



BENEFITS OF A DDI

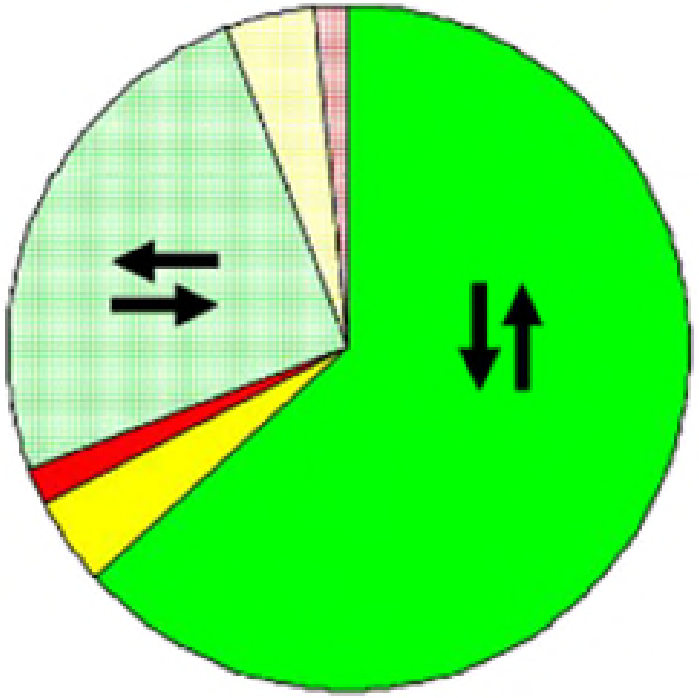
Benefits of a DDI

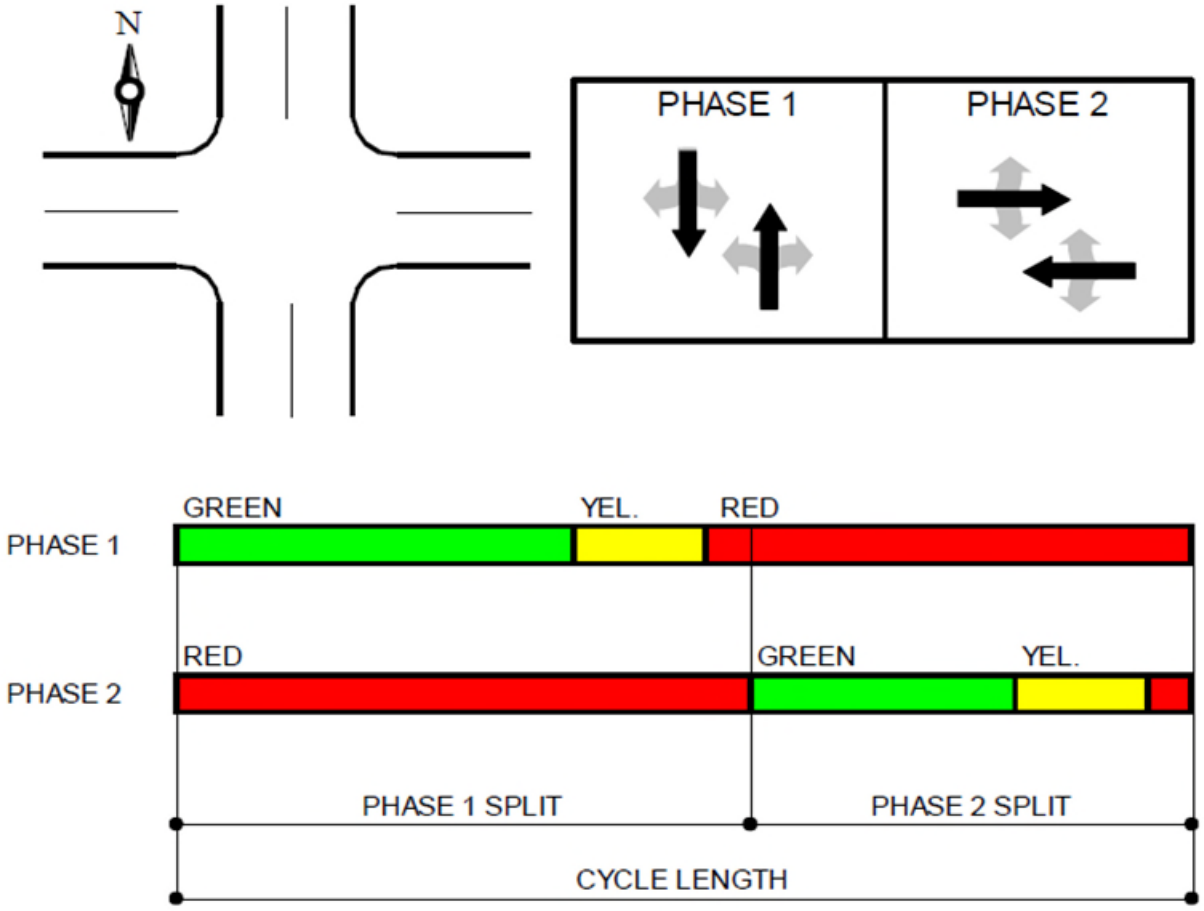


- **Better Traffic Operations**
  - Reduced Intersection Delay
  - Eliminates the need for left turn signal phases
- **Lower Cost**
  - Retrofit – Possibility to keep existing bridge structure
  - New Construction – Smaller structure footprint due to fewer lanes; less width on the approach to the interchange due to fewer lanes
- **Improved Safety**
  - Fewer conflict points for vehicles and pedestrians
  - Lower travel speeds

Better Traffic Operations

- Basic two-phase signal operation

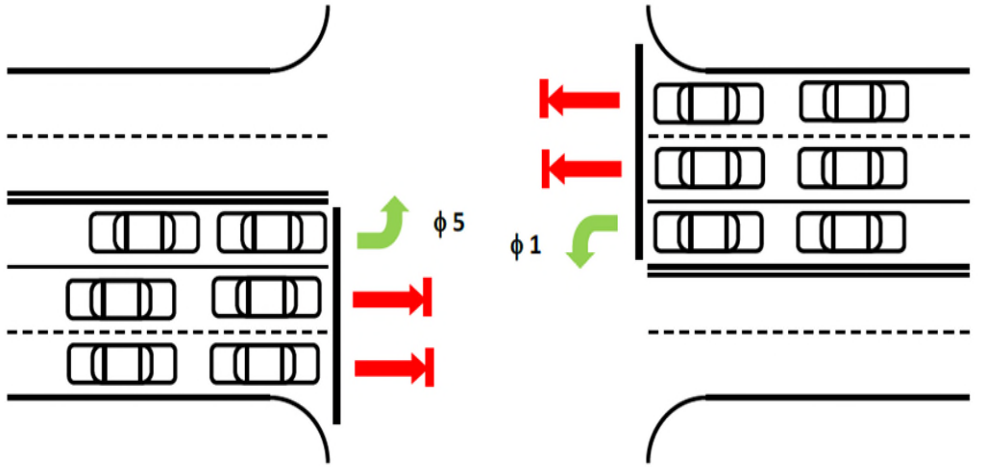


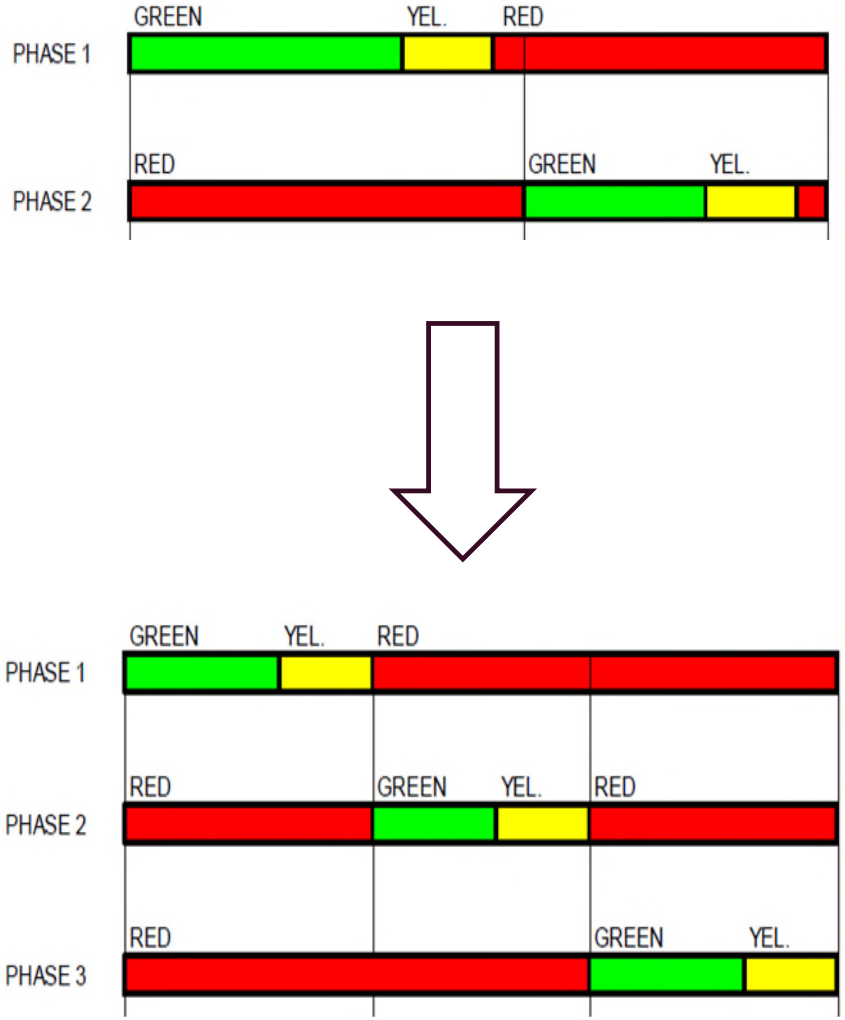


Source: MnDOT Traffic Signal Timing and Coordination Manual

Better Traffic Operations

- **When left turn phases are added….**
  - Adding “protected” left-turn phases is common as traffic volumes increase

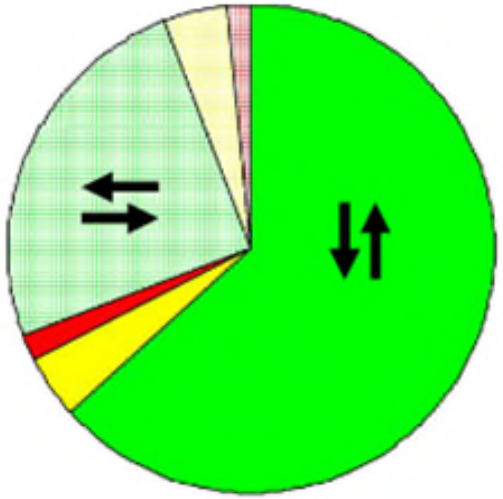


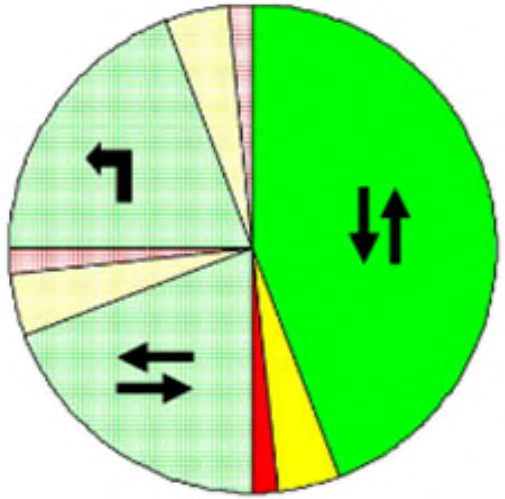


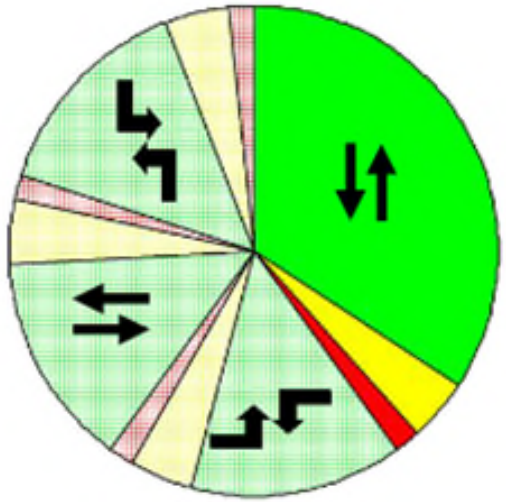
Source: MnDOT Traffic Signal Timing and Coordination Manual

Better Traffic Operations

- **When more phases are added….**
  - Adding more phases “steals” time away from the major through movement and can increase intersection delays
  - More phases also add more “lost time” (clearance intervals)

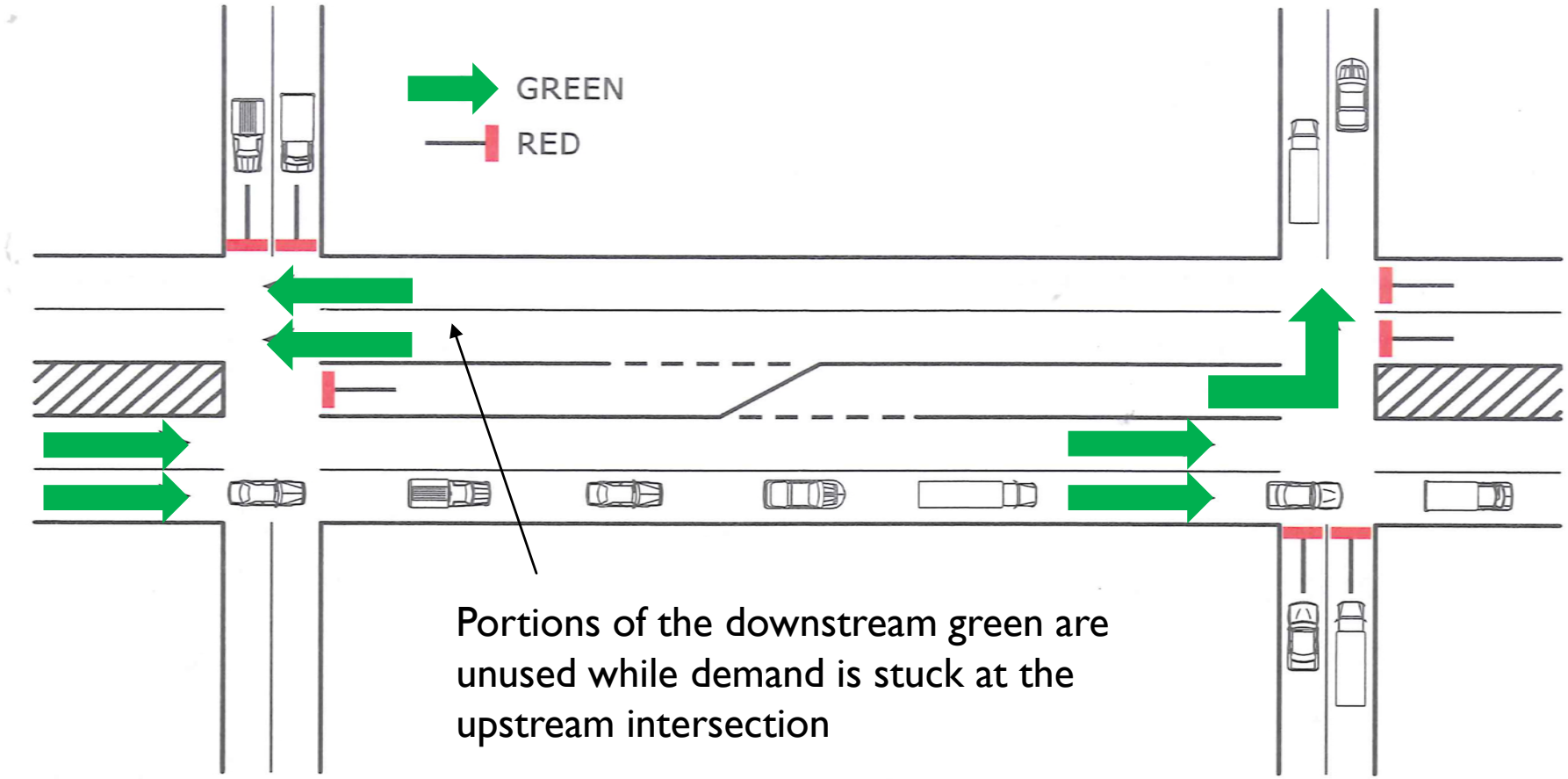






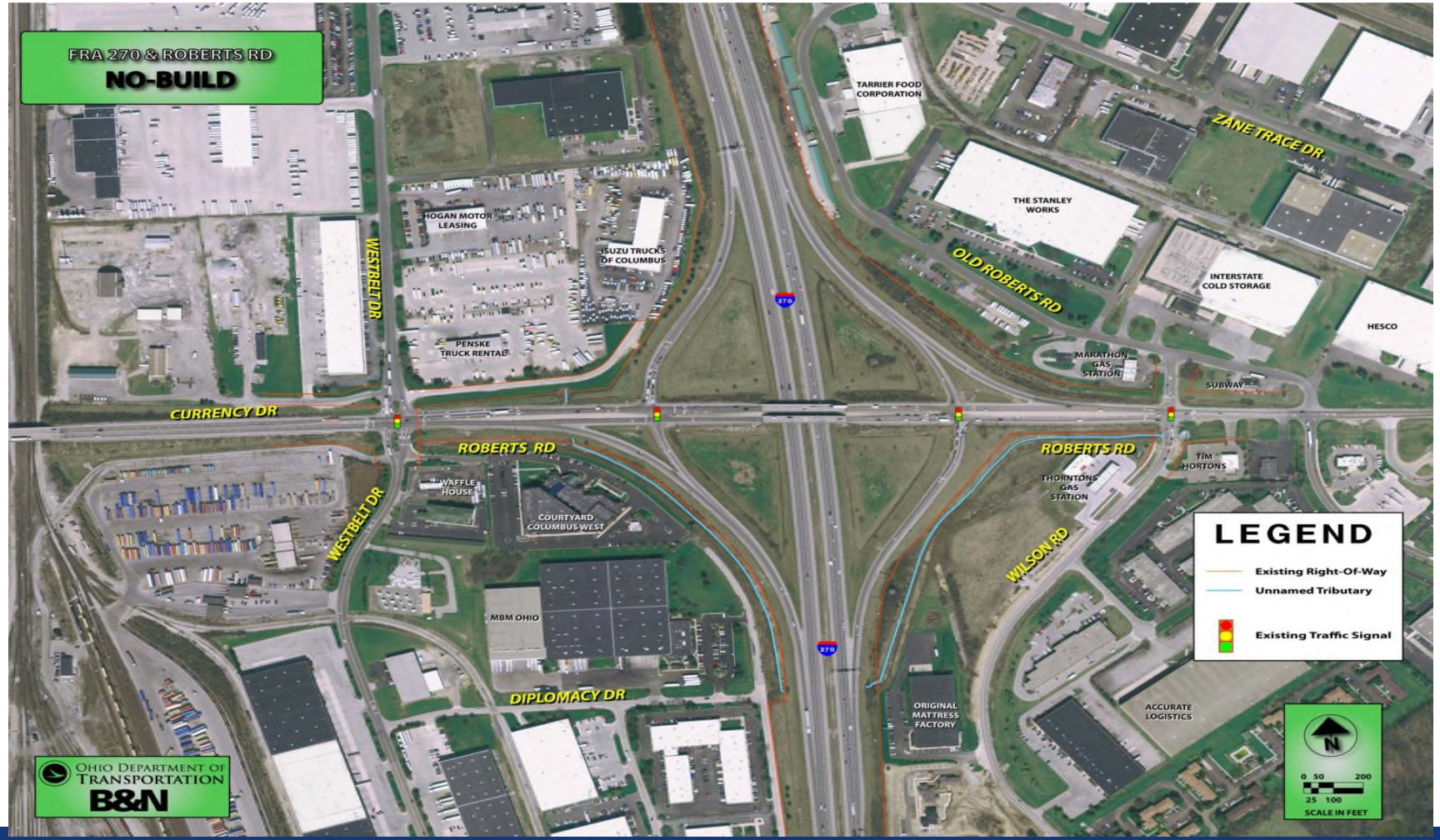
Better Traffic Operations

- **Demand Starvation**
  - Vehicles blocked by the upsteam intersection causes unused/ineffective green time at the downstream signal



Better Traffic Operations

- Signalization of a Traditional Diamond



Better Traffic Operations

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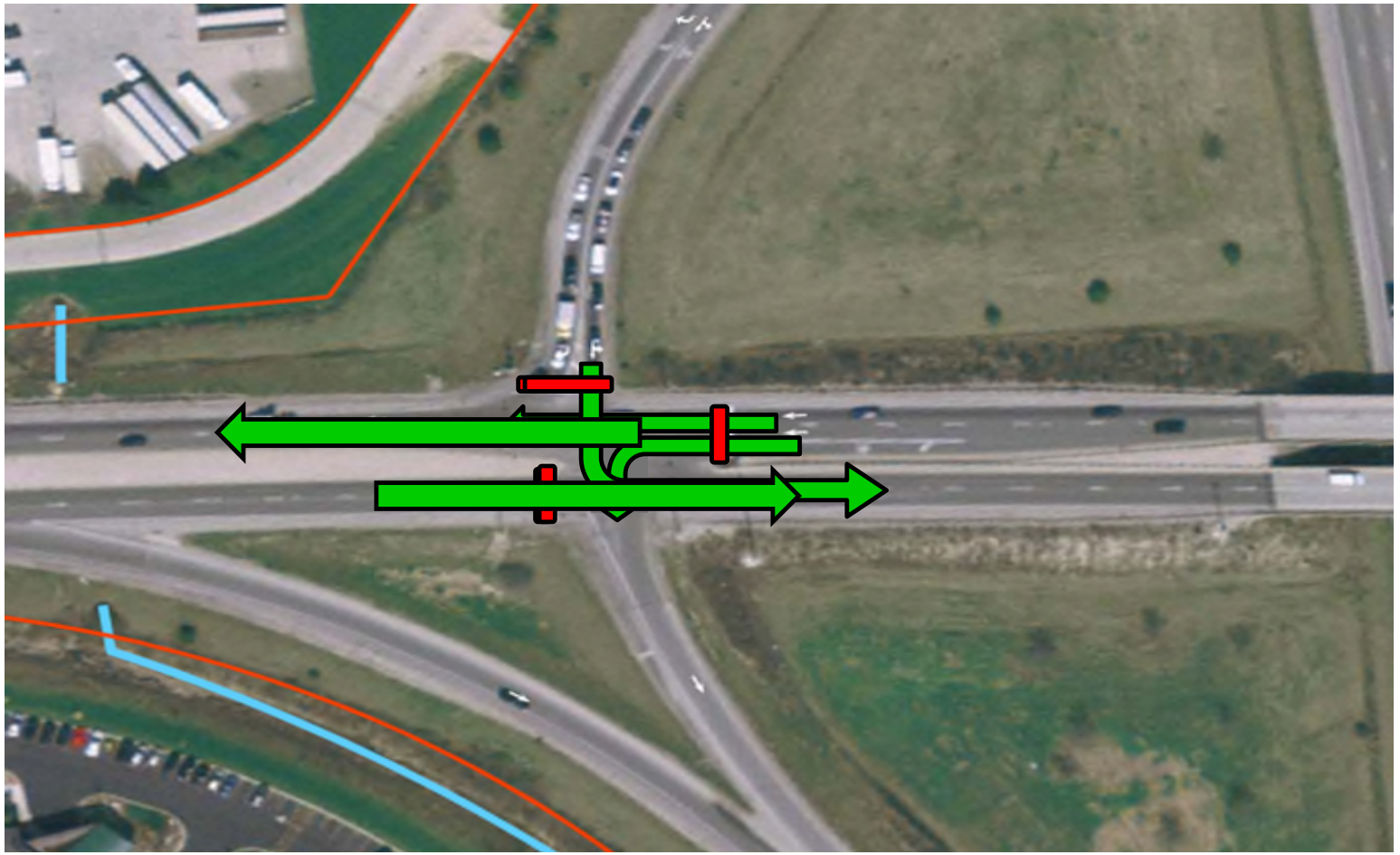
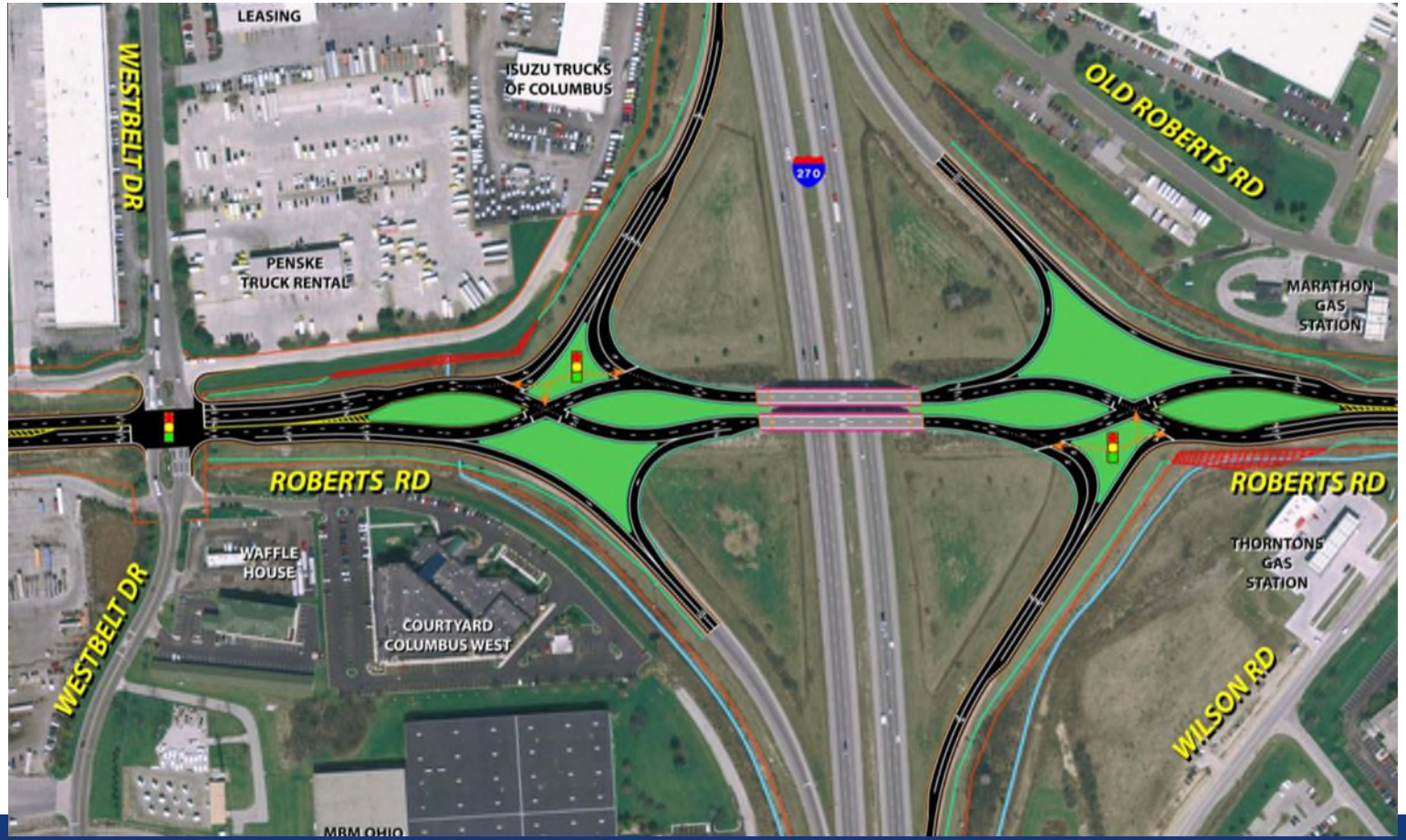


Better Traffic Operations

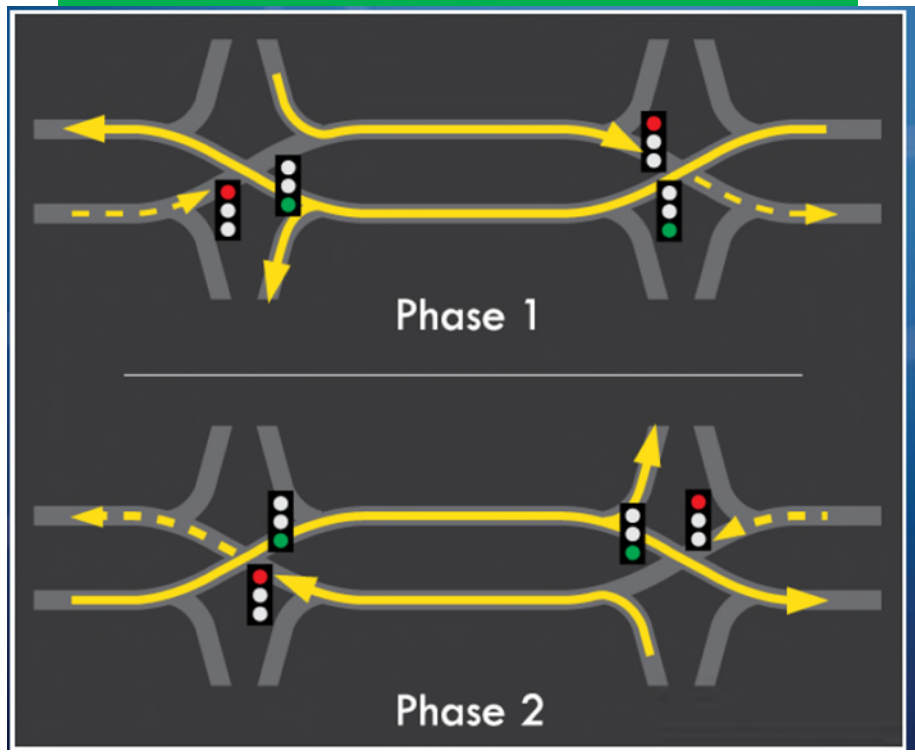
- How a DDI Operates



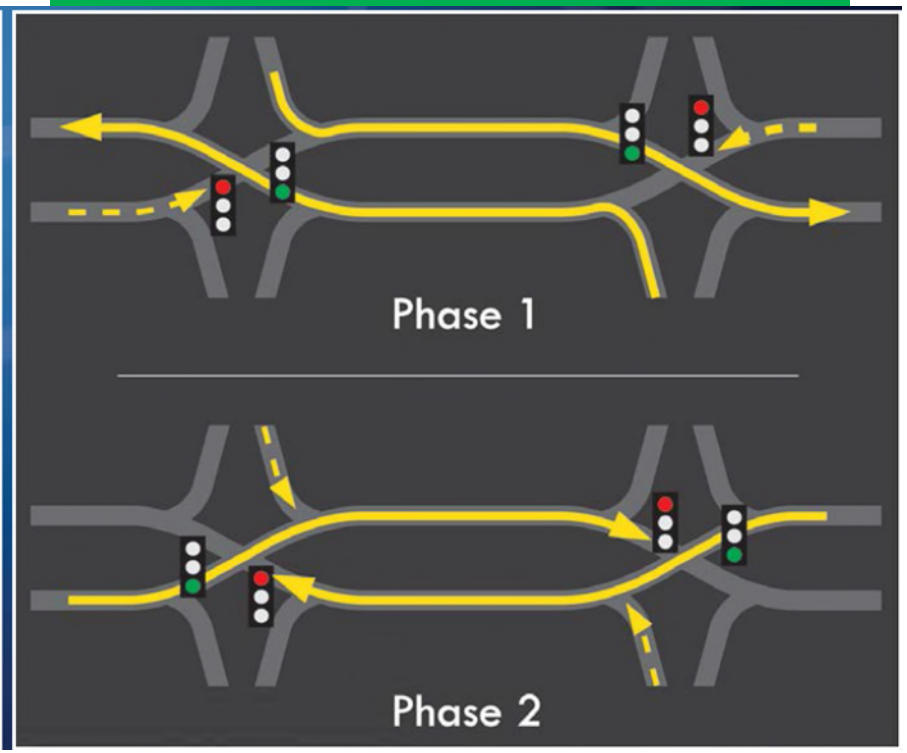
Better Traffic Operations

- Two Basic Signal Phasing Options

Alternating Directional Progression for Crossroad



Progression for Left-Turns from the Exit Ramps



Lower Cost

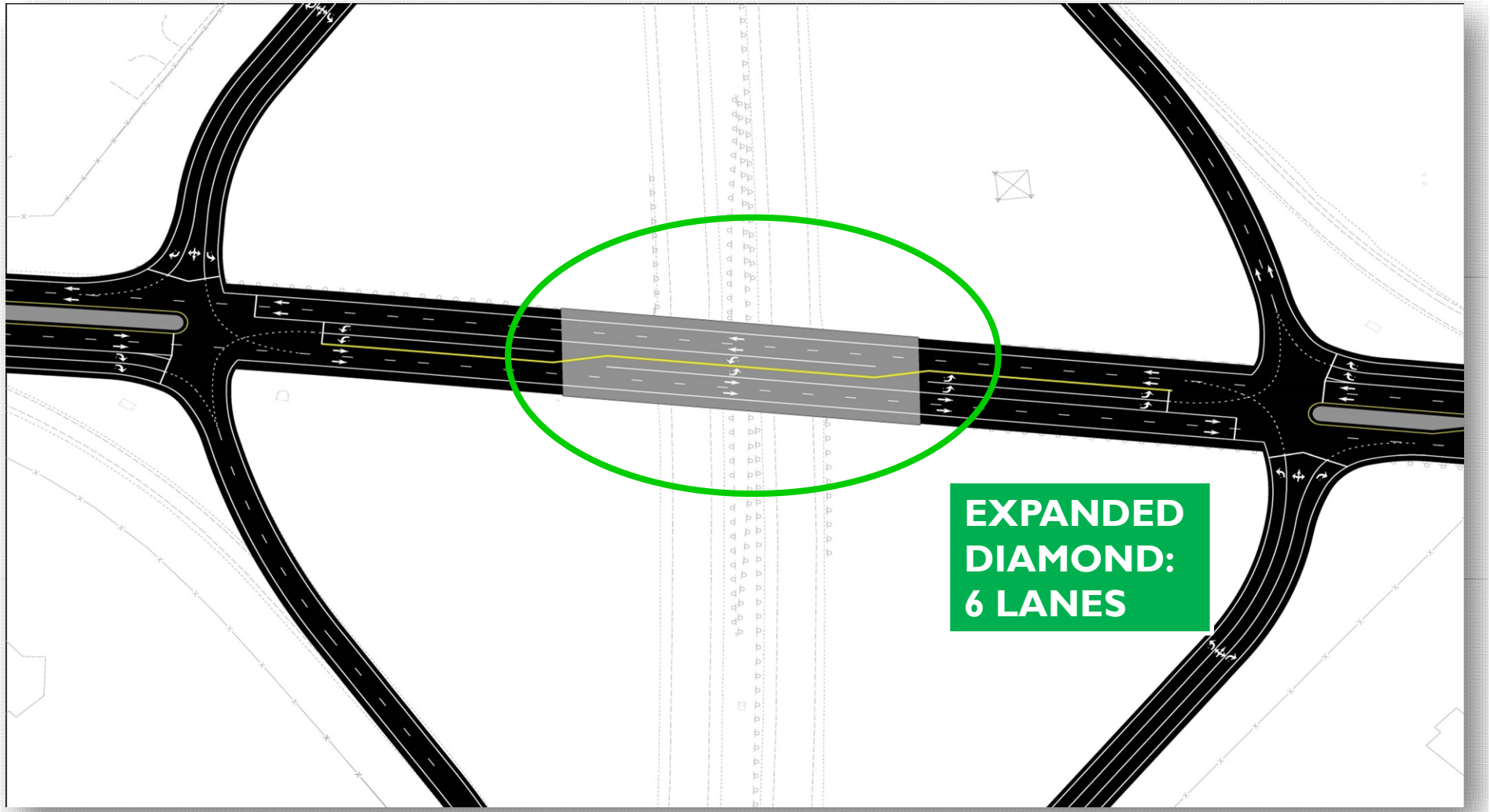
What is typically the main factor regarding the cost of an interchange project?

Lower Cost

- **The increased capacity and unique configuration of the DDI provides the potential to reduce the number of lanes on the crossroad, often reducing the right-of-way needed for the interchange compared to other traditional interchange types**
  - Within interchange area
  - On arterial approaches
- **This reduction in the number of lanes through the interchange often results in a smaller bridge footprint**

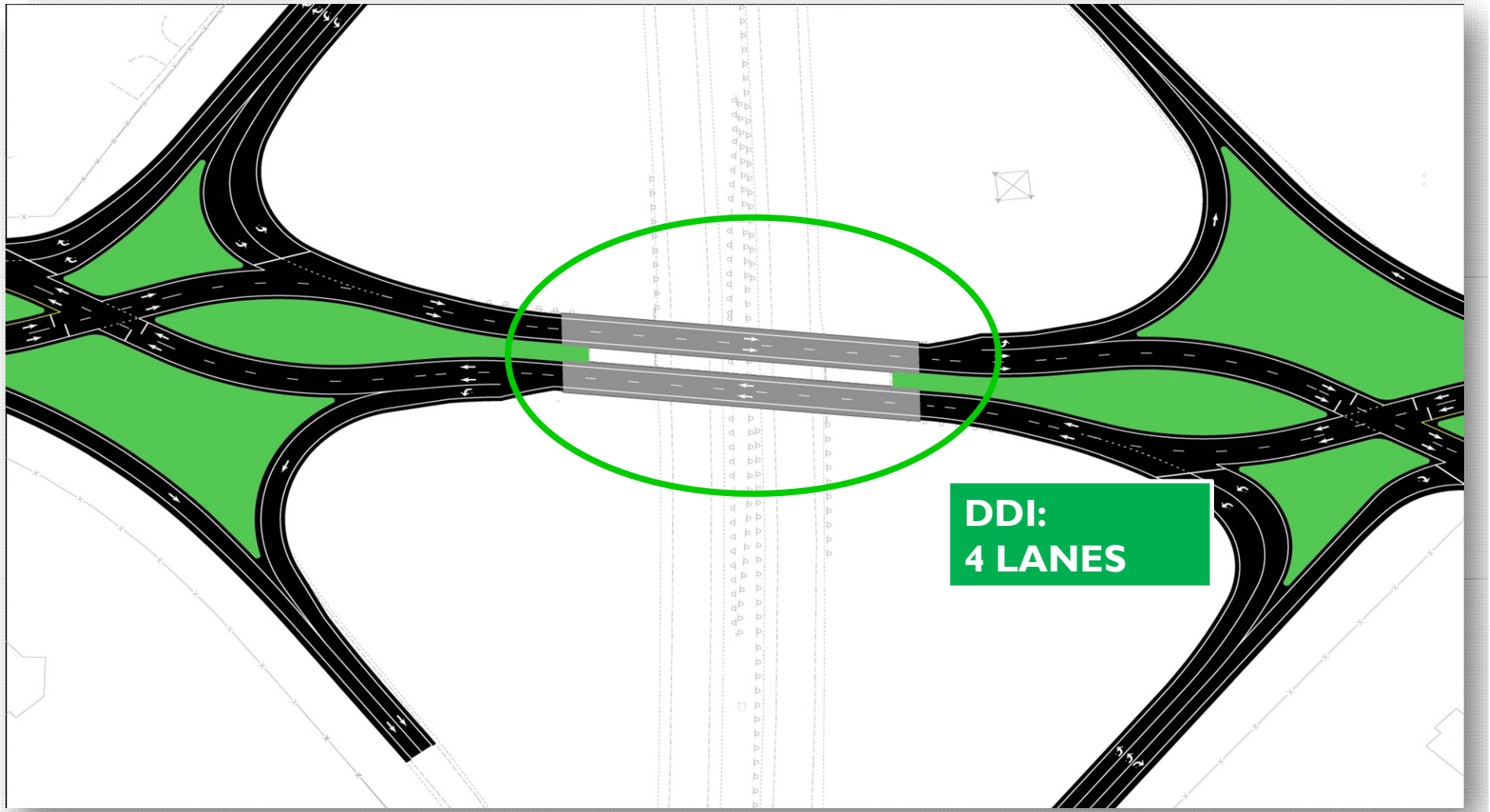
Lower Cost

- Traditional Diamond



Lower Cost

- **DDI**
  - Same location

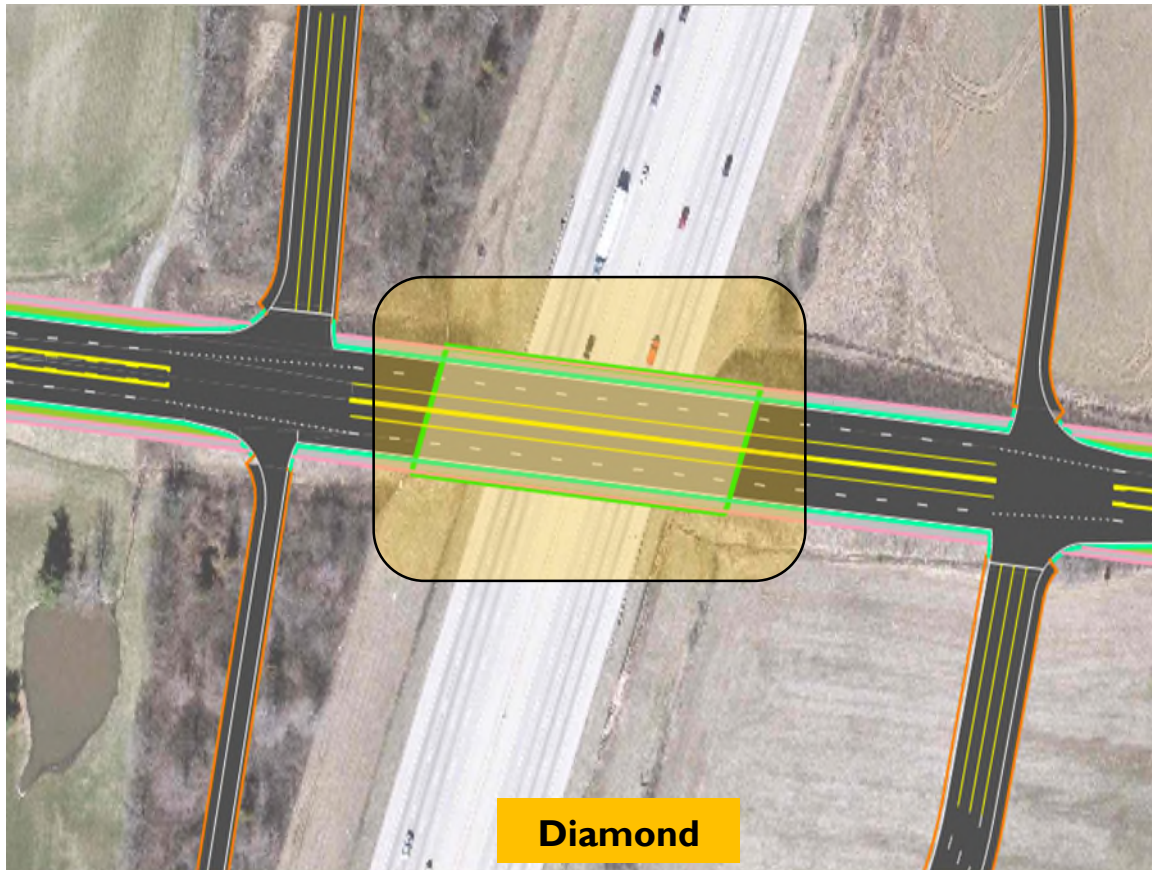


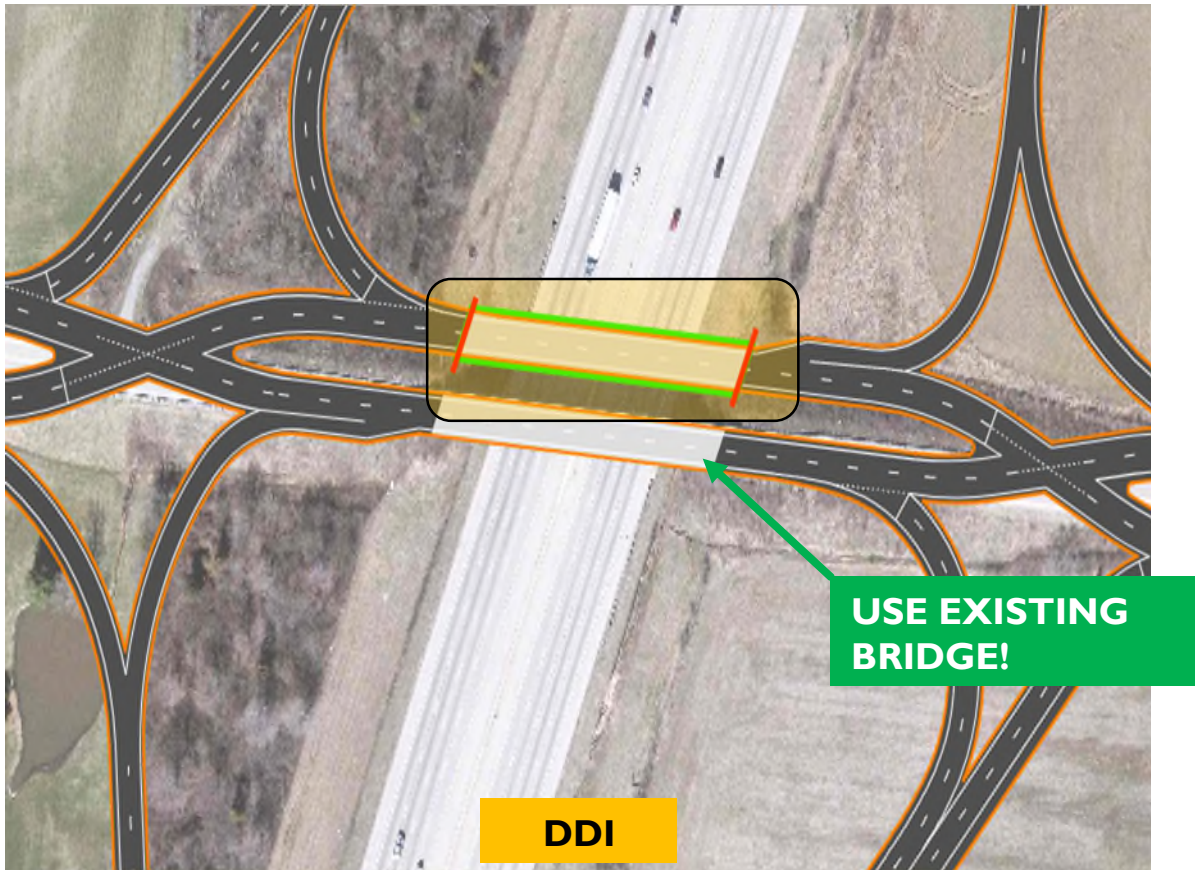
Lower Cost

- **Existing Grade Separation Example**
  - 2-lane bridge over I-75
  - No Interchange

Lower Cost

- Existing Grade Separation Example



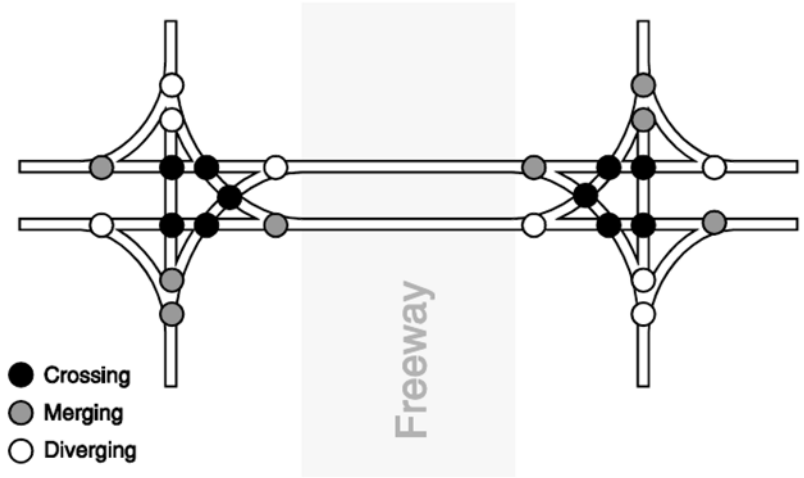
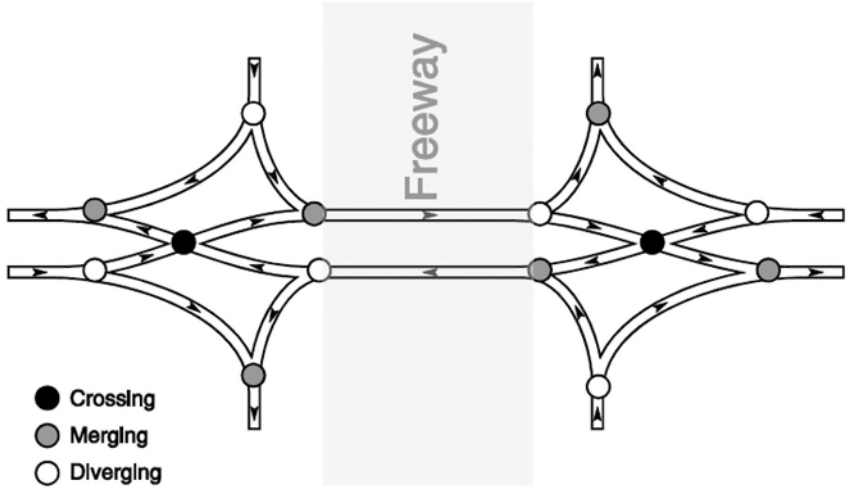


Improved Safety

- **Early Safety Concerns**
- **Will it _____ ?**
  a) Cause driver confusion
  b) Cause head-on collisions
  c) Create wrong-way movements
  d) Cause pedestrian confusion
  e) Be difficult for bicyclists to navigate
  f) Delay emergency vehicles
  g) Work when the power is out?

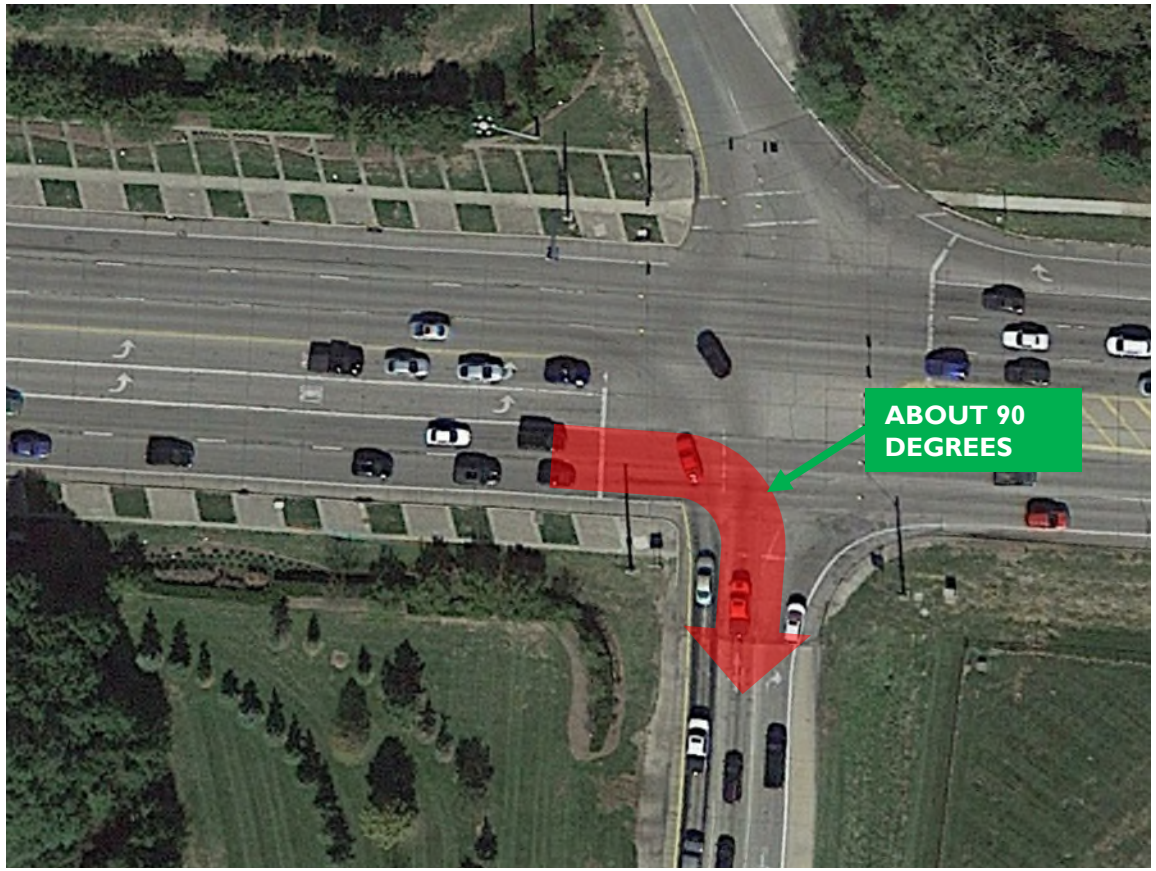
Improved Safety

- Intersection Conflict Points

Conventional Diamond	Diverging Diamond
	
10 Crossing Conflicts (most severe) 26 Total Conflict Points	2 Crossing Conflicts (most severe) 14 Total Conflict Points

Improved Safety

- Discouraging Wrong-Way Movements



Improved Safety

- **FHWA Field Evaluation (2015)**
  - Evaluated 7 of the earliest DDI conversions in the United States
    - 4 in Missouri
    - 1 in Kentucky
    - 1 in Tennessee
    - 1 in New York
  - Collected 4 years of “before” and 3 years of “after” DDI conversion crash data
  - Recommended CMF = 0.68 for Total Crashes
  - Recommended CMF = 0.61 for Injury/Fatal Crashes

TECHBRIEF

Field Evaluation of Double Crossover Diamond Interchanges

FHWA Publication No.: FHWA DTFH61-10-R-00030

FHWA Contact: Dr. Wei Zhang, HRDA-10, (202) 493-3317, Wei.Zhang@dot.gov

This document is a technical summary of the Federal Highway Administration Year Two Summary Report, Field Evaluation of Double Crossover Diamond Interchanges (DTFH61-10-C-00029)

Objective

This TechBrief provides results from the second year of a major study commissioned by the Federal Highway Administration (FHWA) to evaluate the first few double crossover diamond (DCD) interchange installations in the United States (U.S.). This research is (1) evaluating the operational and safety impacts of converting an existing diamond interchange into a DCD and (2) investigating how accurately field-observed traffic conditions at DCDs can be replicated in the microscopic simulation model VISSIM.

This research studied the following seven recently constructed and operated DCD interchanges:

- Bessemer Street at US 129, Alcoa, TN;
- MO 13 at I-44, Springfield, MO;
- National Avenue at US 60, Springfield, MO;
- Dorsett Road at I-270, Maryland Heights, MO;
- Harrodsburg Road at KY 4, Lexington, KY;
- Front Street at I-435, Kansas City, MO; and
- Winton Road at I-590, Rochester, NY.

Figure 1. Harrodsburg Road at KY 4 DCD Interchange, Lexington, KY

Source: © 2014 Google

Operational Characteristics

The DCD interchange, also known as a diverging diamond interchange, is an alternative to other service interchange forms, such as conventional diamond interchanges and partial cloverleaf interchanges. The primary difference between a DCD and a conventional diamond interchange occurs at the directional crossovers along the cross-street on

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Improved Safety

- **Missouri DOT Evaluation Study (2015)**
  - Evaluated 6 early DDI implementations in the state of Missouri
  - Compared these to 6 comparable Diamond interchanges
  - Collected average of 2.5 years of “before” and 2.5 years of “after” DDI conversion crash data
  - Reduction of Total Crashes by over 40%
  - Reduction of Injury/Fatal Crashes by over 60%

Improved Safety

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  - **Reduction of Total Crashes by over 40%**
  - **Reduction of Injury/Fatal Crashes by over 60%**

“In summary, the DDI offers significant crash reduction benefits over conventional diamond interchanges.”

Safety Evaluation of Diverging Diamond Interchanges in Missouri

Prepared by
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MoDOT
Final Report Prepared for Missouri Department of Transportation
2015 January Project TR201406 Report cmr15-006

WHEN SHOULD A DDI BE CONSIDERED?

When to Consider a DDI?

- DDI Applications

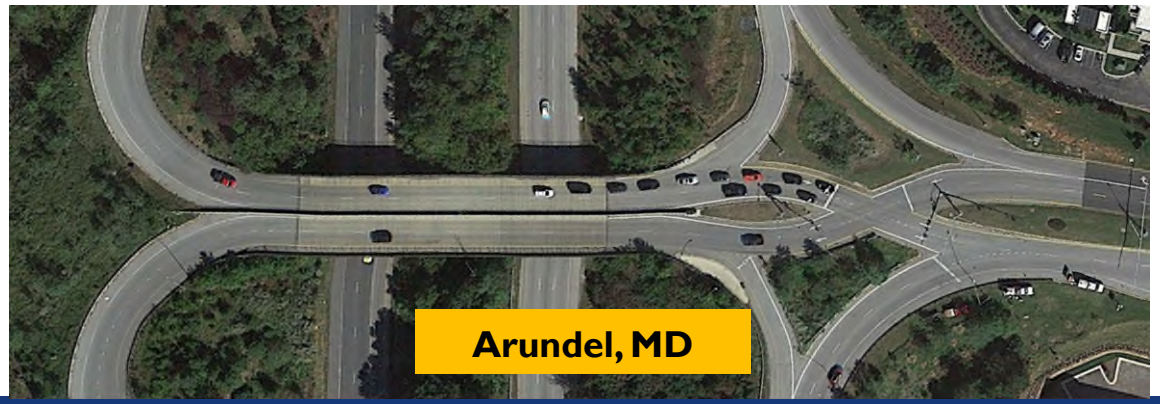
DDIs are a one-size-fits-all solution that will work everywhere!!!

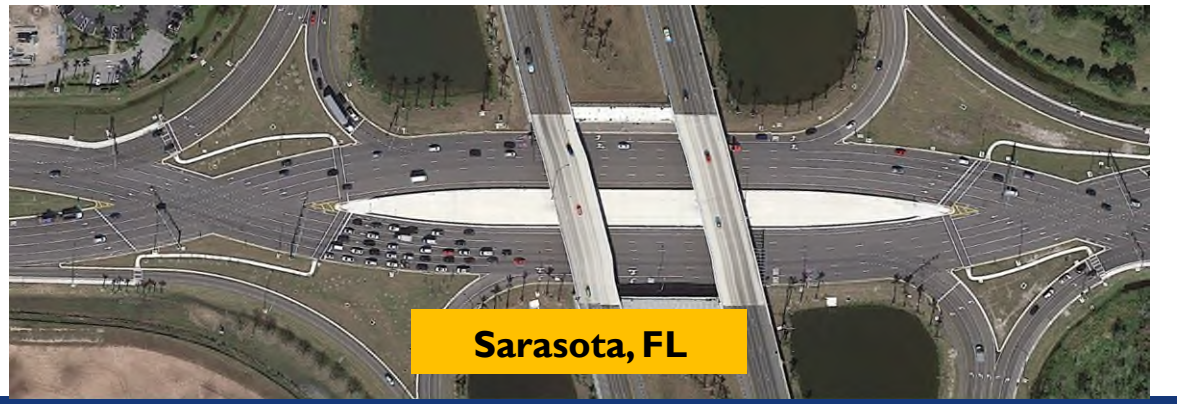
When to Consider a DDI?

- **When is a DDI a Good Alternative?**
  - Retrofits to improve existing interchanges
    - Improved operations and safety may be achieved without the need to replace the existing bridge structures
  - New interchanges with high left turn volumes
    - Generally cost advantageous due to superior operations with fewer lanes
    - High ranges of traffic capacity depending on the number of lanes included

When to Consider a DDI?

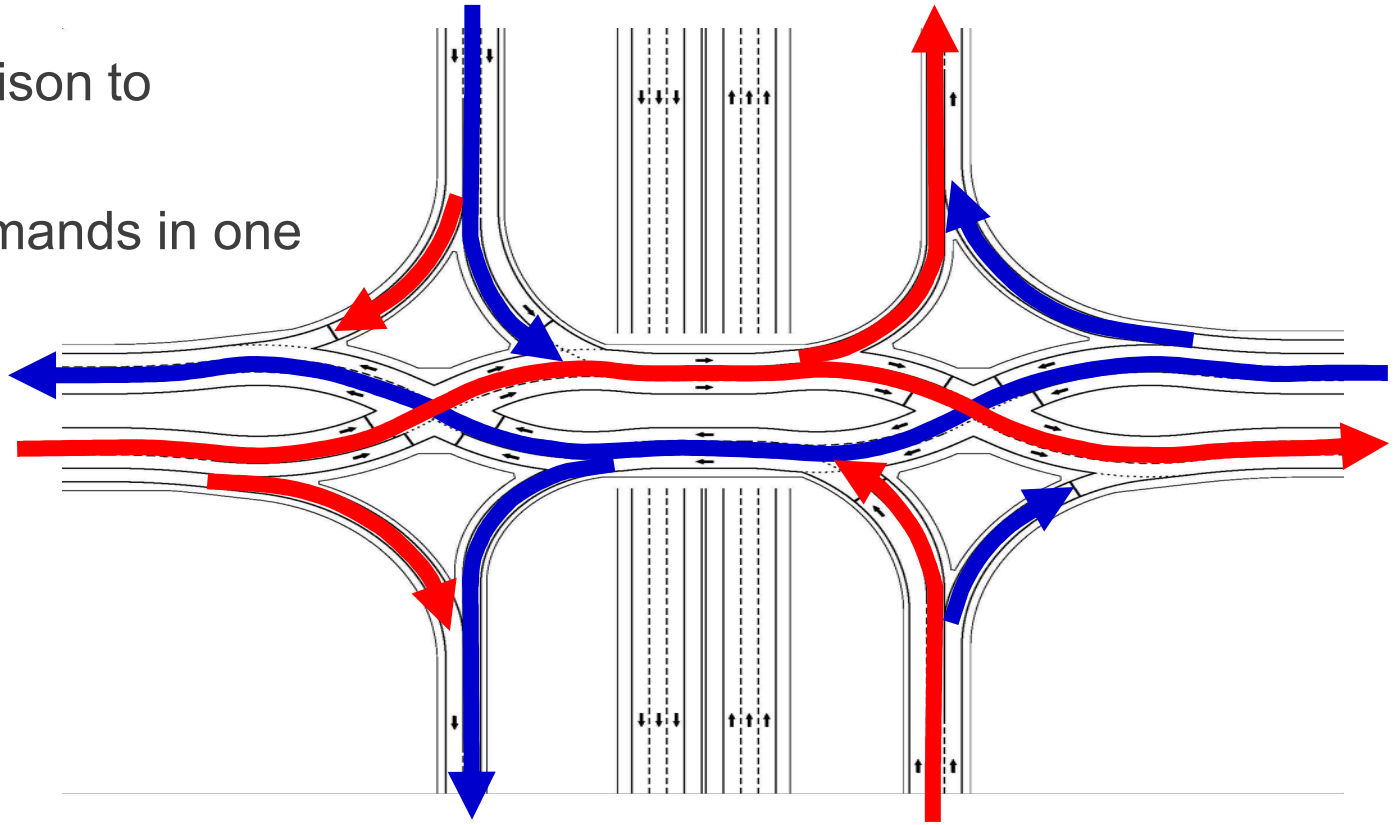
- **DDIs in all sizes**
  - The DDI is applicable for a wide range of traffic volumes
    - Single lane DDI – Cheyenne, WY (I-25 & College Drive)
    - Largest DDI in the US – Sarasota, FL (I-75 & SR 93)
    - 3-legged DDI – Arundel, MD (B-W Parkway at Arundel Mills Blvd)





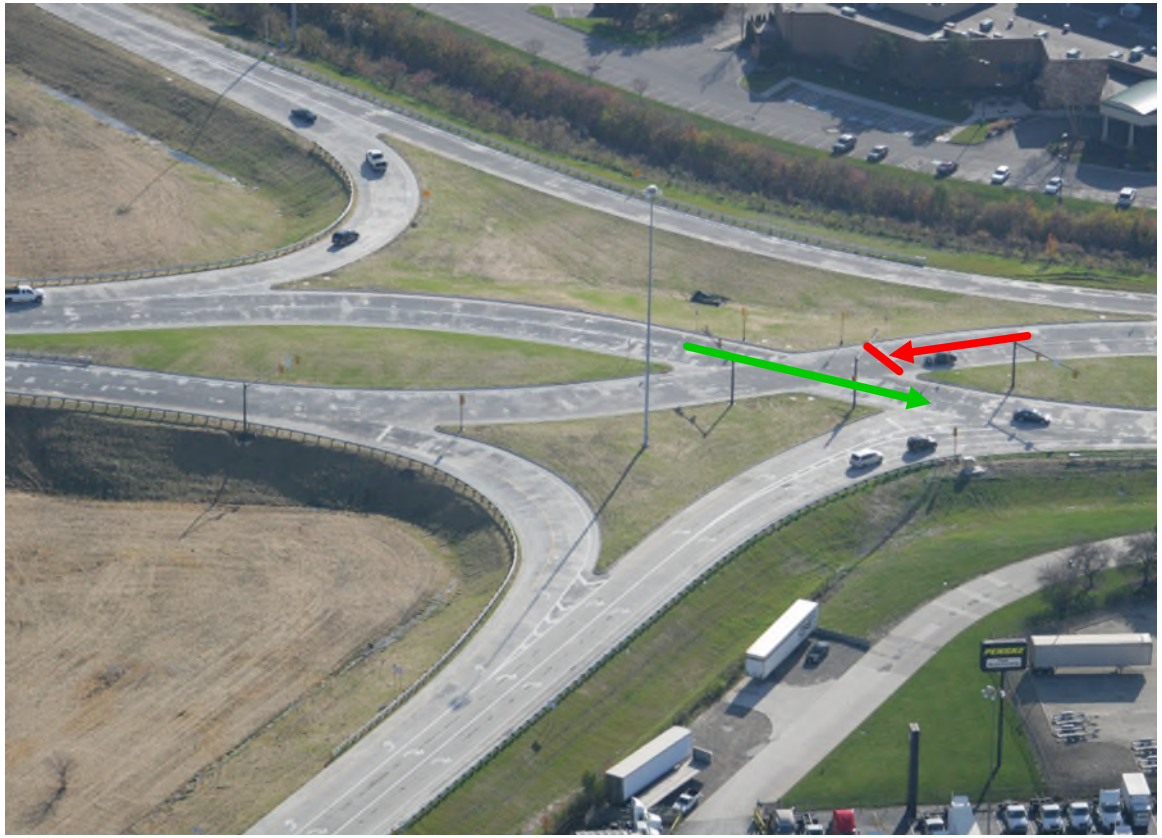
When to Consider a DDI?

- **DDIs Good When……**
  - Heavy left turn demands in comparison to crossroad through traffic volume
  - Heavy crossroad through traffic demands in one direction and light left turn volumes



When to Consider a DDI?

- **DDIs Not So Good When……**
  - Heavy opposing through movements on the crossroad
    - DDI functions by split phasing the through movements



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  - There are close adjacent signalized intersections that are saturated and unable to be improved
    - Overall corridor operations may not significantly improve

When to Consider a DDI?

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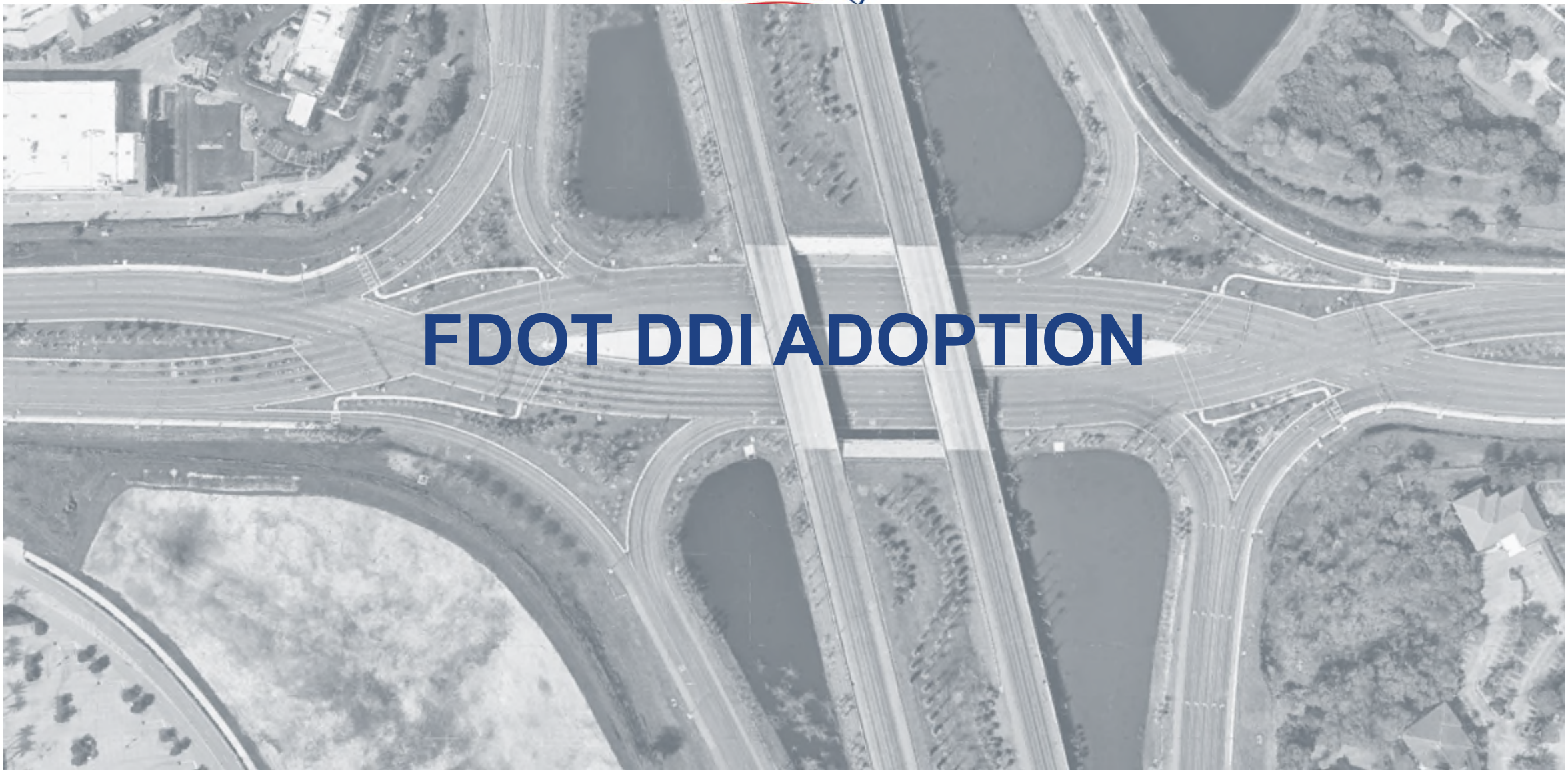
  - Heavy opposing through movements on the crossroad
    - DDI functions by split phasing the through movements
  - There are close adjacent signalized intersections that are saturated and unable to be improved
    - Overall corridor operations may not significantly improve
  - When constraints along the crossroad don't allow constructing the crossover intersections
    - Narrow R/W, Environmental Impacts, etc.

When to Consider a DDI?

- **DDIs Not So Good When……**
  - On a heavy load permitted route where there is substantial need to accommodate over-height vehicles with an exit ramp to entrance ramp through movement to bypass the interchange bridge.
    - Vehicles can’t travel from the exit ramp directly to the entrance ramp at a DDI



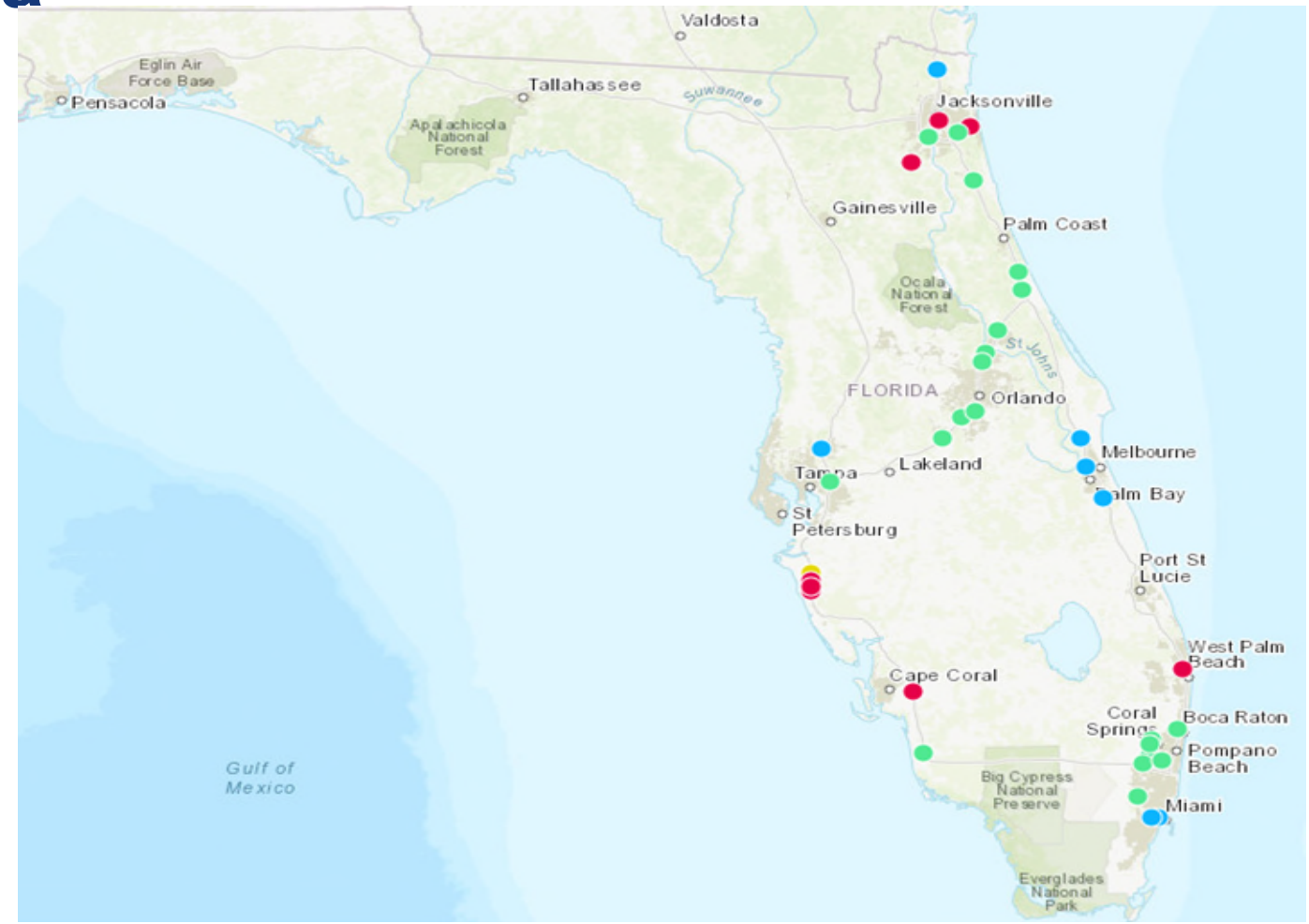
FDOT DDI ADOPTION

History of DDIs in Florida

- FDOT first DDI Project: I-75 at University Parkway
- Design began in 2011
- Completed and open to traffic in 2018
- Currently the largest DDI in the United States

History of DDIs in Florida

- **Current FDOT Projects:**
  - 1 DDI Open To Traffic
  - 7 DDIs Under Construction
  - 8-DDIs With Approved SO&E
  - 21 DDI's In Early Planning



History of DDIs in Florida

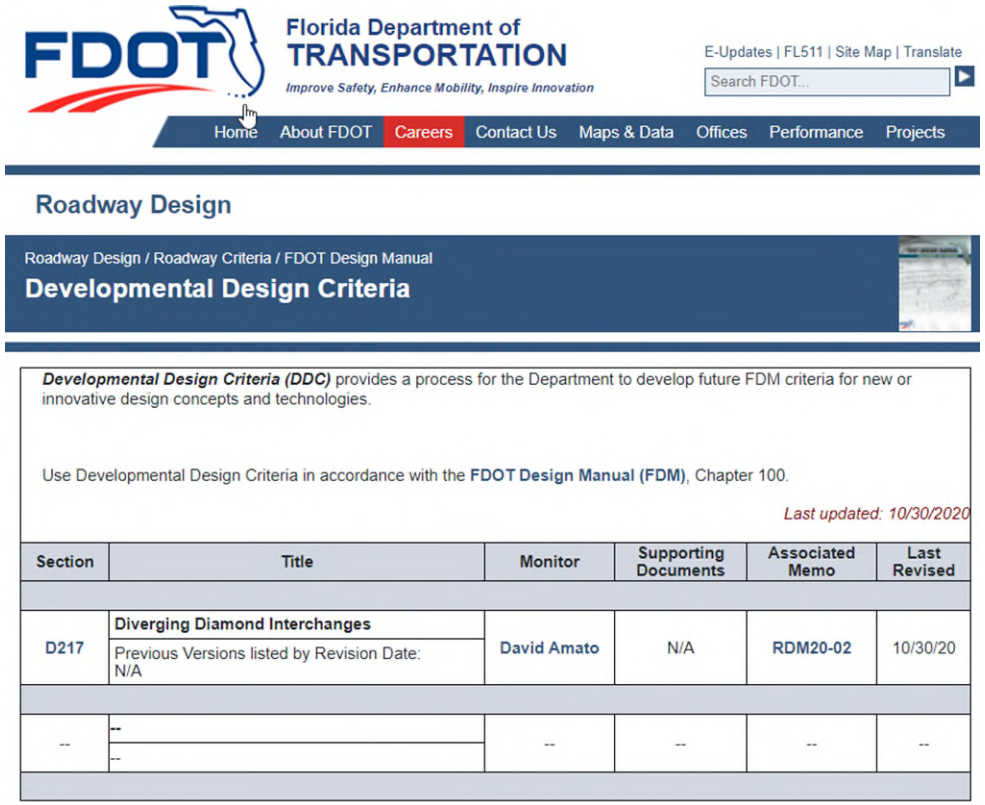
- **FDOT Design Criteria:**

- **Early Designs Relied On:**
  - National Guidance (NCHRP DDI Informational Guide)
  - Guidance From Other States (Missouri, Utah)
  - Expertise Of EOR

- **FDOT Developmental Design Criteria (DDC)**
  - DDC D217 Published in November 2020
  - Located on FDOT Design Manual Web Page
  - Covers Major DDI Design Topics

DDC D217 Diverging Diamond Interchanges

- **Purpose**
  - Provides Florida-Specific Guidance
  - Provides Consistency In Design And Detailing
  - Provides Mechanism For Input On Criteria Development
- **Major Topics**
  - Traffic Operations
  - Geometric Design
  - Multi-Modal Accommodation
  - Signing and Pavement Marking
  - Signalization
- **Design Variation Process Does Not Apply**
- **Deviation From Criteria Requires Monitor Approval**
- **Takes Precedence over National Guidance**



Florida Department of TRANSPORTATION

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Roadway Design

Roadway Design / Roadway Criteria / FDOT Design Manual

Developmental Design Criteria

Developmental Design Criteria (DDC) provides a process for the Department to develop future FDM criteria for new or innovative design concepts and technologies.

Use Developmental Design Criteria in accordance with the **FDOT Design Manual (FDM)**, Chapter 100.

Last updated: 10/30/2020

Section	Title	Monitor	Supporting Documents	Associated Memo	Last Revised
D217	**Diverging Diamond Interchanges** Previous Versions listed by Revision Date: N/A	David Amato	N/A	RDM20-02	10/30/20
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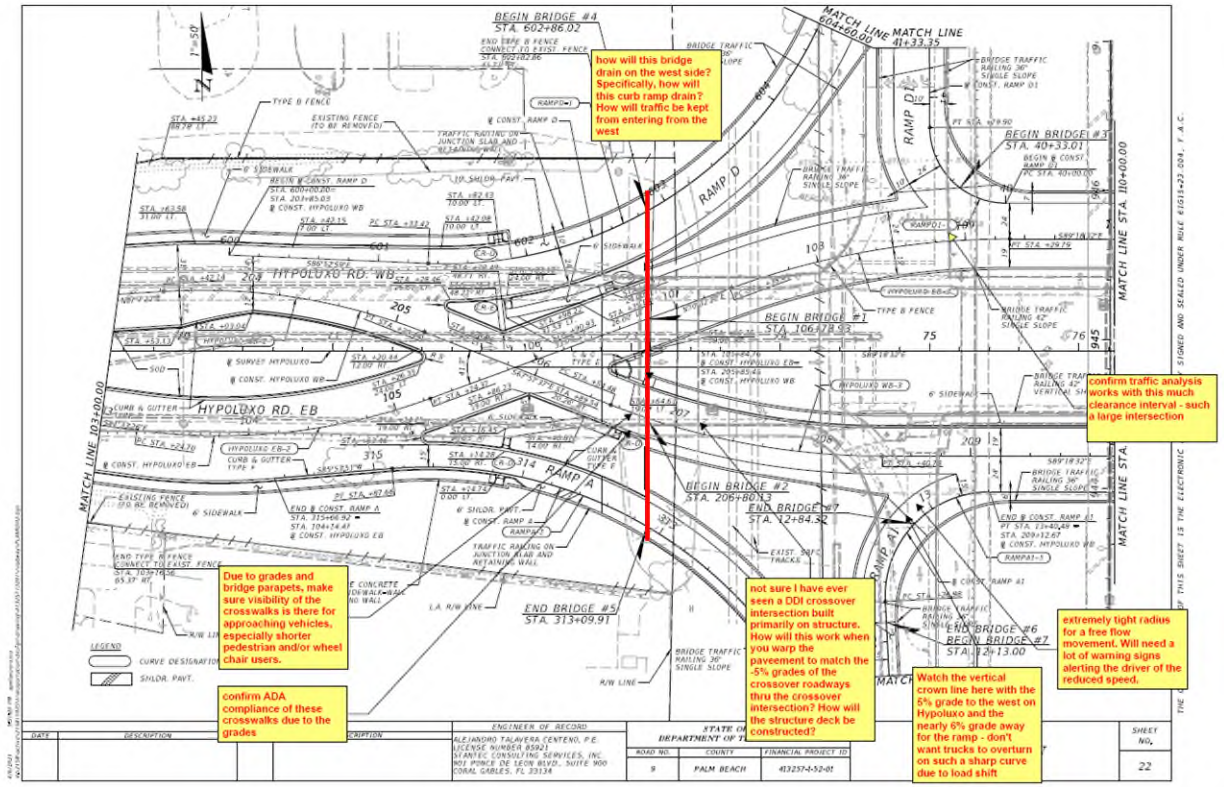
DDI Review

- **FDOT Policy – FDM 116**
  - All DDIs Require Central Office Review Of All Design Phases
  - Include Representative Of The State RDO as Lead Reviewer in ERC

- **Submittals – FDM 301.4**
  - DDI Review Package Submitted With Phase I Plans
  - Submittal Requirements:
    - Traffic Analysis Results (To Verify Lane Configuration)
    - Geometric Layout (PDF and CADD)
    - Autoturn Analysis
    - Master Signing Plan

- **Review Process**
  - Submittal Documents Uploaded To ERC
  - Review Conducted and Comments Entered In ERC
  - Project Team Meeting Held To Discuss The Review Comments
  - Formal Comment Responses Entered In ERC



KEY DDI DEVELOPMENT FEATURES

Key DDI Development Features

- Traffic Operations
- Geometric Design
- Traffic Signals
- Signing and Pavement Markings
- Multimodal Accommodations
- Constructability
- Plan Detailing
- Public Involvement

Key DDI Development Features

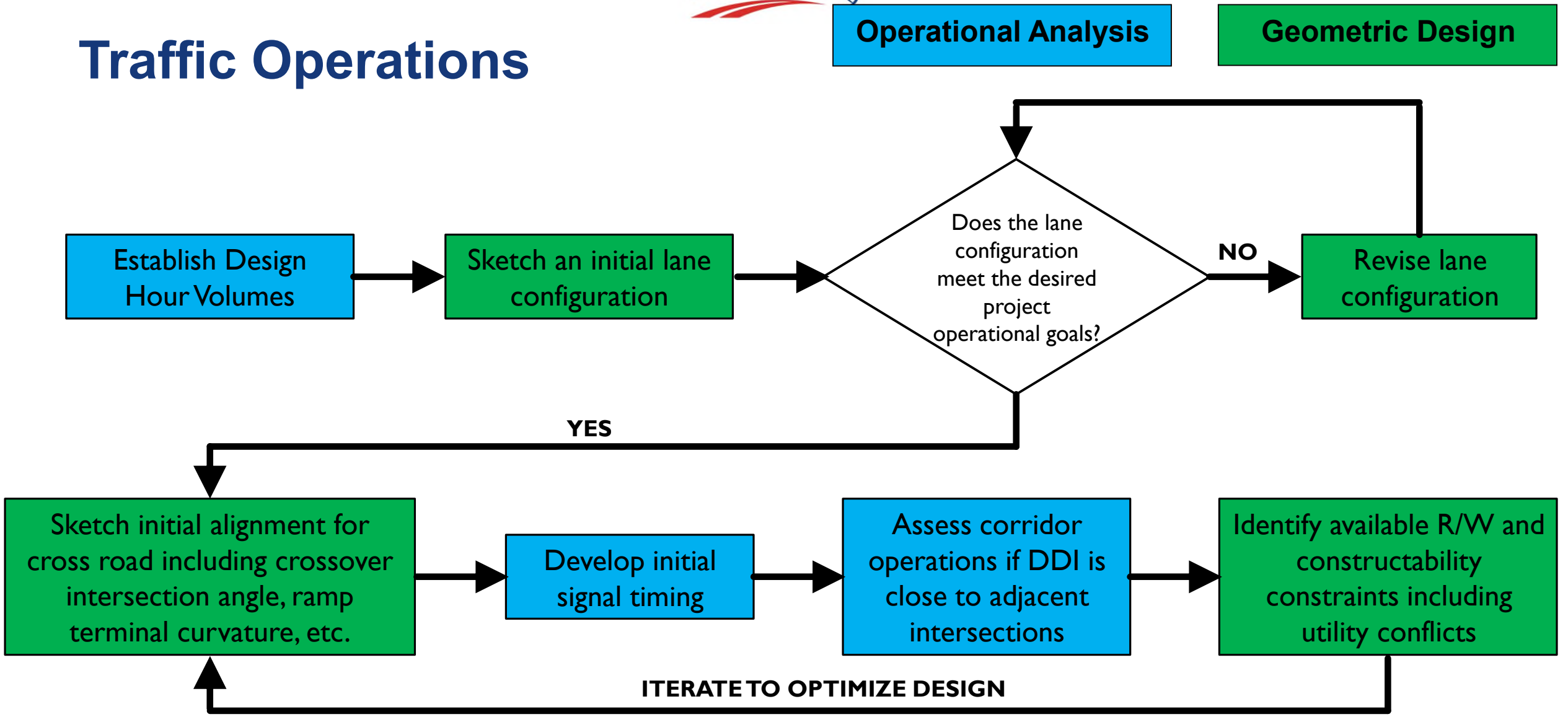
- Traffic Operations (8/10/21)
- Geometric Design (6/29/21)
- Traffic Signals
- Signing and Pavement Markings (7/16/21)
- Multimodal Accommodations (8/24/21)
- Constructability
- Plan Detailing (9/7/21)
- Public Involvement (9/7/21)

TRAFFIC OPERATIONS

Traffic Operations

- **Research shows that compared to a traditional Diamond interchange, the DDI:**
  - Reduces intersection delay 15% - 60%
  - Increases intersection through traffic 10% - 30%
  - Increases intersection capacity 15% - 25%
- **Simple two-phase signal operation**
- **Increased capacity for the left-turning movements to/from the ramps**
- **Left-turn vehicles only go through one signal**
- **Traffic is better spread out entering freeway**

Traffic Operations



Traffic Operations

- **Closely spaced signalized intersections**
  - Common myth of how to “break a DDI”
  - **No “magic dimension”**

Traffic Operations

- **Closely spaced signalized intersections**
  - Example

Traffic Operations

- **Closely spaced signalized intersections**
  - Example

Existing Lane Configuration

Traffic Operations

- **Closely spaced signalized intersections**
  - Adjust intersection to give more green time back to the primary road
  - Dual left from the secondary street

Proposed Lane Configuration

Traffic Operations

- **Closely spaced signalized intersections**
  - Don’t “blindly” trust your traffic simulation models!

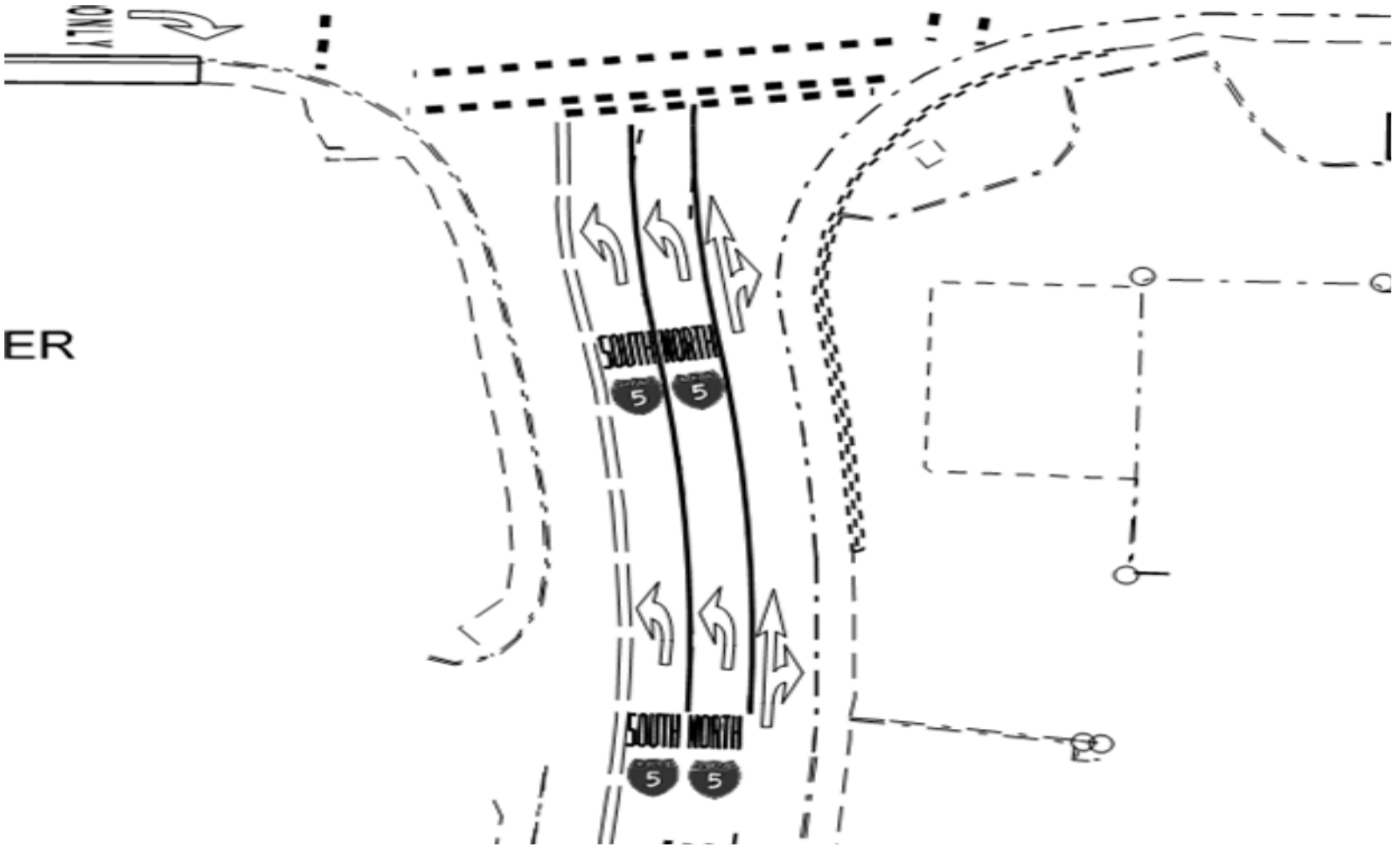
Traffic Operations

- **Closely spaced signalized intersections**
  - May need to make adjustments after construction is completed

Proposed Lane Configuration

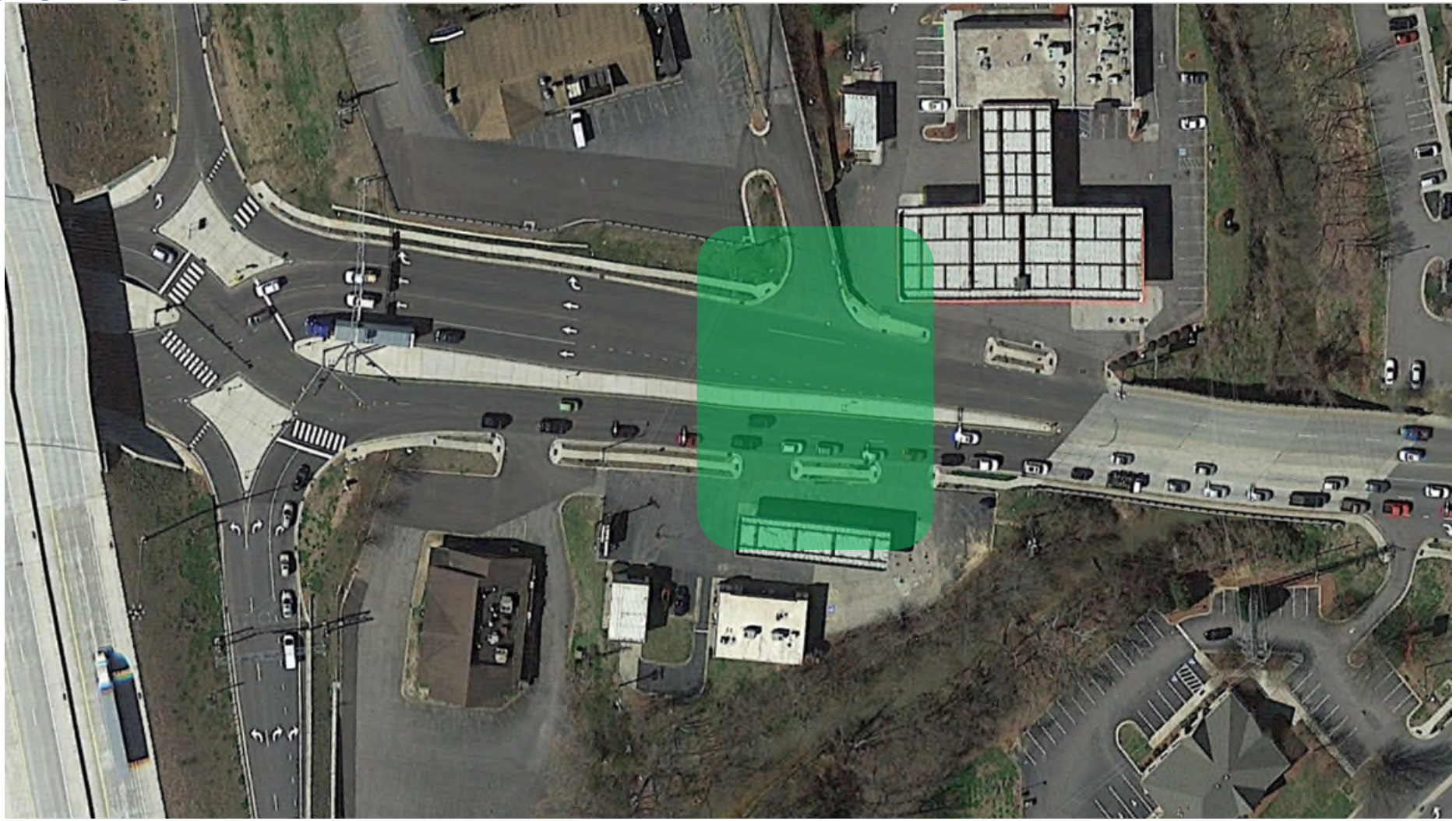
Traffic Operations

- **Closely spaced signalized intersections**
  - Pavement Markings can help alleviate confusion when making turns from the secondary streets near a DDI



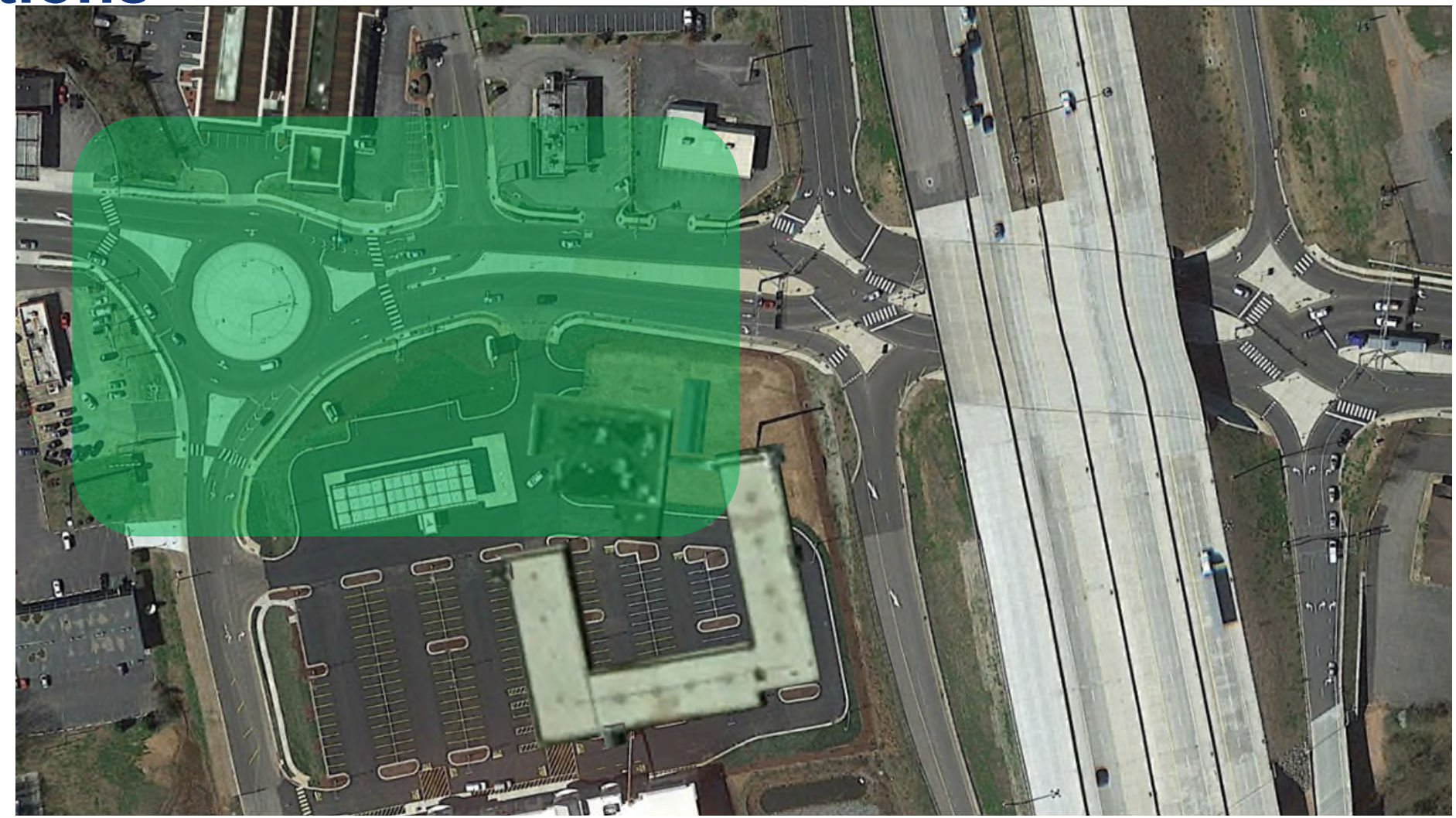
Traffic Operations

- **Closely spaced signalized intersections**
  - Can the adjacent signal be eliminated?



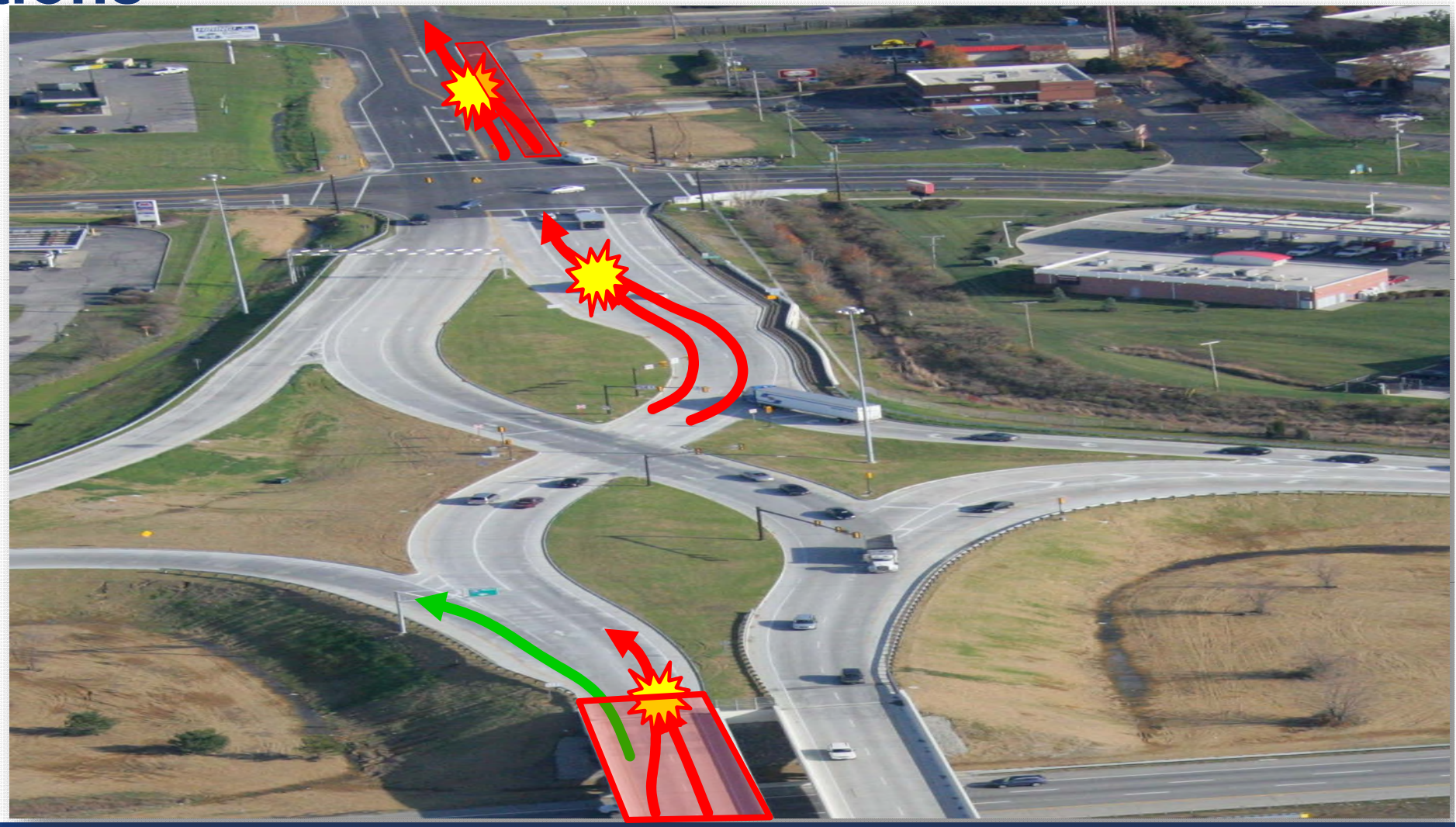
Traffic Operations

- **Closely spaced signalized intersections**
  - Can the adjacent signal be eliminated?



Traffic Operations

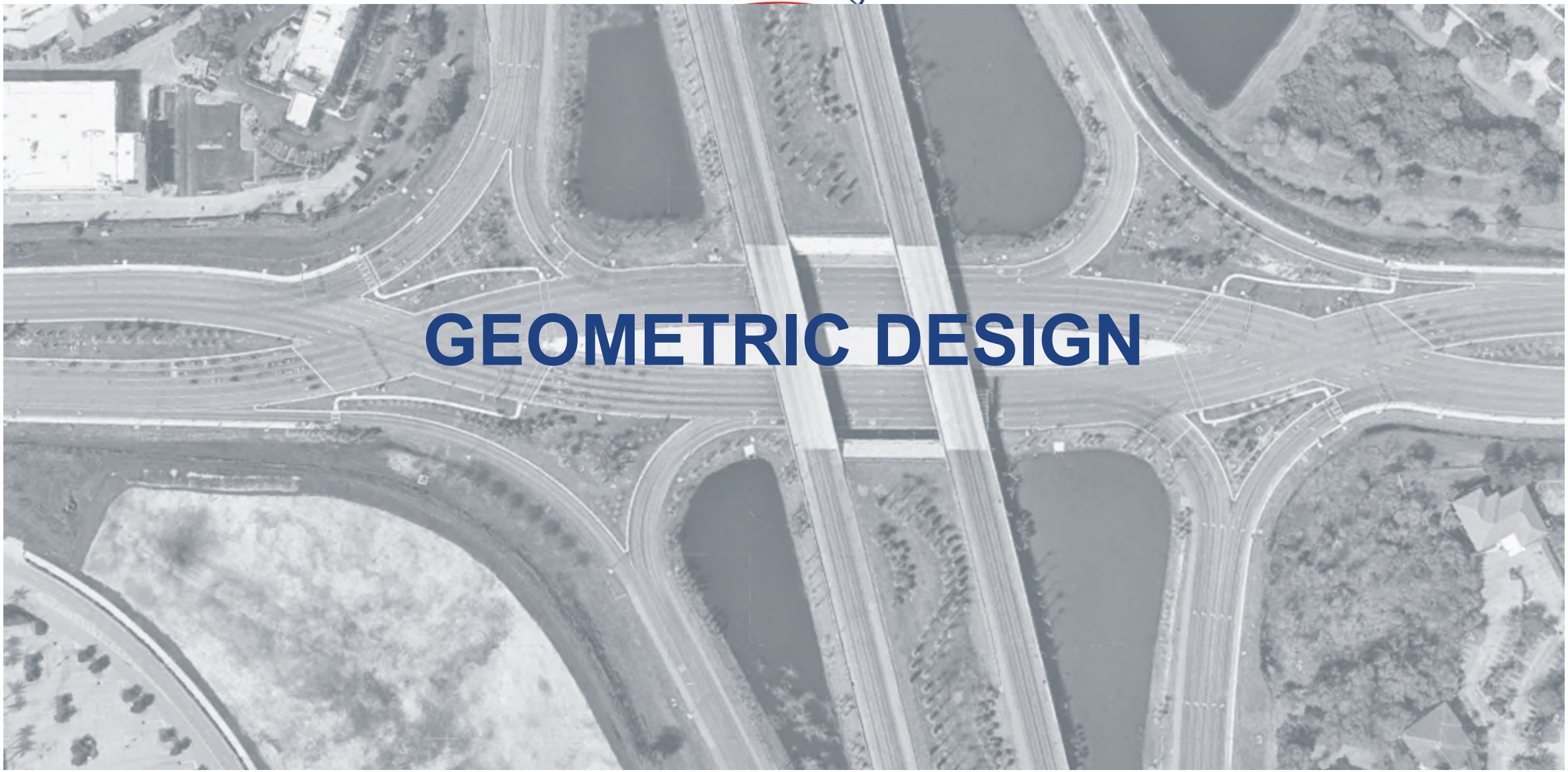
- **Lane Utilization through a DDI**
  - Think about how lane assignments affect traffic flow
  - Minimize turbulence within the DDI



Traffic Operations

More Information on DDI Traffic Operations:

August 10, 2021 @ 2-3pm



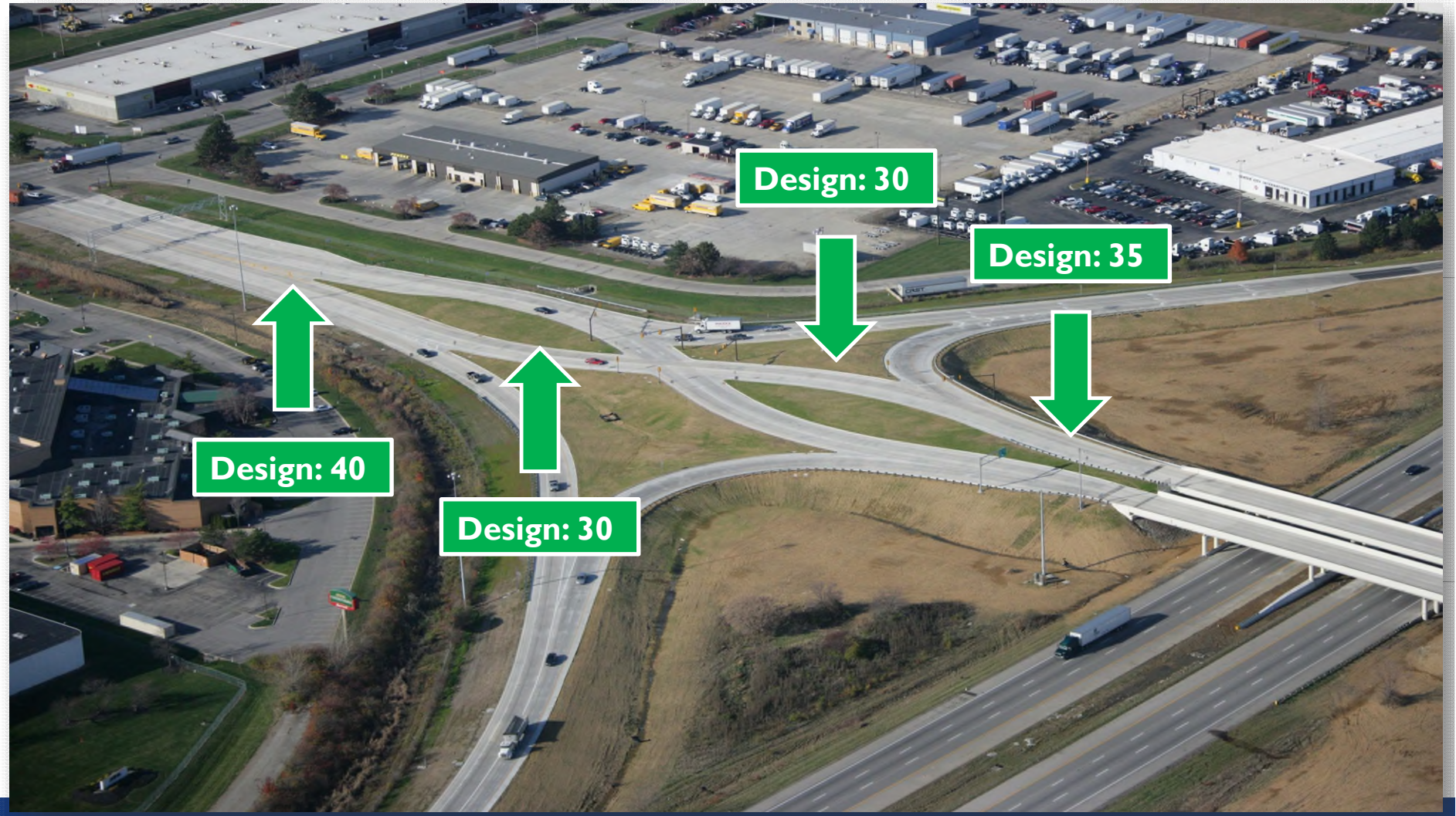
GEOMETRIC DESIGN

Geometric Design

- Intuitive to Drivers

Geometric Design

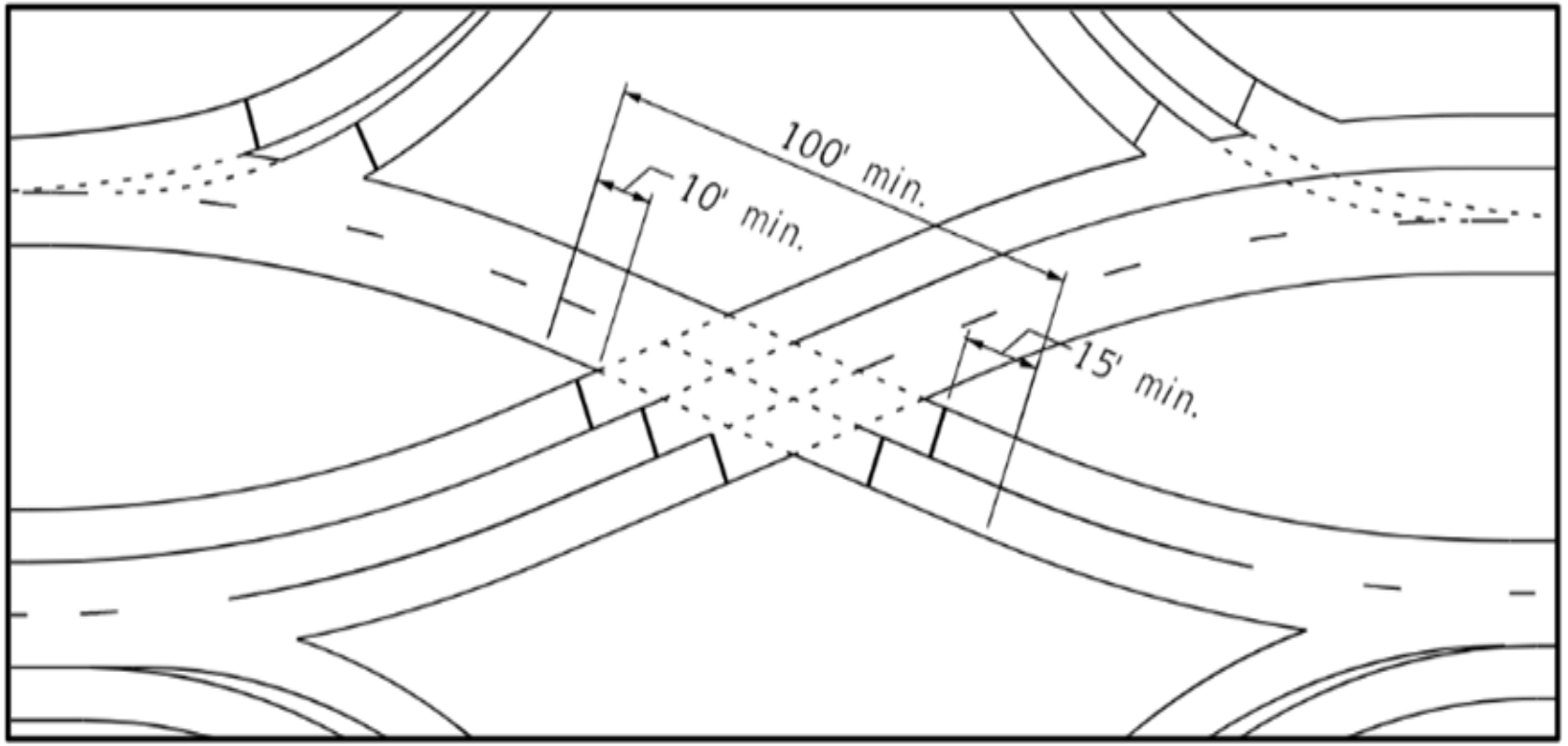
- **Intuitive to Drivers**
  - Reduce approach speeds



Geometric Design

- **Intuitive to Drivers**
  - Reduce approach speeds
  - Don’t introduce curvature within the crossover

Figure 217.3.3 Tangents at Crossover Intersections



Geometric Design

- **Intuitive to Drivers**
  - Reduce approach speeds
  - Don’t introduce curvature within the crossover
  - Crossover Angle vs Eyebrow

Geometric Design

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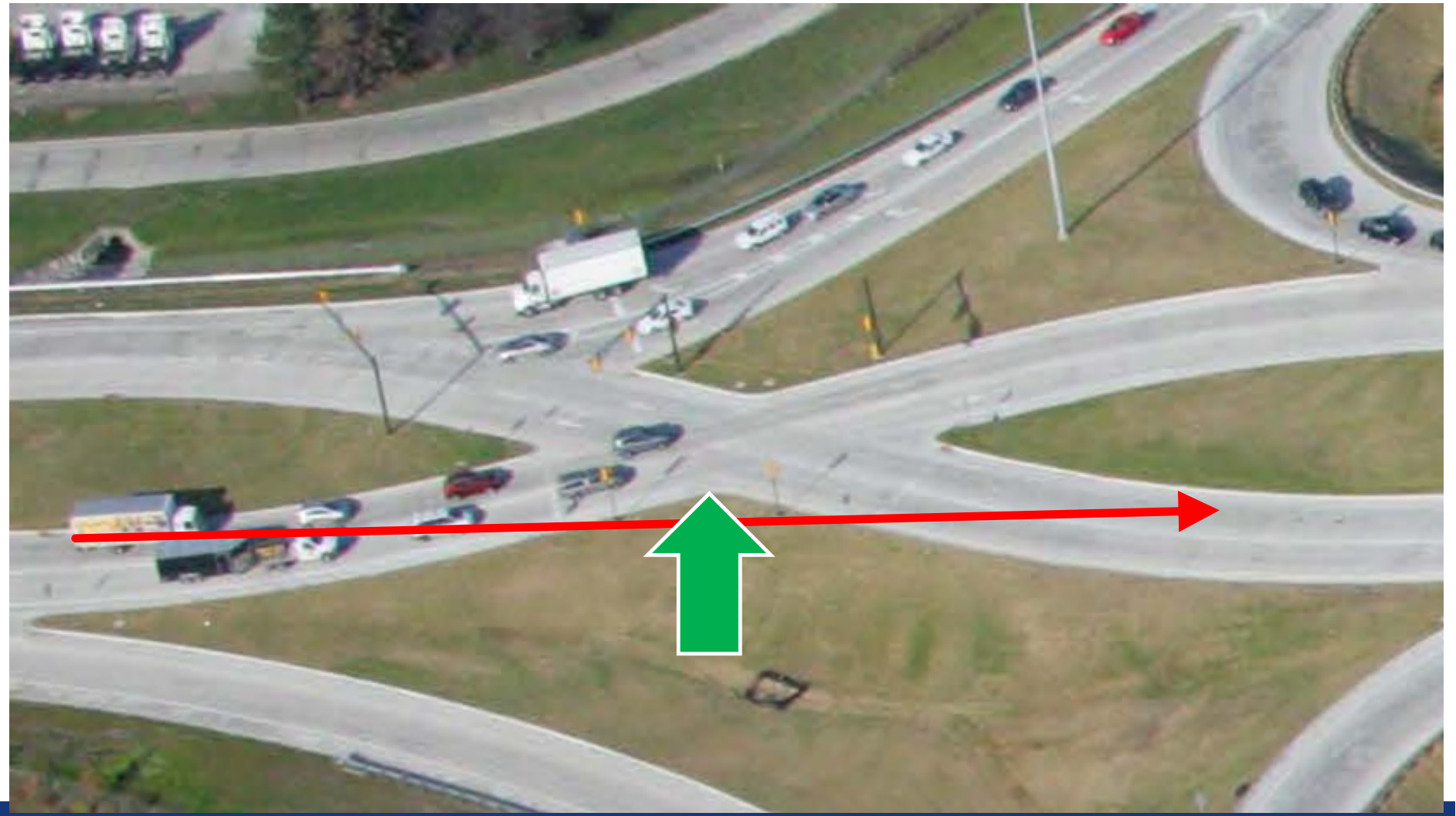

Geometric Design

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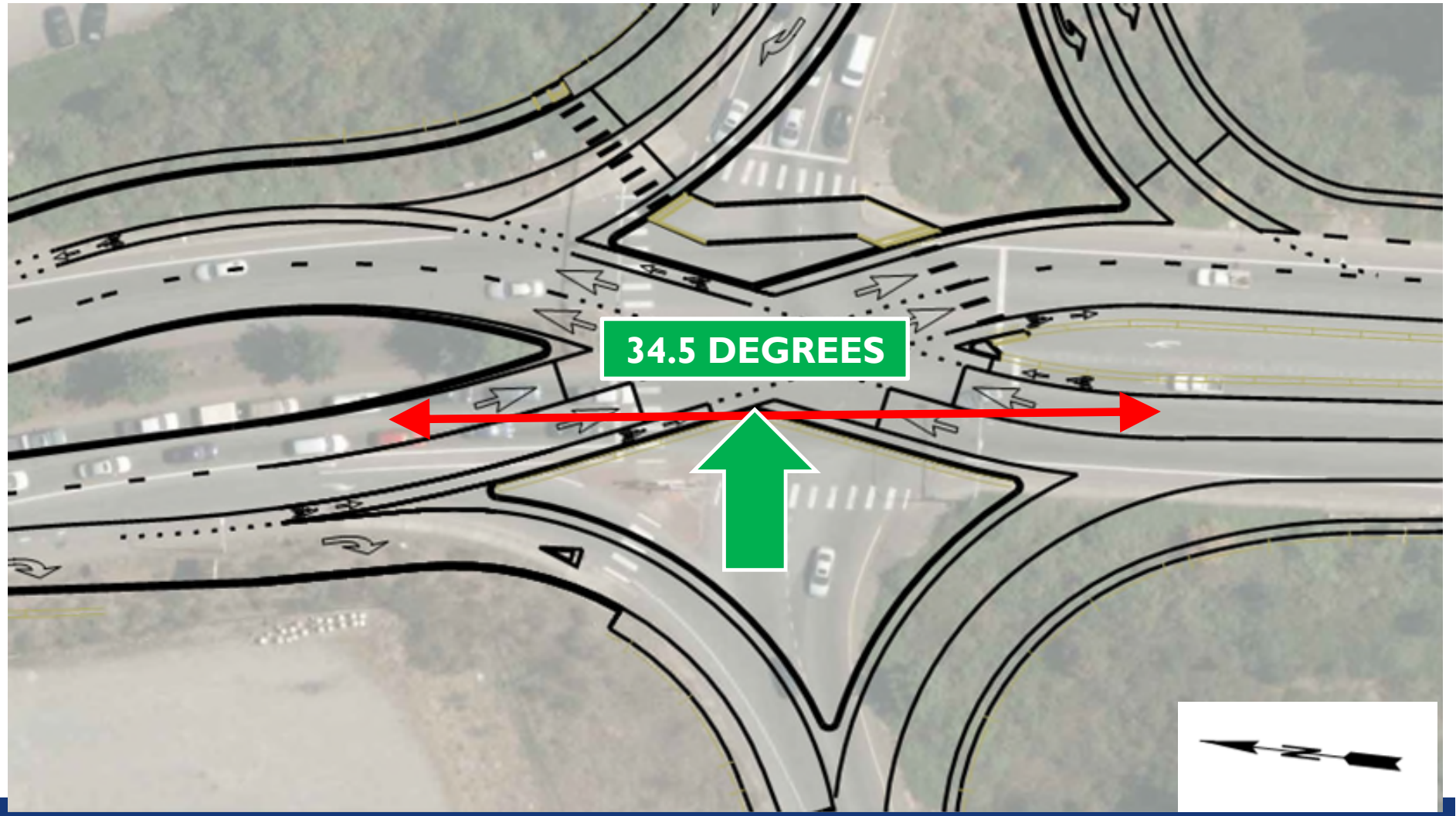

Geometric Design

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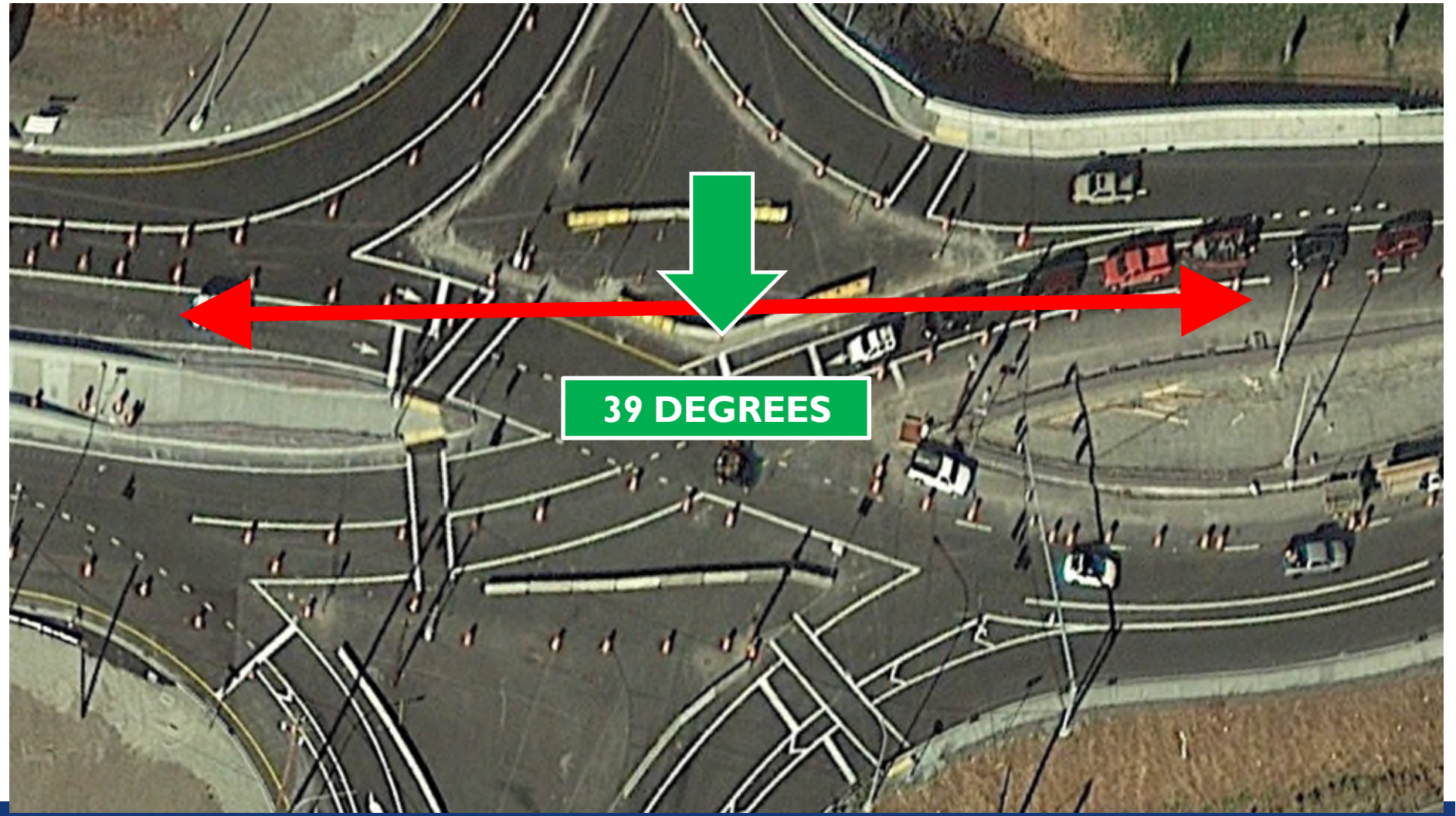
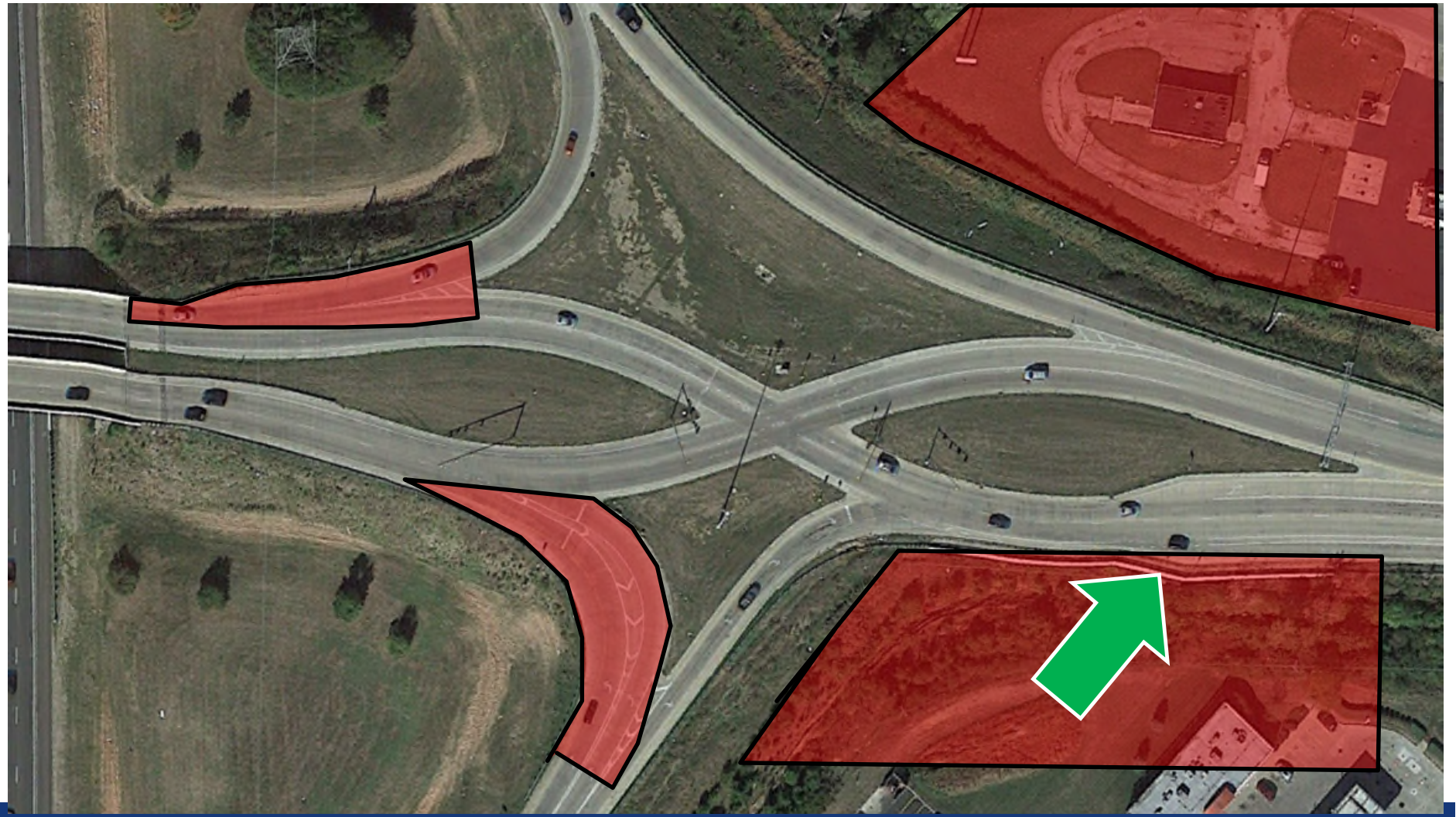


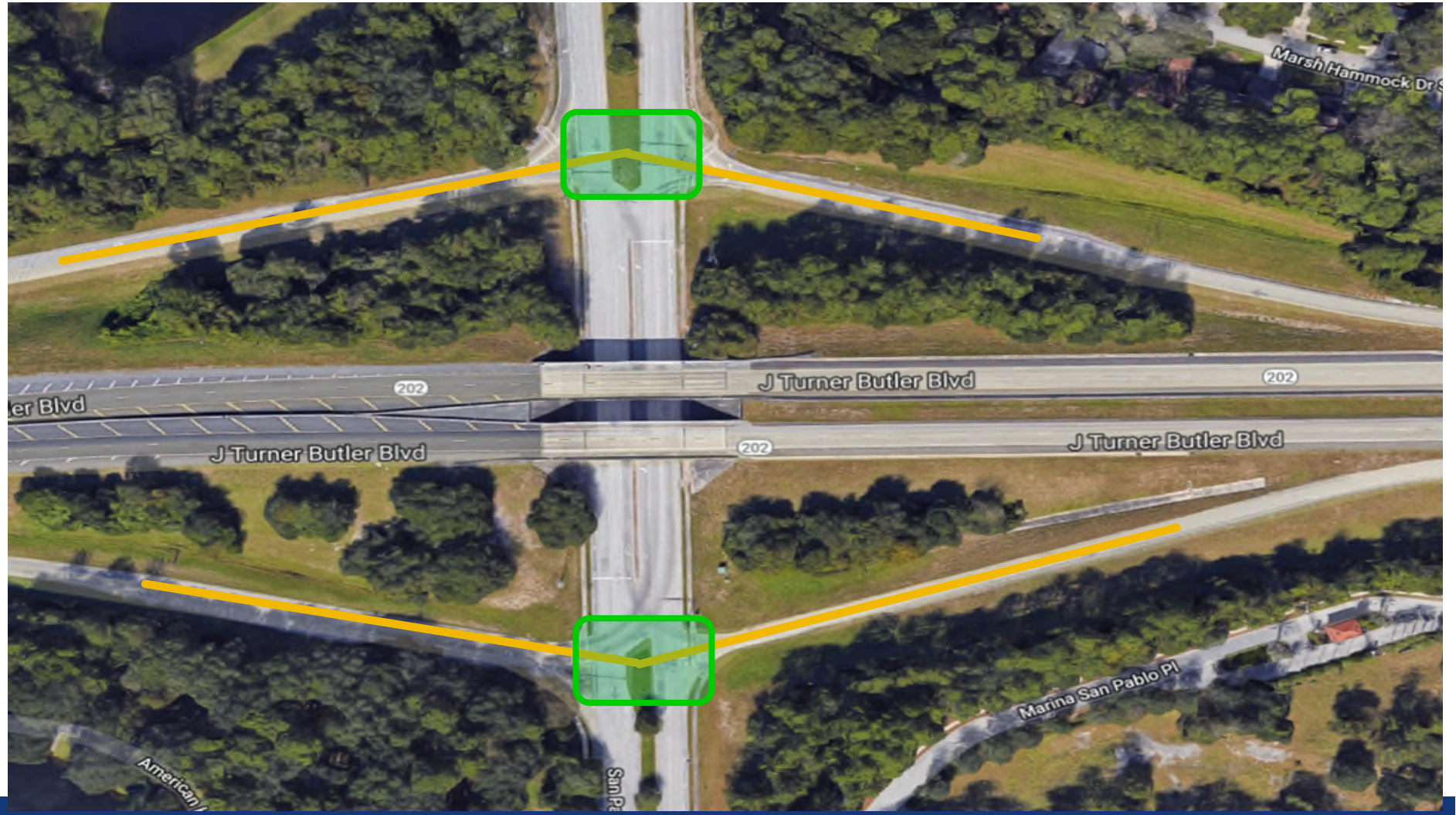
Geometric Design

- **Intuitive to Drivers**
  - Reduce approach speeds
  - Don’t introduce curvature within the crossover
  - Crossover Angle vs Eyebrow
    - R/W impacts
    - Additional costs
    - Ramp curvature
    - Ramp decel lane



Geometric Design

- **Crossover Intersection Design**
  - Locate the intersections

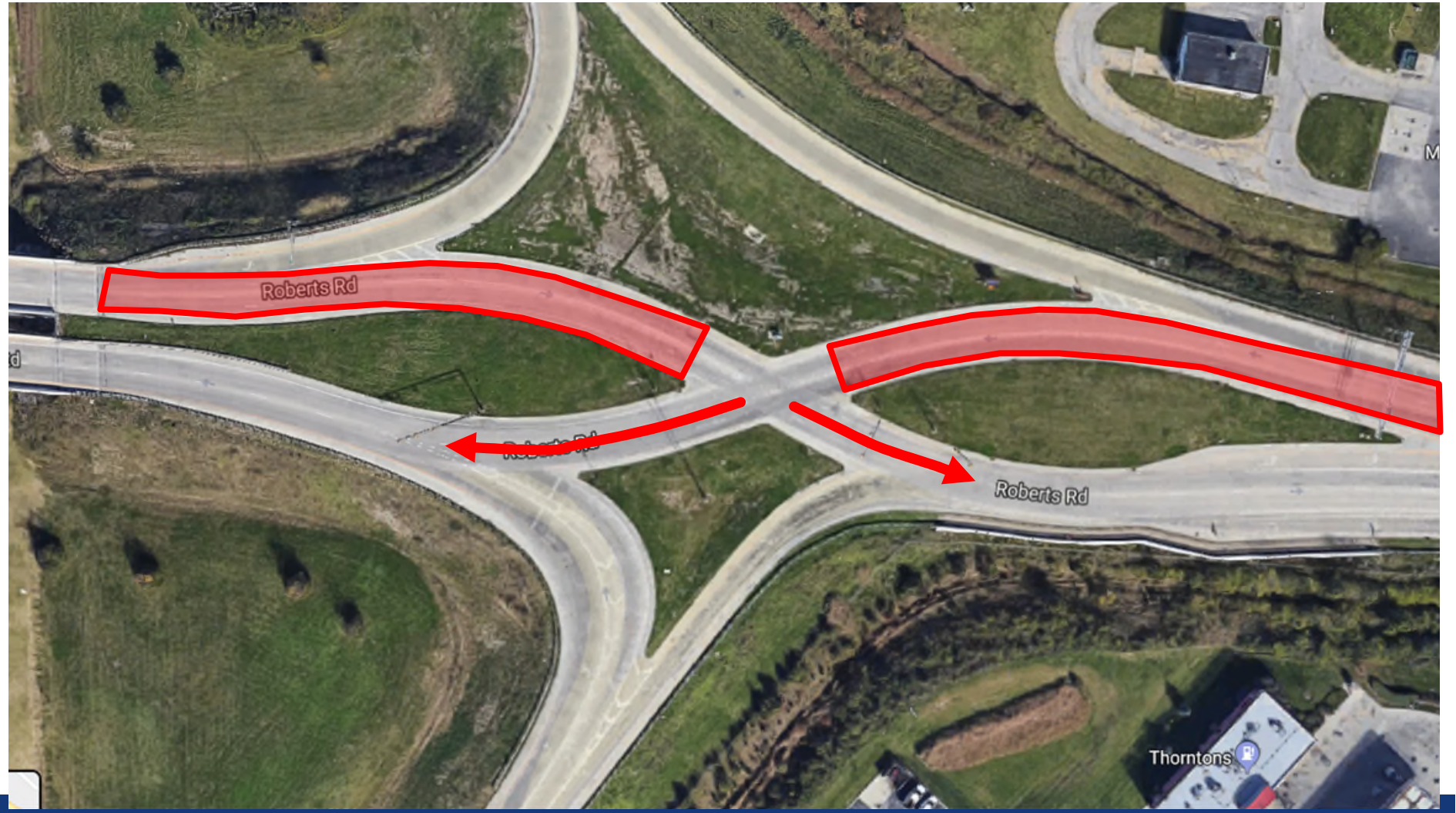


Geometric Design

- **Crossover Intersection Design**
  - Locate the intersections
  - Assess existing bridge

Geometric Design

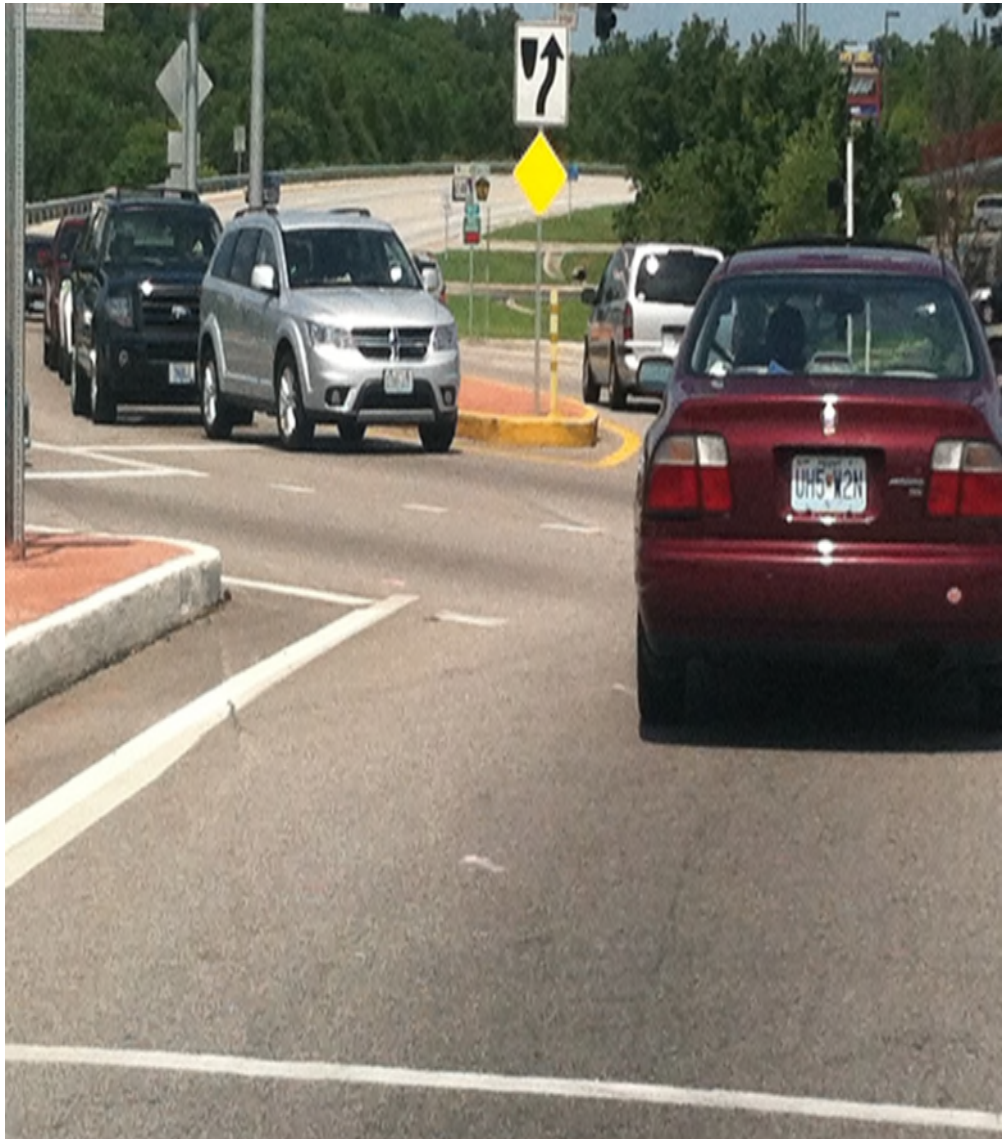
- **Crossover Intersection Design**
  - Locate the intersections
  - Assess existing bridge
  - Identify how geometrics may impact traffic operations



Geometric Design

More Information on DDI Geometric Design:

June 29, 2021 @ 2-3pm



BREAK!

Be Back by 3:45pm

TRAFFIC SIGNALS

Traffic Signals

- **Signal Head Placement**
  - Signals on back side of crossover
    - Ensure proper distance from stop bar to signal head

Traffic Signals

- **Signal Head Placement**
  - Signals on back side of crossover
    - Ensure proper distance from stop bar to signal head
  - Single mast arm for both directions
    - Watch alignment for vehicles approaching the signal heads

Traffic Signals

- **Signal Head Placement**
  - Supplemental head usage

Traffic Signals

- **Signal Head Placement**
  - Supplemental head usage
    - Seeing the signal head along the ramp when approaching

Traffic Signals

- **Signal Head Placement**
  - Supplemental head usage
    - Seeing the signal head along the ramp when approaching
    - Avoid confusion

Traffic Signals

- **Signal Head Placement**
  - Supplemental head usage
    - Seeing the signal head along the ramp when approaching
    - Avoid confusion – conflicting indications

Traffic Signals

- **Signal Head Placement**
  - Supplemental head usage
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Traffic Signals

- **Signal Head Placement**
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Traffic Signals

- **Signal Head Placement**
  - Supplemental head usage
    - Seeing the signal head along the ramp when approaching
    - Avoid confusion – conflicting indications
    - Use of arrows

Traffic Signals

- **Signal Head Placement**
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Traffic Signals

- **Signal Head Placement**
  - Supplemental head usage
    - Seeing the signal head along the ramp when approaching
    - Avoid confusion – conflicting indications
    - Use of arrows

Traffic Signals

- **Signal Head Placement**
  - Crossover Intersection
    - Basic green ball

Traffic Signals

- **Signal Head Placement**
  - Crossover Intersection
    - Basic green ball
    - Straight up arrow

Traffic Signals

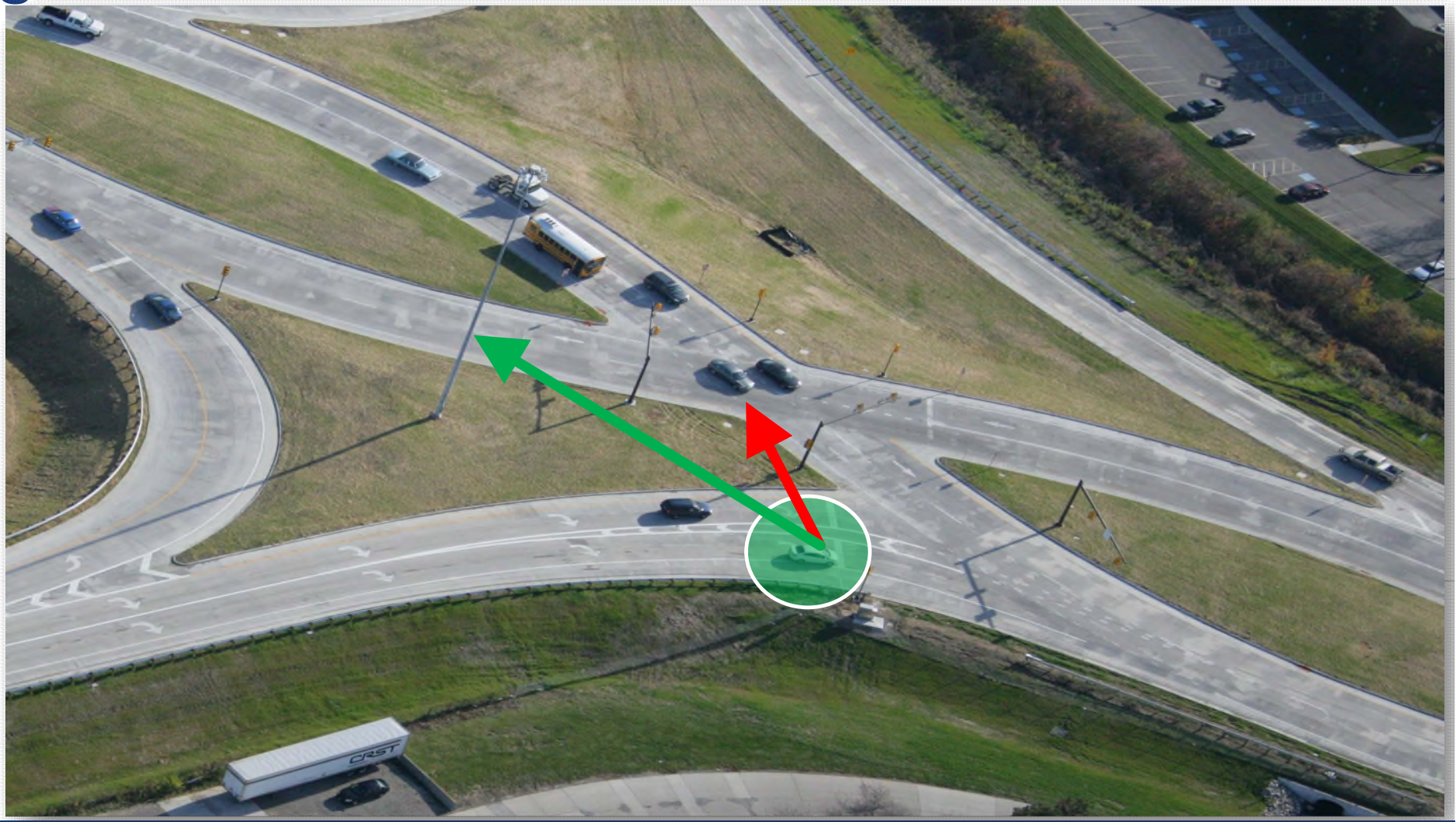
- **Signal Head Placement**
  - Crossover Intersection
    - Basic green ball
    - Straight up arrow
    - Diagonal arrow (up)

Traffic Signals

- **Signalized Right Turns**

Traffic Signals

- **Signalized Right Turns**
  - Poor sight lines can lead to driver error
  - Dual turn lanes can cause sight line obstructions



Traffic Signals

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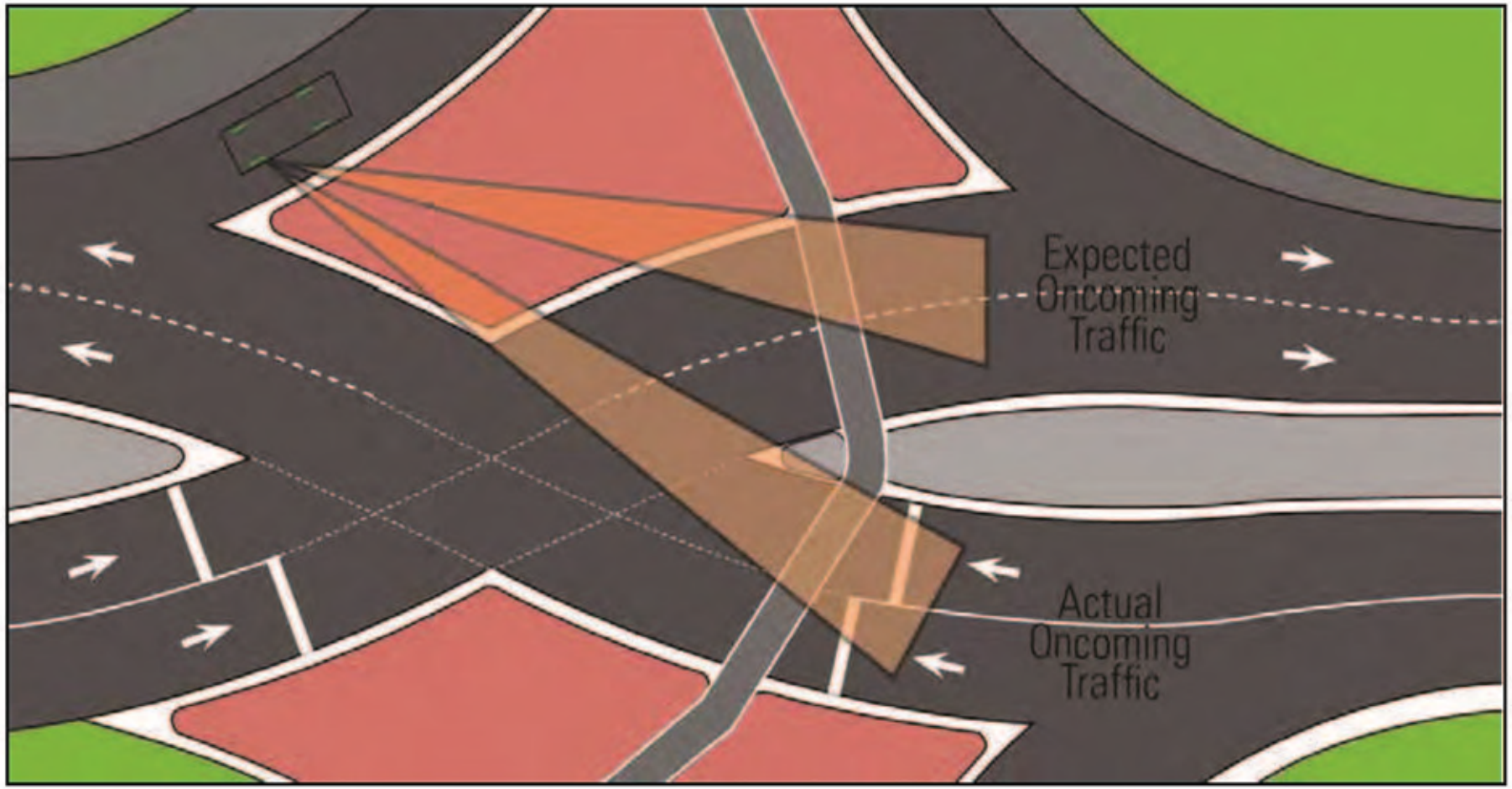


Figure 2.8 Diagram of expected oncoming traffic versus actual oncoming traffic

Source: MoDOT DDI Lessons Learned –2010

Traffic Signals

- **Signalized Right Turns**
  - Poor sight lines can lead to driver error
  - Dual turn lanes can cause sight line obstructions
  - No turns on red

Traffic Signals

- **Signalized Right Turns**
  - Poor sight lines can lead to driver error
  - Dual turn lanes can cause sight line obstructions
  - No turns on red

Traffic Signals

- **Signalized Left Turns**
  - Same sight line issues for left turns as with right turns
  - No turns on red

Traffic Signals

- **Number of Signal Cabinets**
  - One or two cabinets can be used
  - Use two if there is concern of connection loss to the controller
    - If the controller is on one side of a bridge and controlling the signal on the other side
  - GPS clocks alleviate some of the two cabinet concerns

Traffic Signals

- **Number of Signal Cabinets**
  - One or two cabinets can be used
  - Use two if there is concern of connection loss to the controller
    - If the controller is on one side of a bridge and controlling the signal on the other side
  - GPS clocks alleviate some of the two cabinet concerns

Source: DDI Information Guide, Second Edition (2021)

Exhibit 7-14. Considerations for one versus two signal controllers at a DDI.

	One Signal Controller		Two Signal Controllers
+	Reduced hardware and installation costs	+	More transparency in signal design and cabinet set-up for designers and technicians
+	Potentially avoids the need for communication infrastructure between crossovers (if no adjacent intersections)	+	Ability to control offsets directly rather than through overlap phases or other programming
+	Improved flow during "free" signal operations (e.g., late night)	+	Easier for technicians to see operations from the cabinet
–	More complicated signal design and cabinet set-up for designers and technicians	+	More room in each cabinet to allow for complicated scenarios (e.g., light-rail)
–	More difficult maintenance and troubleshooting for technicians	–	Additional hardware and installation costs
–	Additional wiring required from signal equipment to controller	–	Need for controllers to communicate and potential for time drift that may impact progression
–	More difficult for technicians to see operations at both crossovers from the cabinet	–	May result in undesirable gap-out situations during low-volume periods

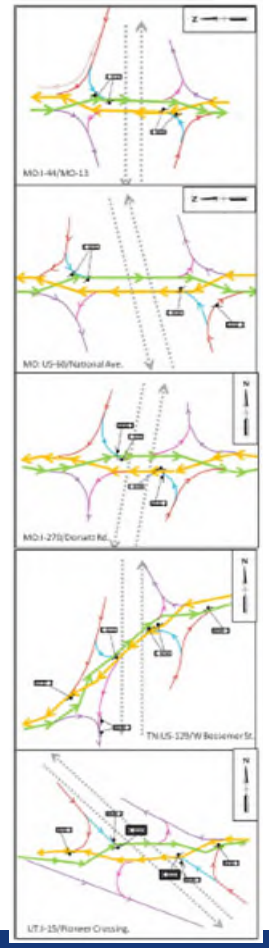
Note: Benefits are shown with a (+) and challenges with a (–).

SIGNING AND PAVEMENT MARKINGS

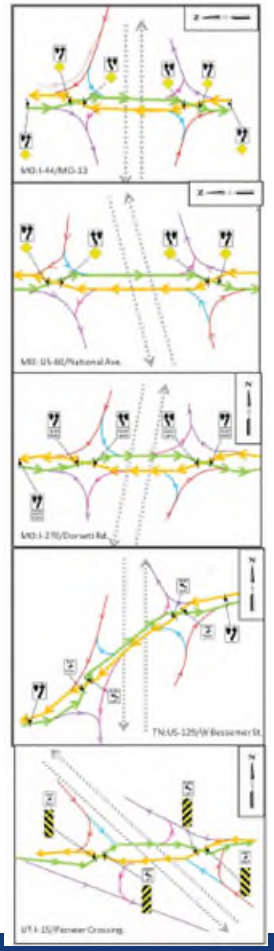
Signing and Pavement Markings

- **Signs**
  - MUTCD does not explicitly address DDI signing details
  - Practices are still evolving
  - A lot of options
  - Minimize confusion

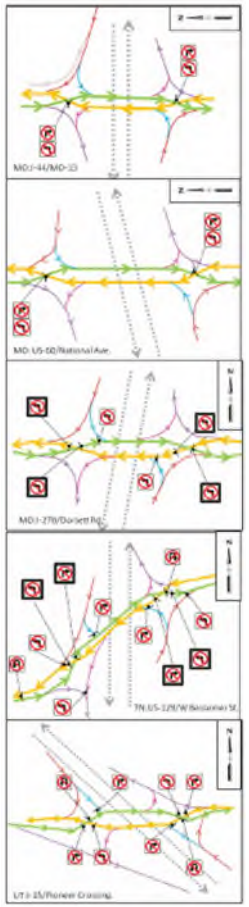
One Way Signs



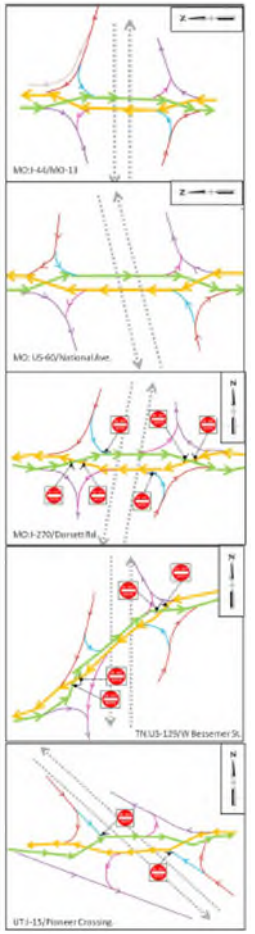
Keep Right/ Left Signs



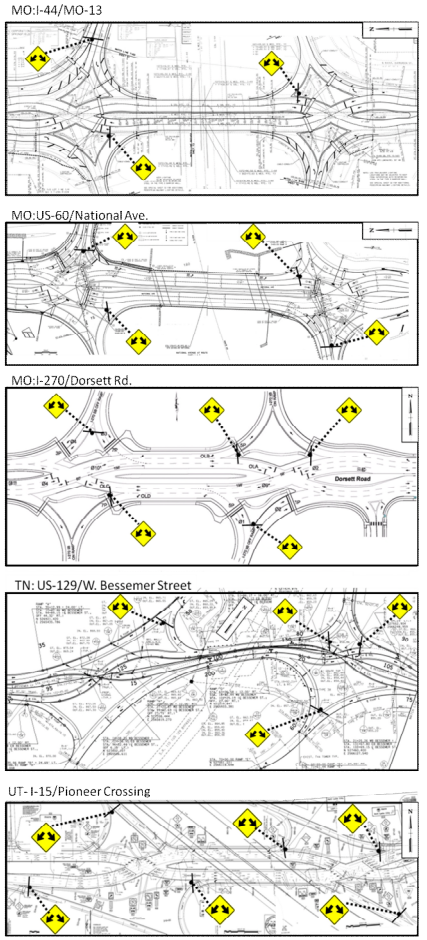
No Turn Signs



Do Not Enter



Lane Split Signs



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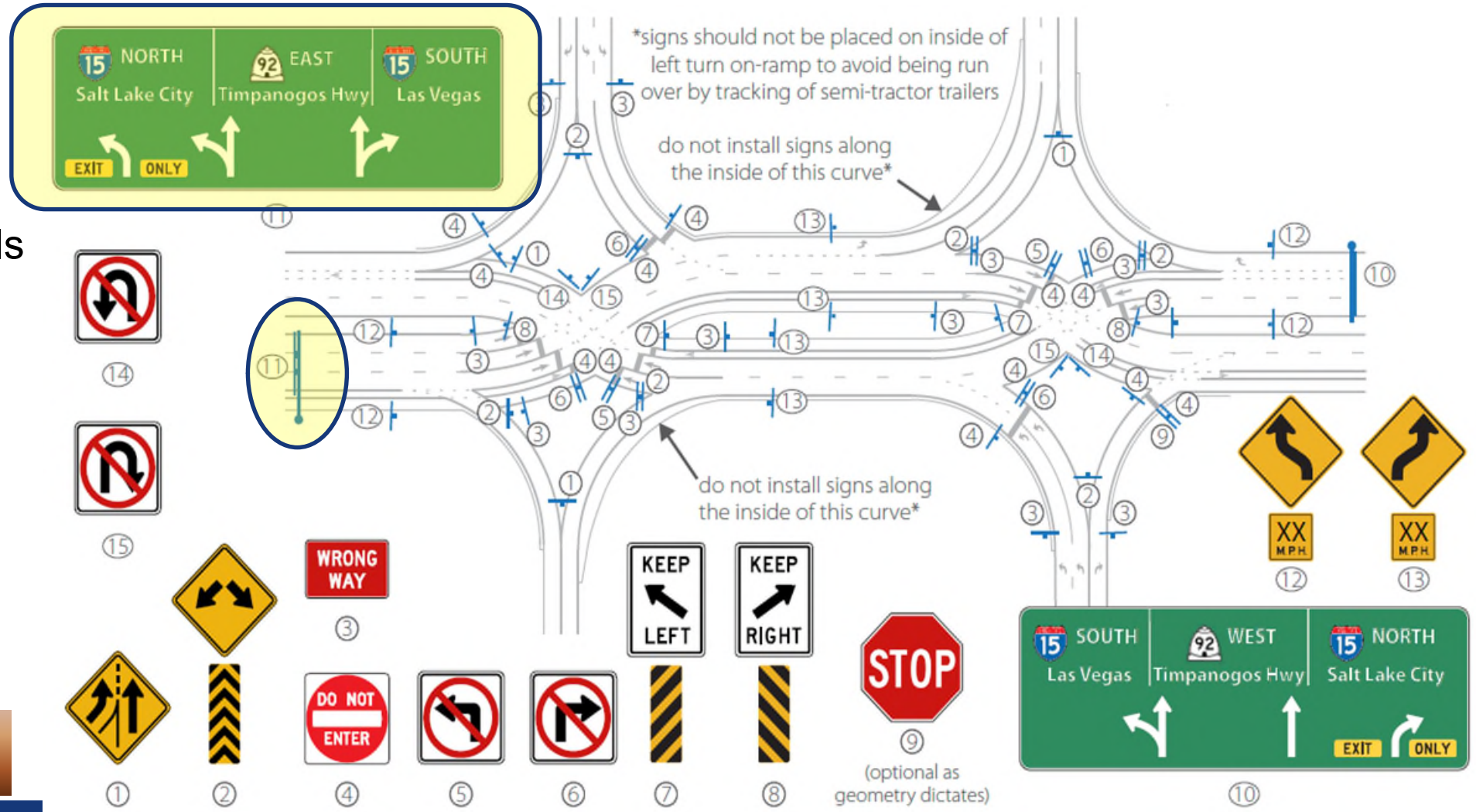

Source: Utah DOT DDI Guidelines

Signing and Pavement Markings

- **Signs**
  - Are the left turn arrows confusing when so in advance of the actual diverge location?

Signing and Pavement Markings

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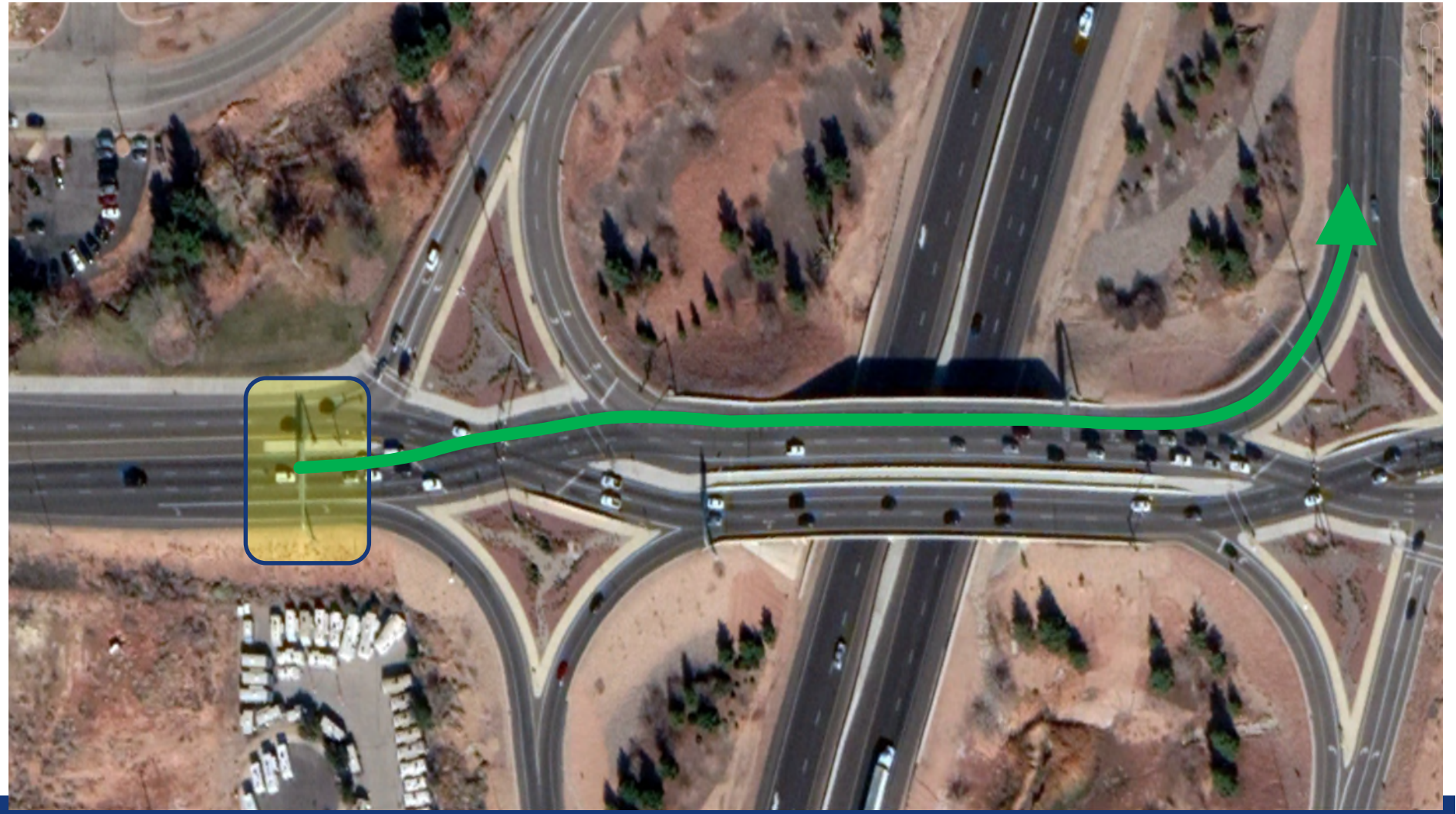

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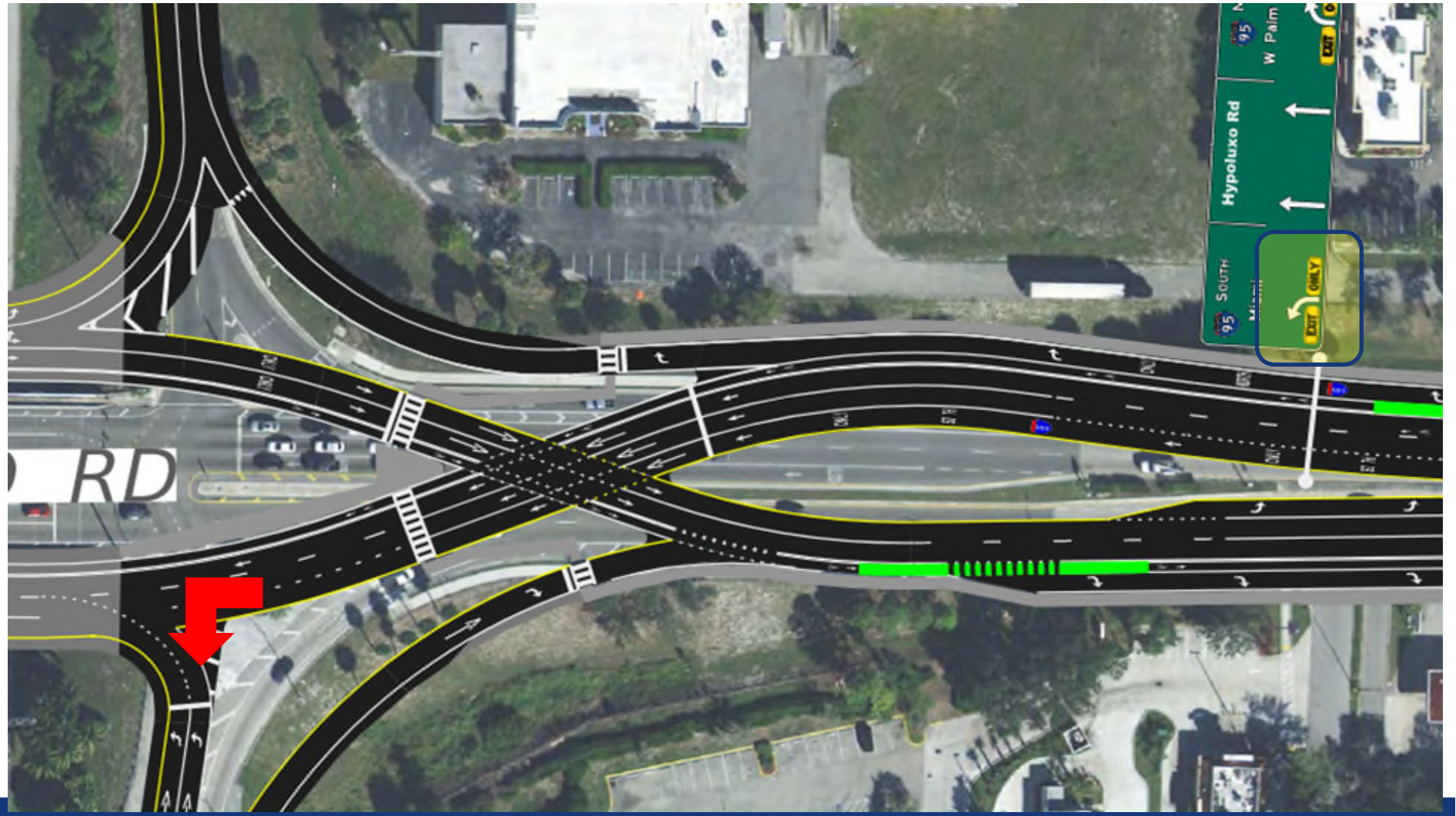
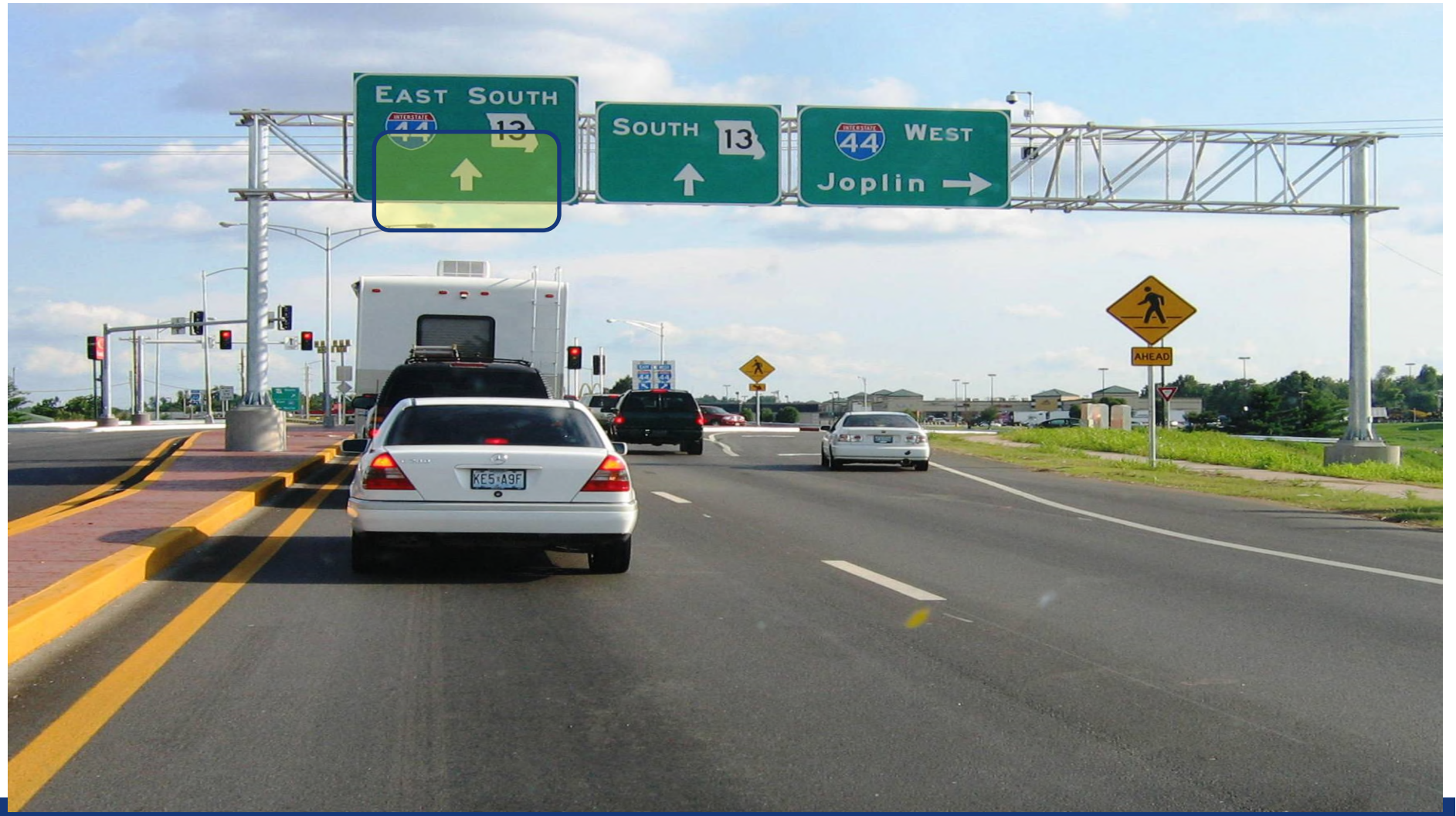


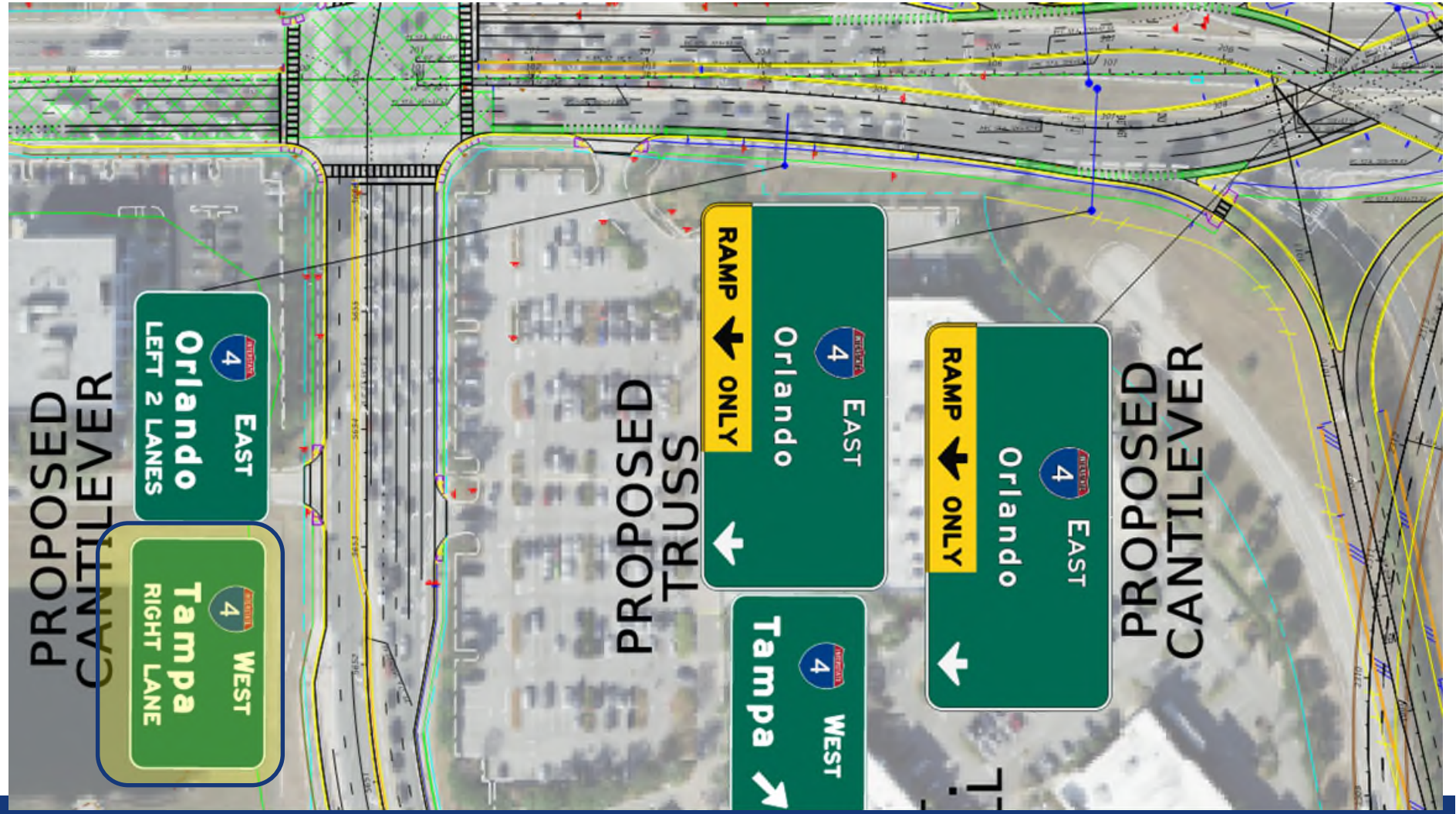
Signing and Pavement Markings

- **Signs**
  - Better to use straight arrows instead?



Signing and Pavement Markings

- **Signs**
  - Are the signs accurate?



Signing and Pavement Markings

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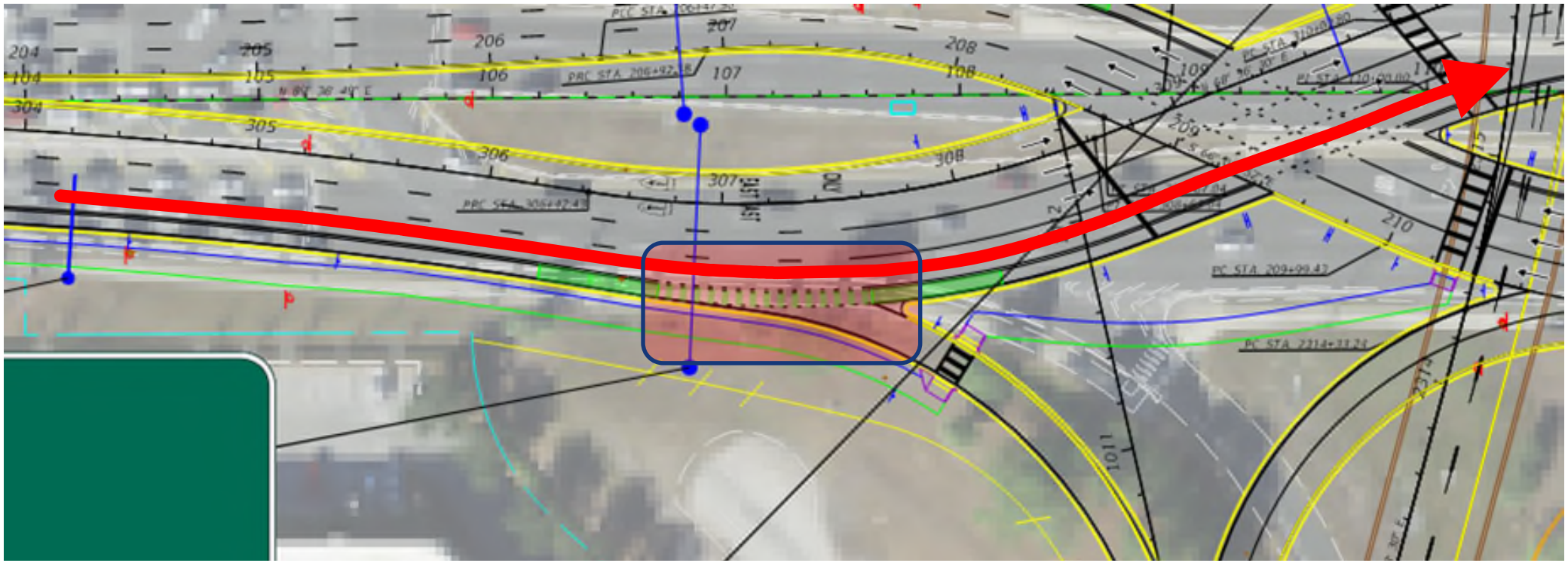
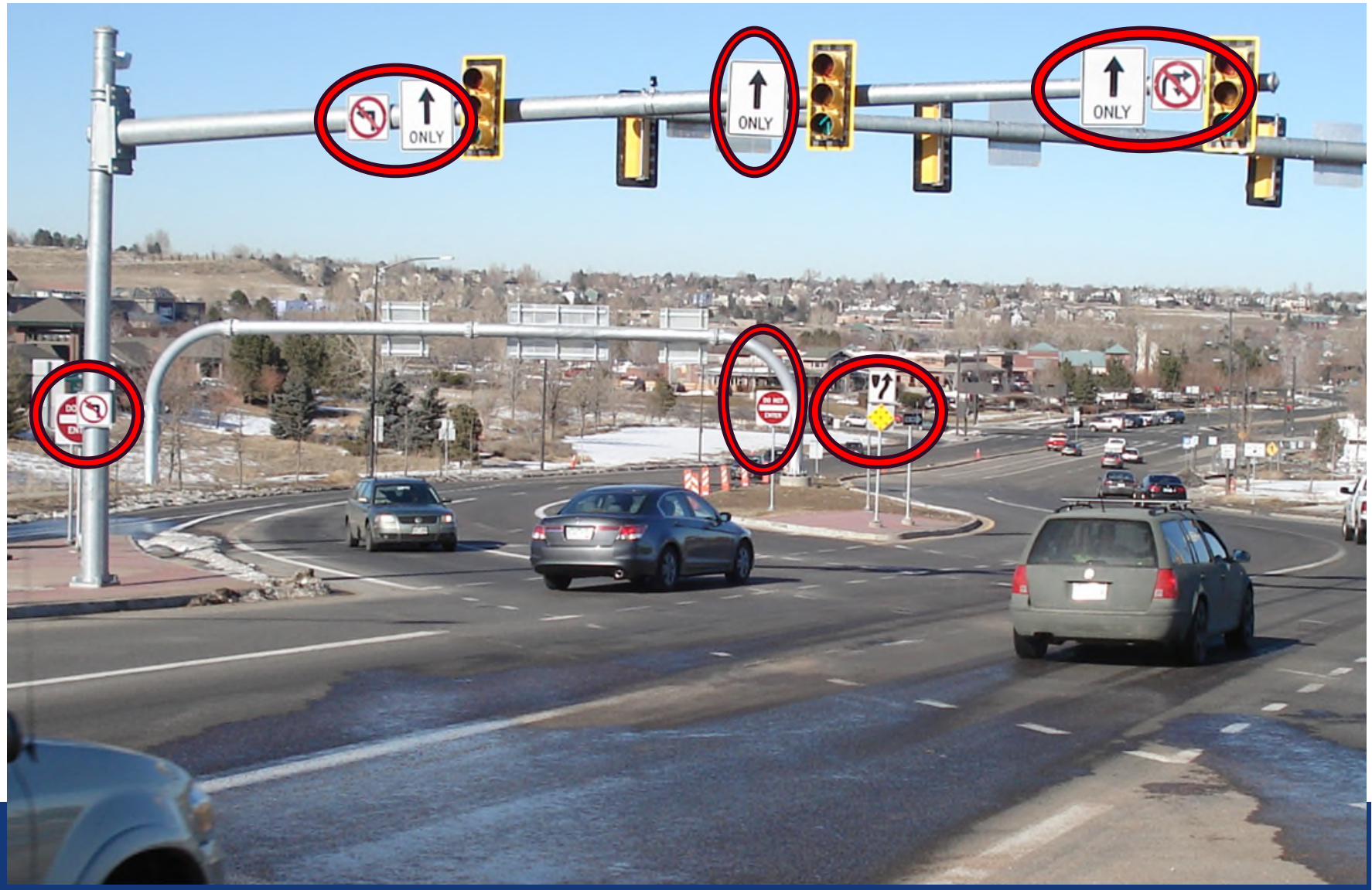


Signing and Pavement Markings

- **Signs**
  - Minimize confusion



Signing and Pavement Markings

- **Signs**
  - Minimize confusion
  - Similar signs, but spaced better throughout the intersection “visual cone”

Signing and Pavement Markings

- **Pavement Markings**
  - Identify the appropriate design vehicles, especially for dual lane turning movements
  - Place excess pavement between lanes in the middle for use by trucks from both turn lanes

Signing and Pavement Markings

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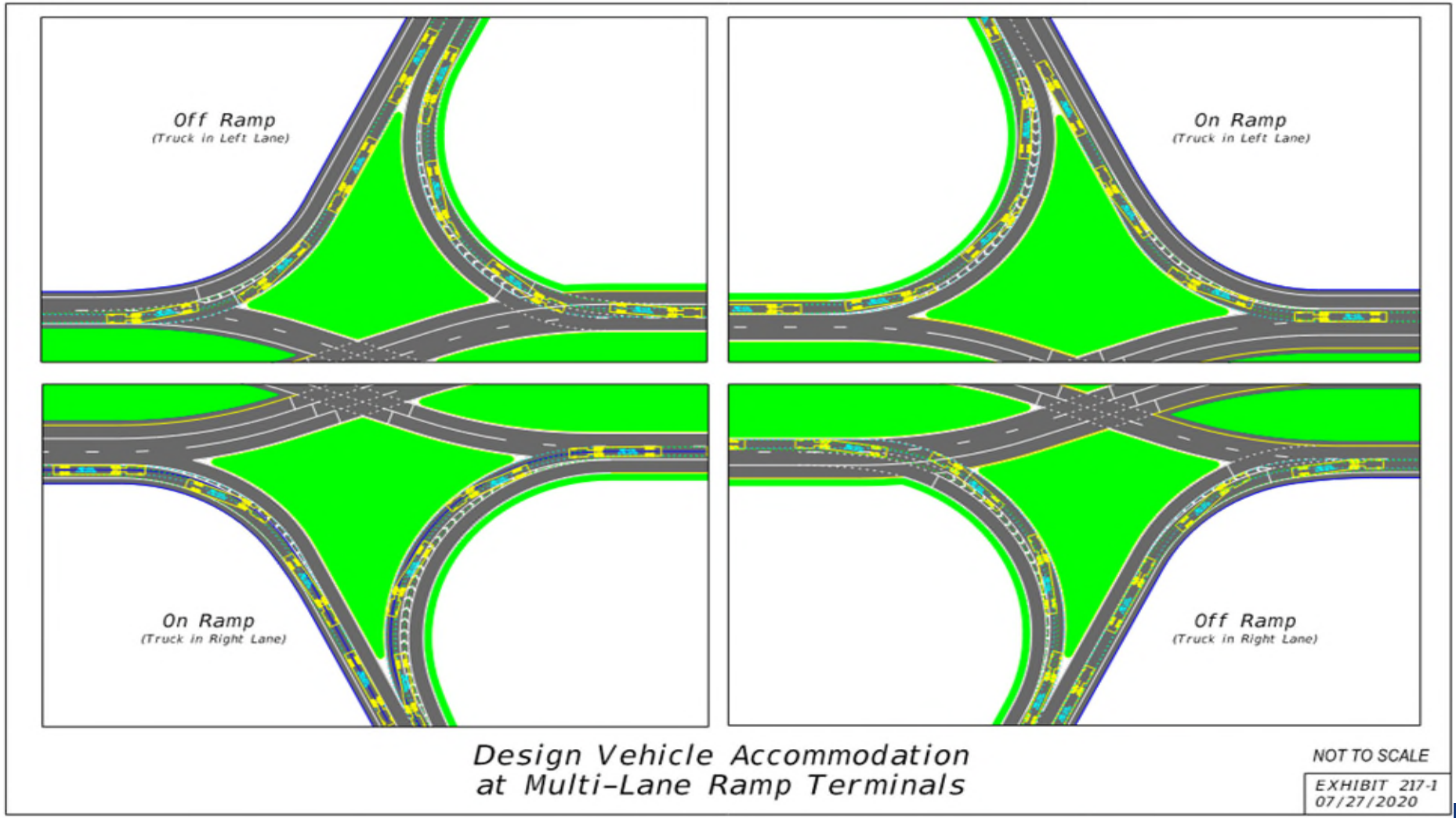
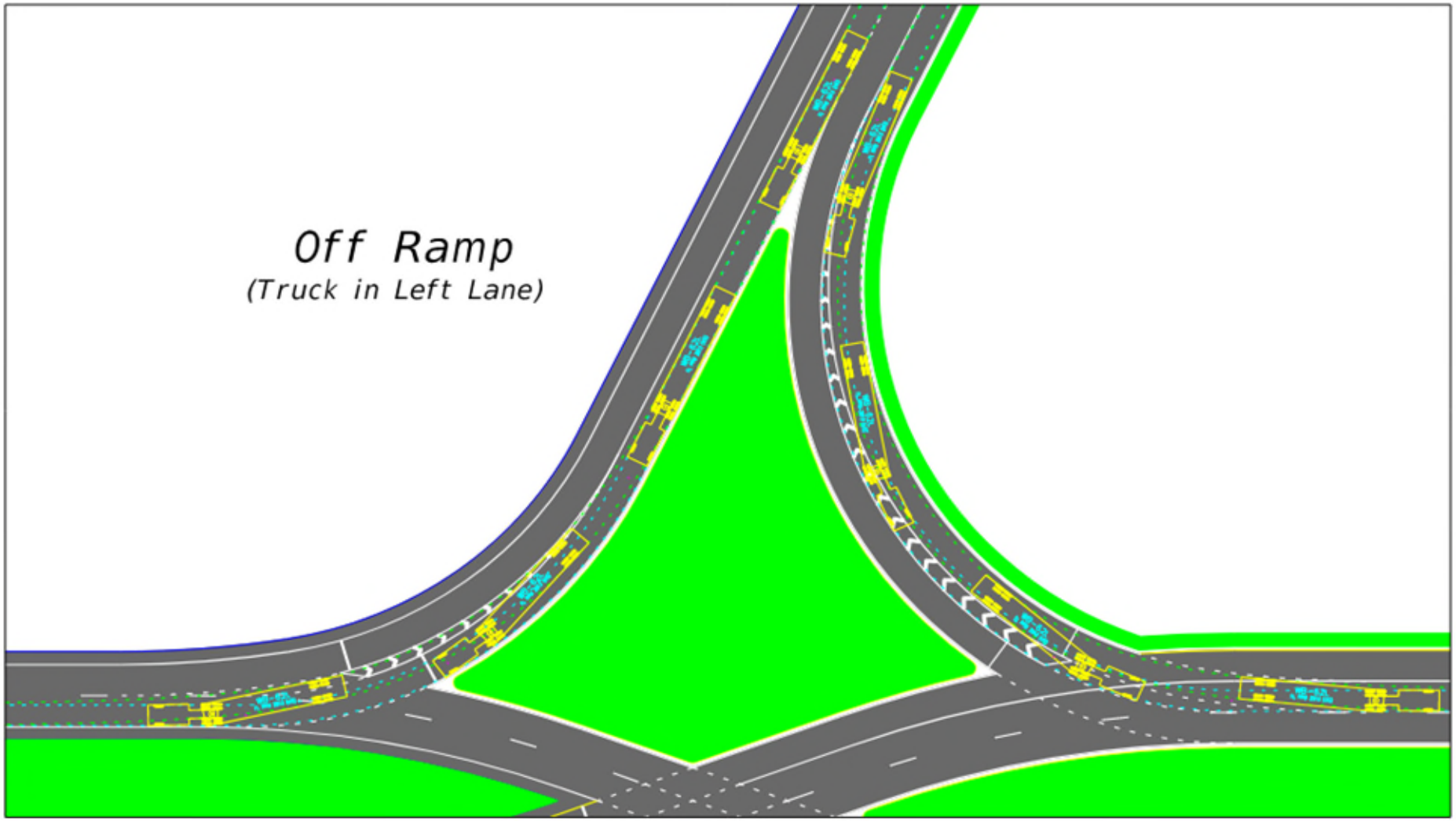
  - Identify the appropriate design vehicles, especially for dual lane turning movements
  - Place excess pavement between lanes in the middle for use by trucks from both turn lanes



Signing and Pavement Markings

- **Pavement Markings**
  - Identify the appropriate design vehicles, especially for dual lane turning movements
  - Place excess pavement between lanes in the middle for use by trucks from both turn lanes



Signing and Pavement Markings

More Information on DDI Signing and Pavement Markings:

July 16, 2021 @ 2-3pm

MULTIMODAL ACCOMMODATIONS

Multimodal Accommodations

- **Benefits of DDIs**
  - Reduced overall right-of-way footprint compared to a conventional diamond interchange
  - Two-phase traffic signal control with reduced pedestrian wait time
  - Minimized crossing distances
  - Simplification of conflicts to one-directional vehicular traffic
  - Opportunities for bicycle lanes and multiuse paths through the interchange

Multimodal Accommodations

- **Challenges of DDIs**
  - Altered travel paths with travel in the center of the interchange between vehicular lanes
  - Traffic approaching from unexpected directions
  - Unfamiliar signal phases
  - Uncontrolled crossing of turn lanes

Multimodal Accommodations

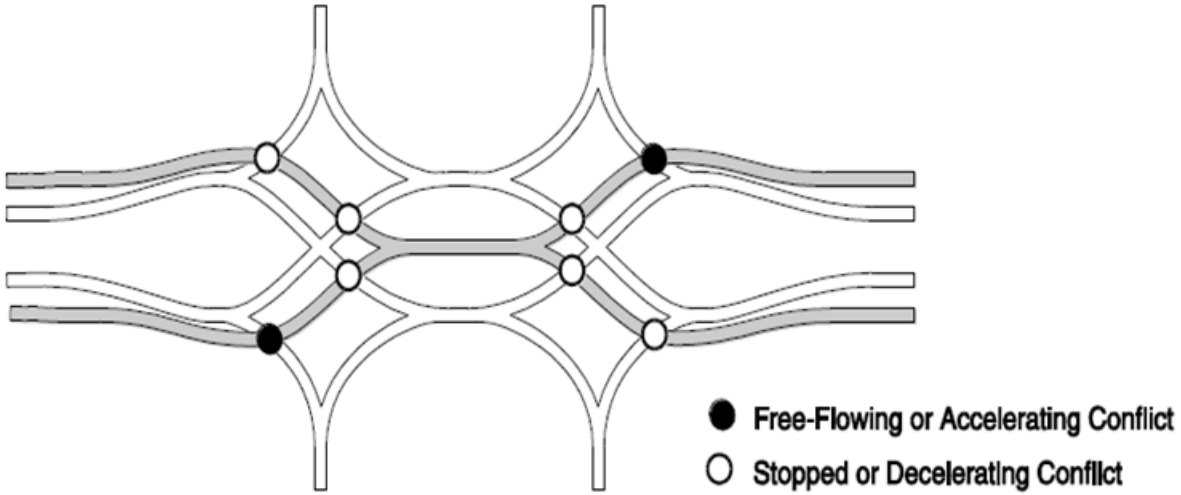
- **Pedestrian Accommodations**
  - Section 217.6 - FDOT DDI Developmental Design Criteria
  - Consider pedestrian accommodations early in the DDI design process
  - Develop a balanced design that meets the safety and mobility needs for all users

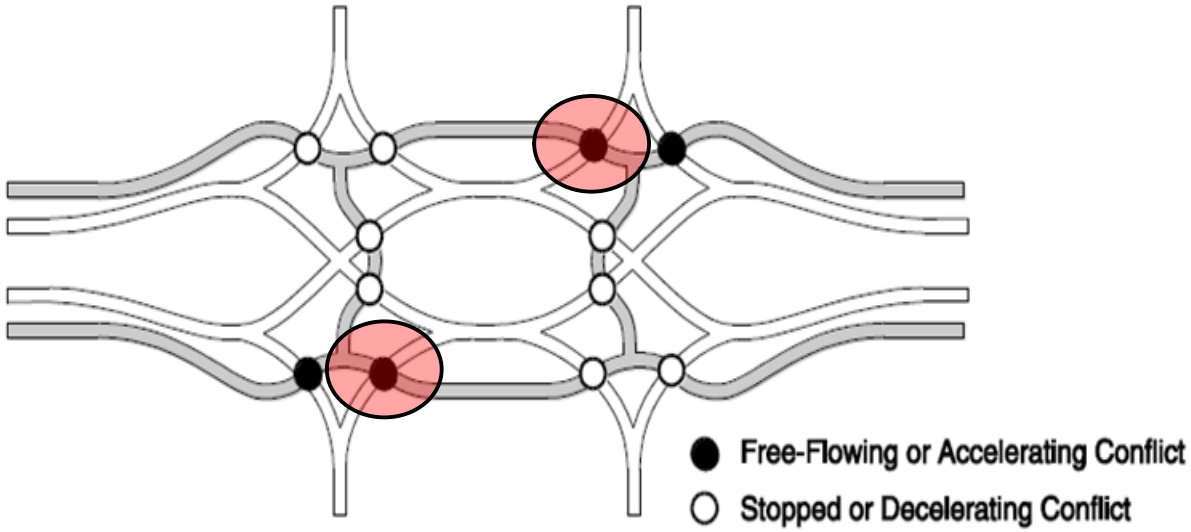
Multimodal Accommodations

- **Pedestrian Accommodations**
  - Inside (center) of the interchange
  - Outside of the interchange

Multimodal Accommodations

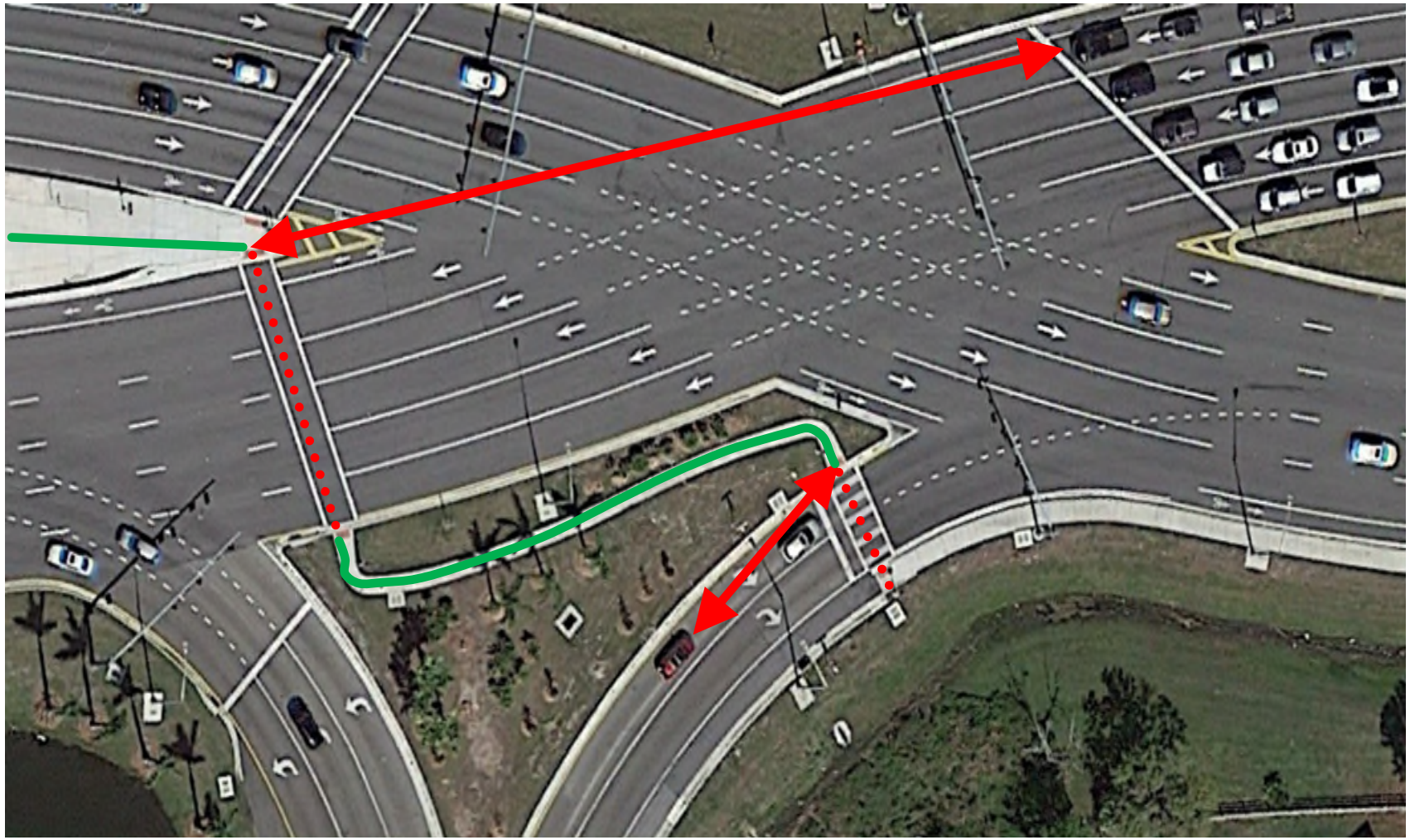
- **Pedestrian Accommodations**
  - *Center walkway is preferred in Florida*
    - Avoids free-flow left turning movement





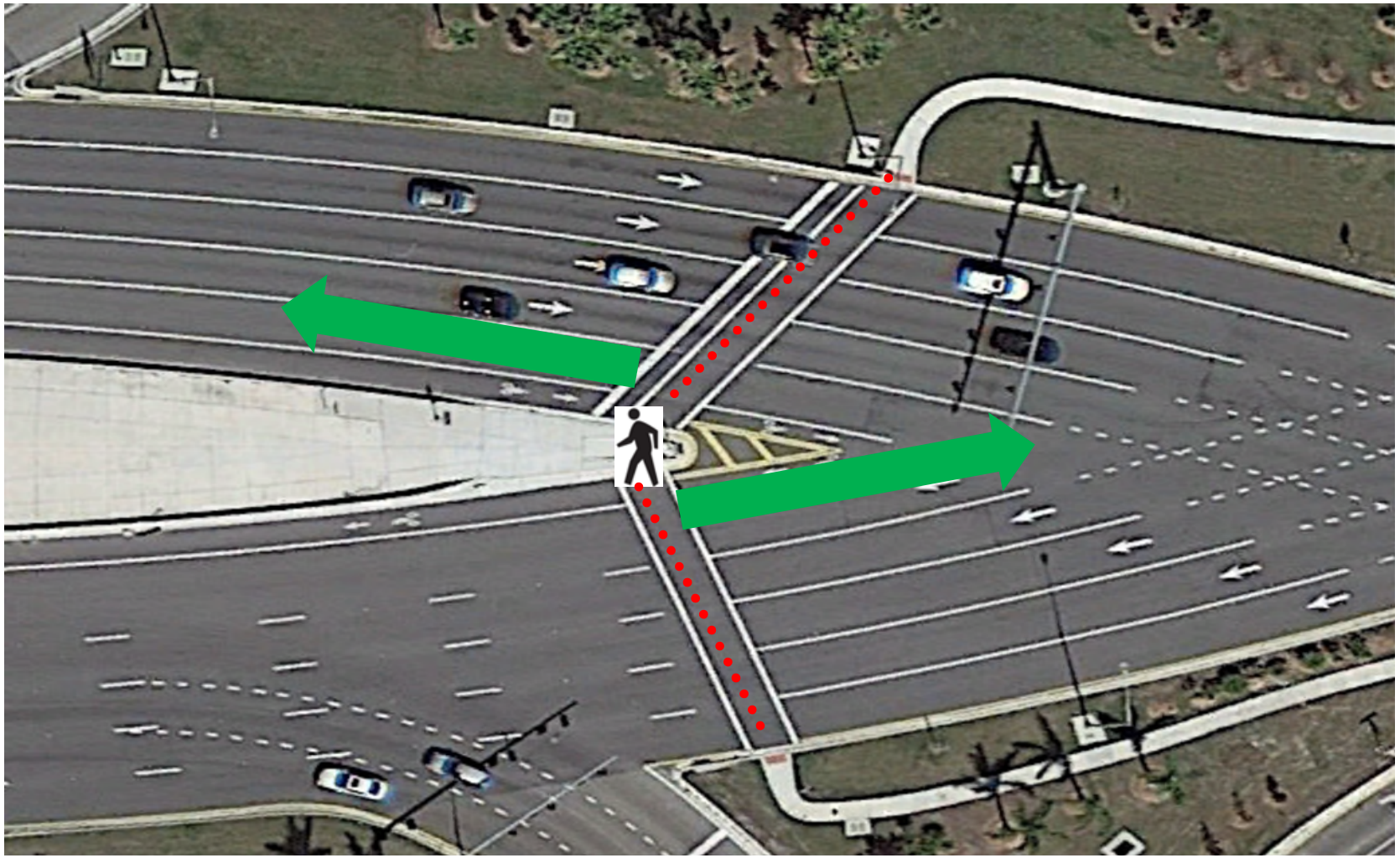
Multimodal Accommodations

- **Pedestrian Accommodations**
  - *Center walkway is preferred in Florida*
    - Avoids free-flow left turning movement
    - Improve line of sight for between pedestrians and drivers



Multimodal Accommodations

- **Pedestrian Accommodations**
  - *Center walkway is preferred in Florida*
    - Avoids free-flow left turning movement
    - Improve line of sight for between pedestrians and drivers
    - Cross at signalized crossover intersection consistent with expectations
      - pedestrians looking left first



Multimodal Accommodations

- **Pedestrians – Outside**
  - Provide clear line of sight at all crossings, especially free-flow crossings

Multimodal Accommodations

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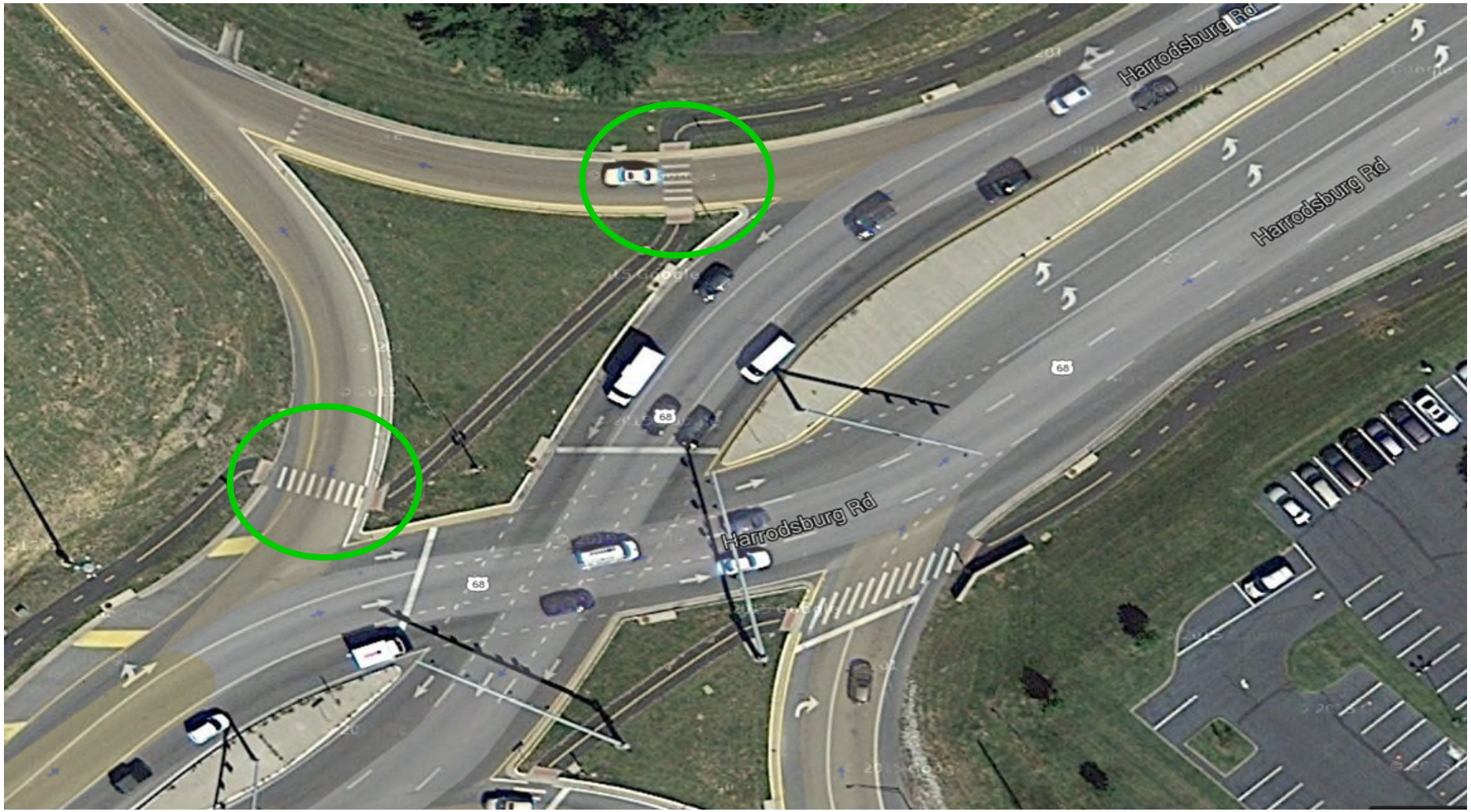
Multimodal Accommodations

- **Pedestrians – Outside**
  - Provide clear line of sight at all crossings, especially free-flow crossings
  - Perpendicular crossings

Multimodal Accommodations

- **Pedestrians – Outside**
  - Provide clear line of sight at all crossings, especially free-flow crossings
  - Perpendicular crossings
  - Position the crossings close to the arterial to reduce high-speed conflicts



Multimodal Accommodations

- **Pedestrians**
  - Particularly vulnerable when crossing after looking to their right

Multimodal Accommodations

- **Pedestrians**
  - Particularly vulnerable when crossing after looking to their right
  - Perhaps offer a reminder of where to look

Multimodal Accommodations

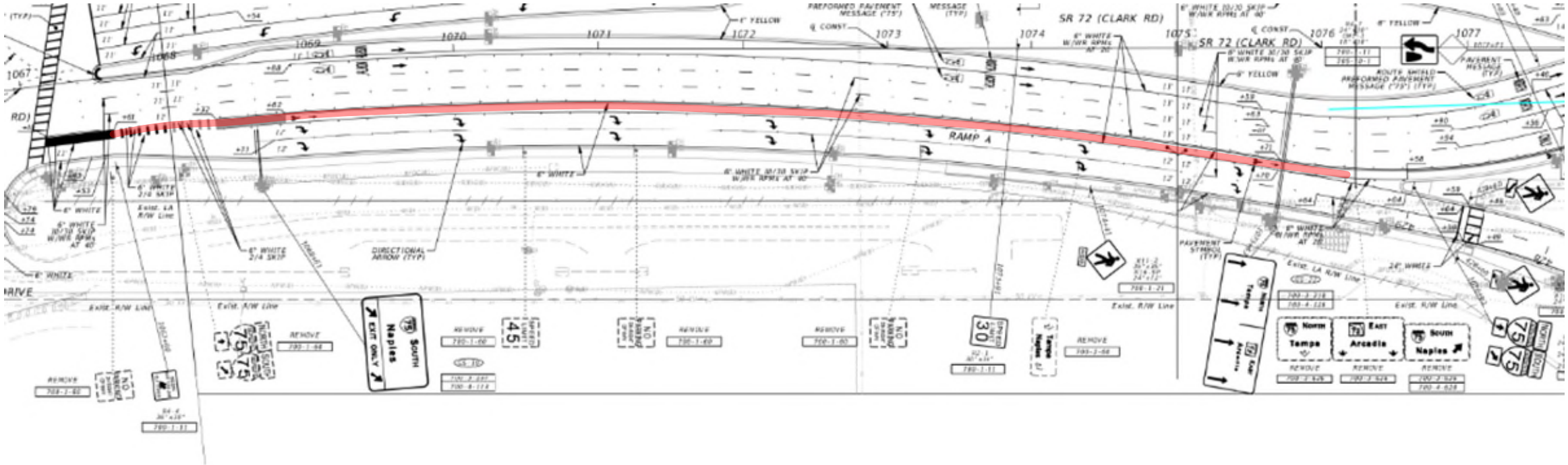
- **Bicyclists**
  - 3 possible treatments at a DDI
    - Separated bicycle lanes or shared use paths
    - Marked bicycle lanes
    - Bicyclists share the driving lanes with vehicular traffic
      - This treatment should be used only in very low-speed conditions

Multimodal Accommodations

- **Bicyclists**
  - Keep to the right of the right-most travel lane
  - Will position the bicyclist on the “inside of the roadway” across the freeway but still are to the right of the driver

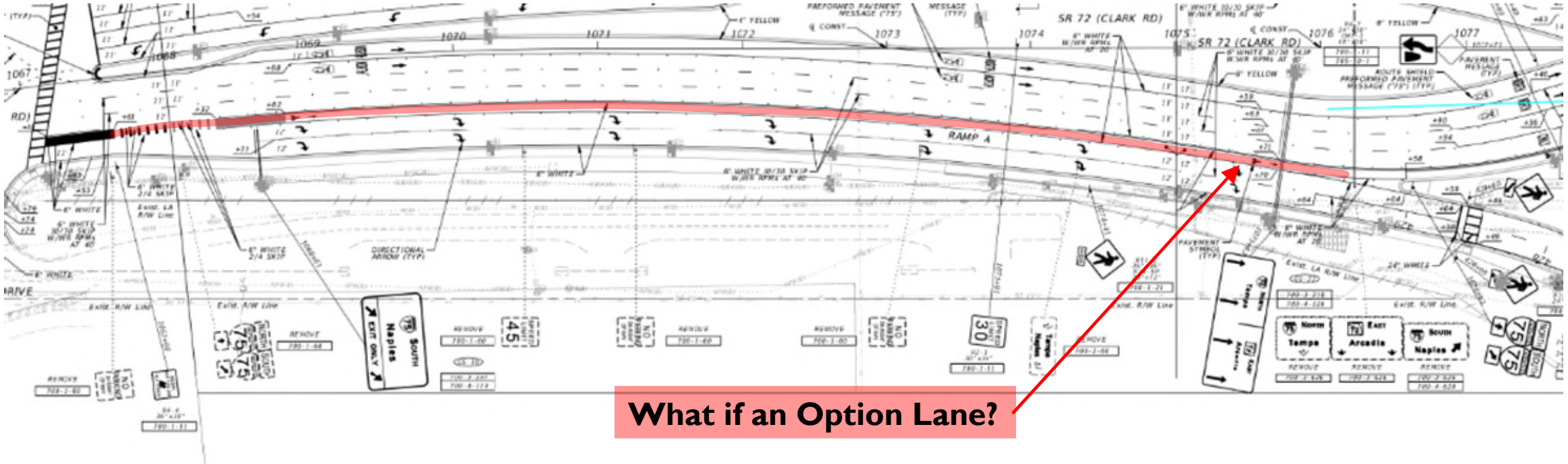
Multimodal Accommodations

- **Bicyclists**
  - Avoid lengthy “key holed” bicyclists if possible



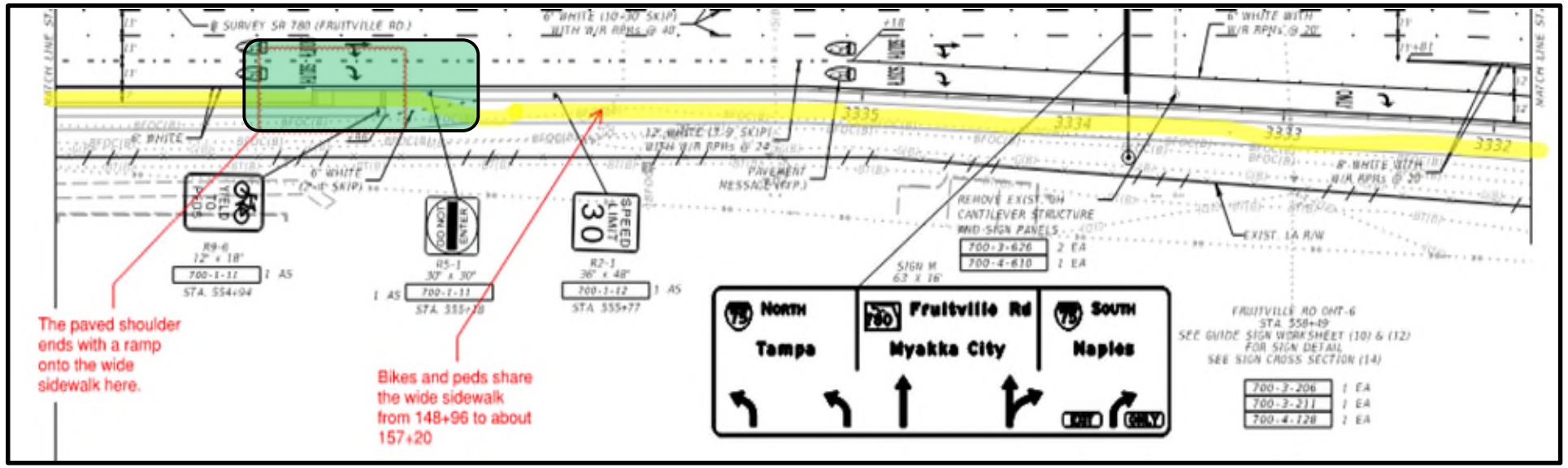
Multimodal Accommodations

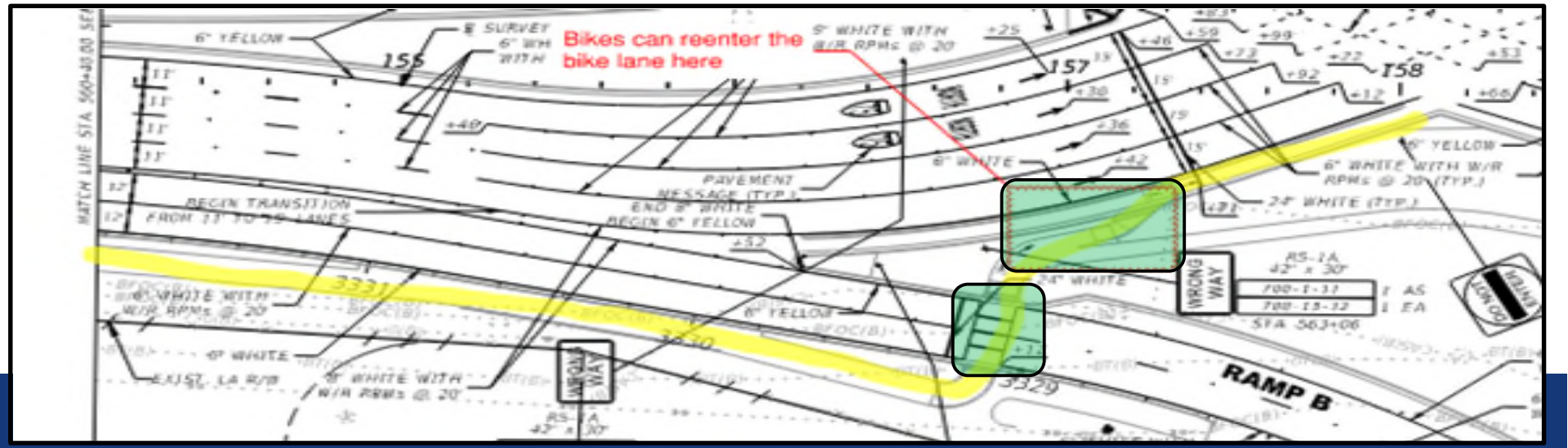
- **Bicyclists**
  - Or option lanes where bicyclists are unclear where drivers are going



Multimodal Accommodations

- **Bicyclists**
  - If the “key hole” occurs, one option is to shift them to a wider sidewalk along the outside
  - Cross the free-flow ramp with the pedestrians
  - Then re-enter the bike lane prior to the crossover





Multimodal Accommodations

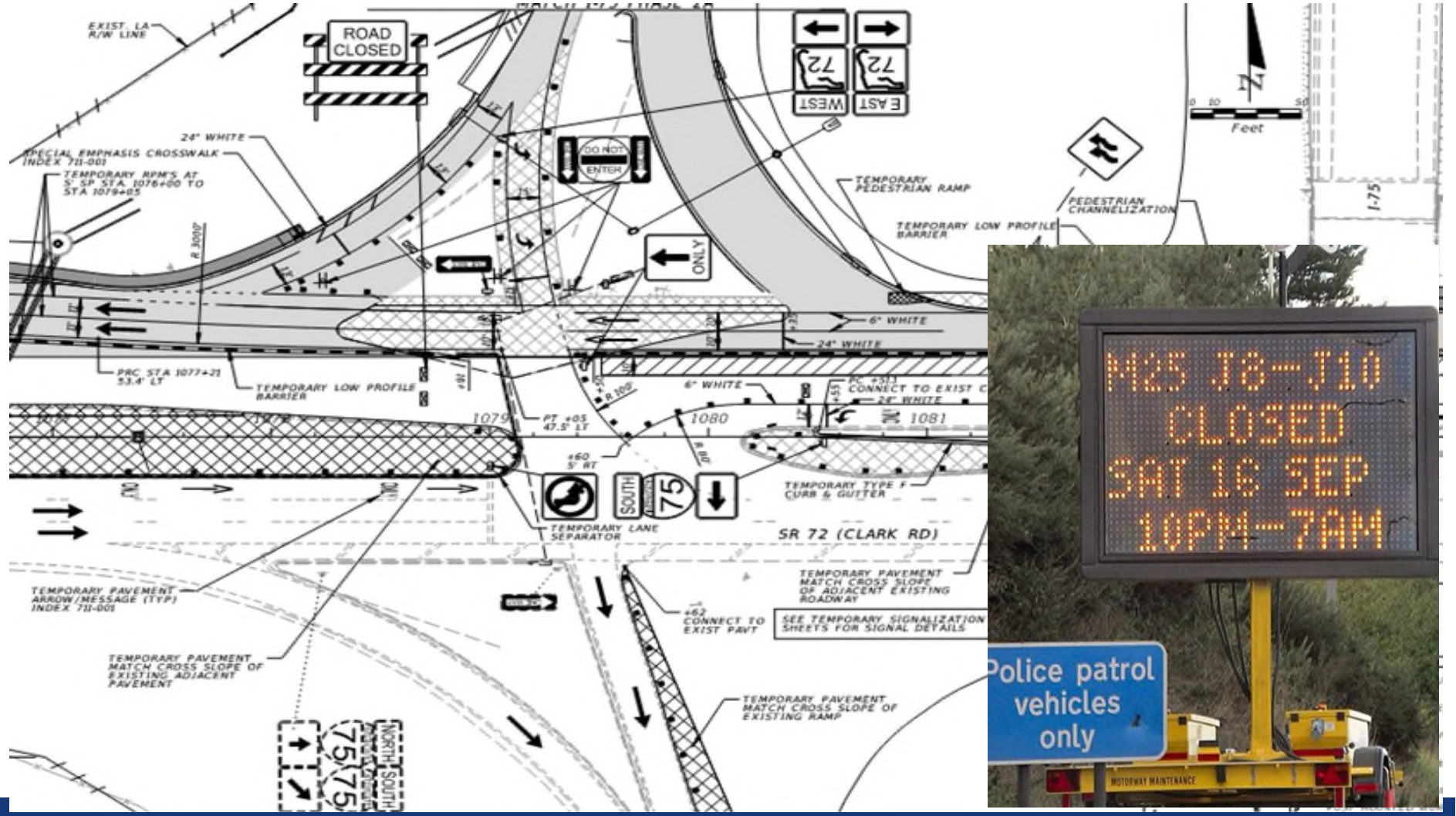
More Information on DDI Multimodal Accommodations:

August 24, 2021 @ 2-3pm

CONSTRUCTABILITY

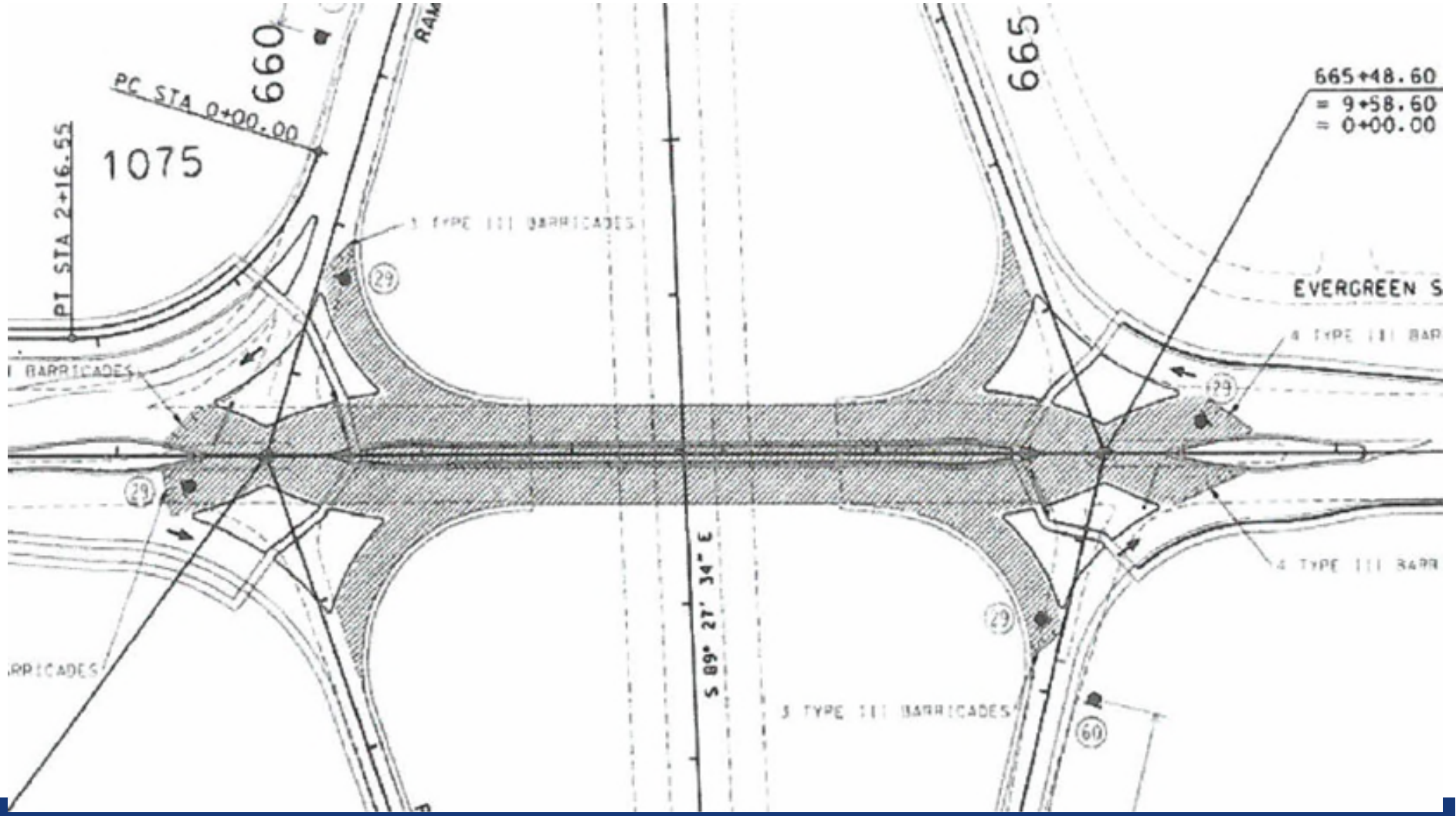
Constructability

- **Temporary Traffic Control**
  - Many options for maintaining traffic
    - Site specific
  - <u>Recommendation:</u> All options have weekend full closure before opening as a DDI
    - Signal testing
    - Final pavement markings



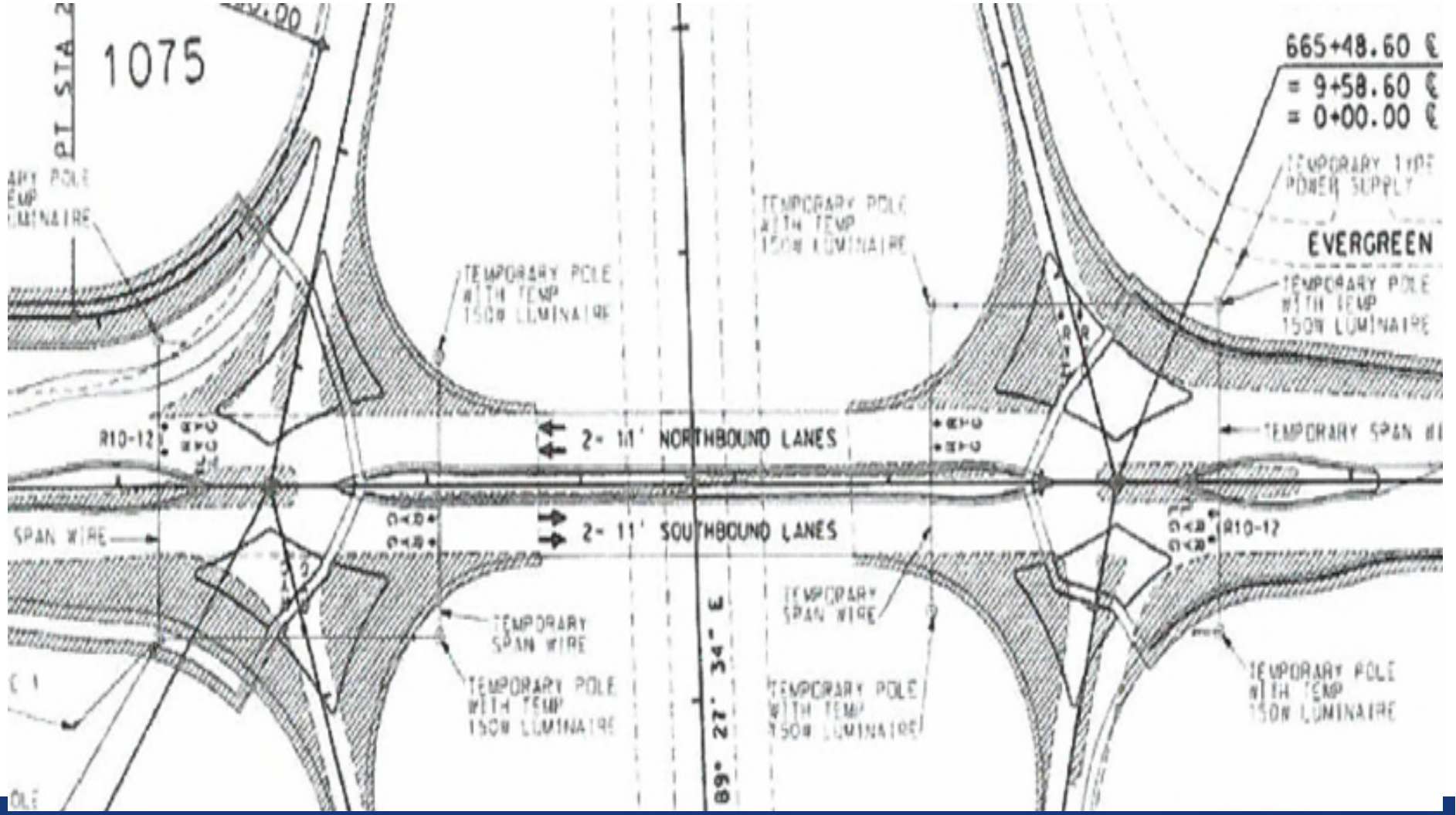
Constructability

- **Temporary Traffic Control**
  - Options for maintaining traffic
    - Closure between crossover intersections



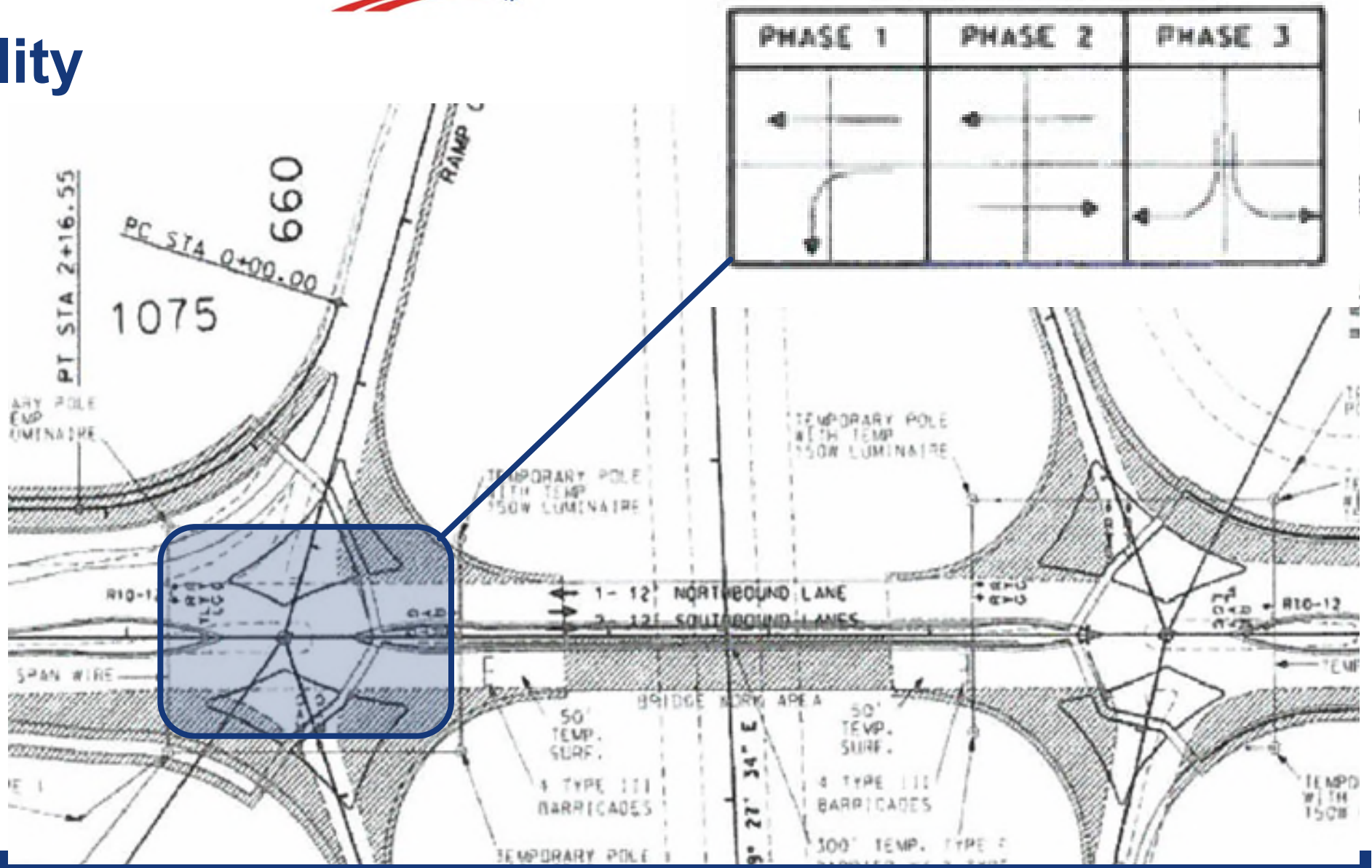
Constructability

- **Temporary Traffic Control**
  - Options for maintaining traffic
    - Closure between crossover intersections
    - Off-line construction



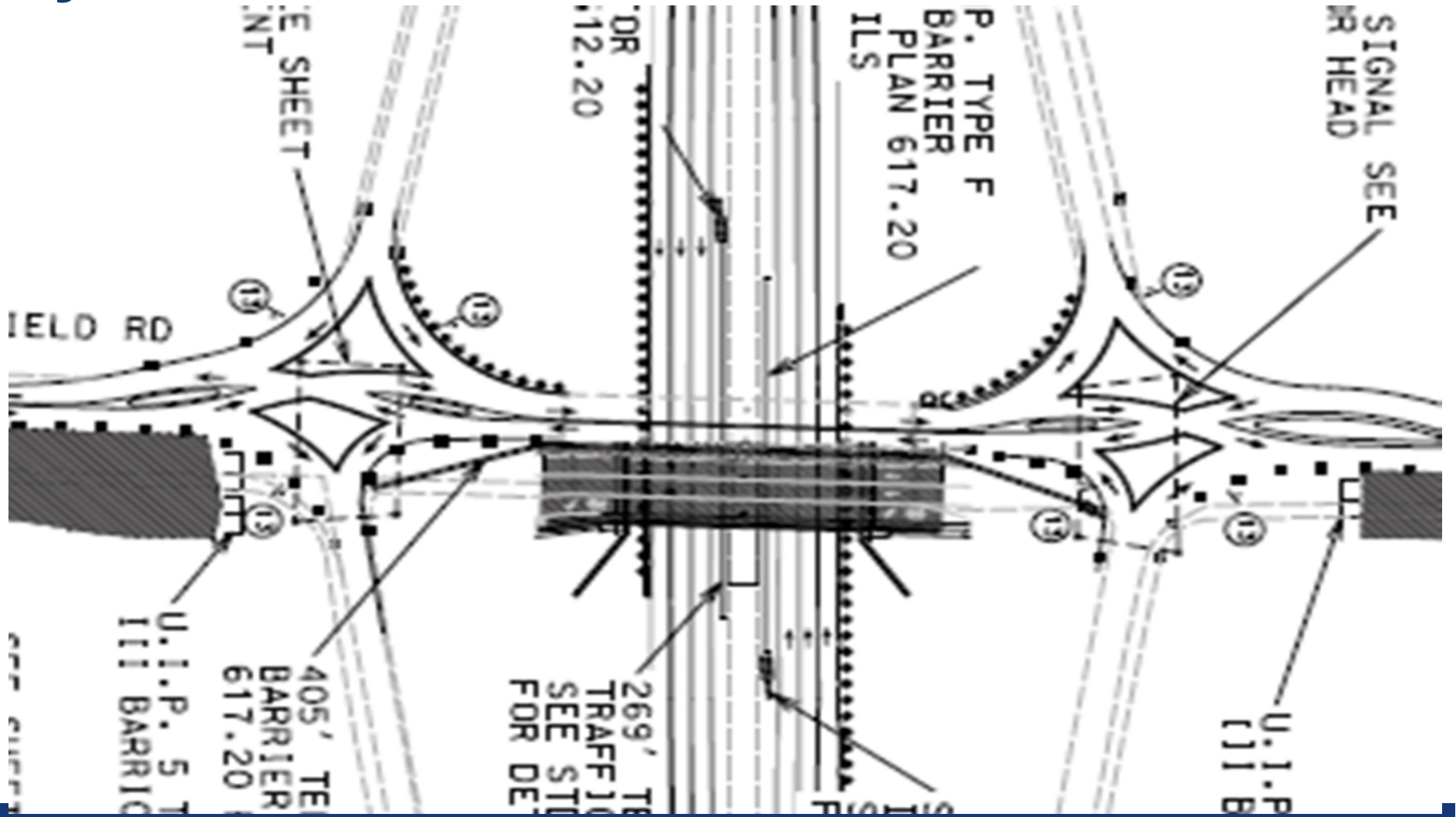
Constructability

- **Temporary Traffic Control**
  - Options for maintaining traffic
    - Closure between crossover intersections
    - Off-line construction
    - Part-width construction



Constructability

- **Temporary Traffic Control**
  - Options for maintaining traffic
    - Closure between crossover intersections
    - Off-line construction
    - Part-width construction
    - Operate as a DDI during construction



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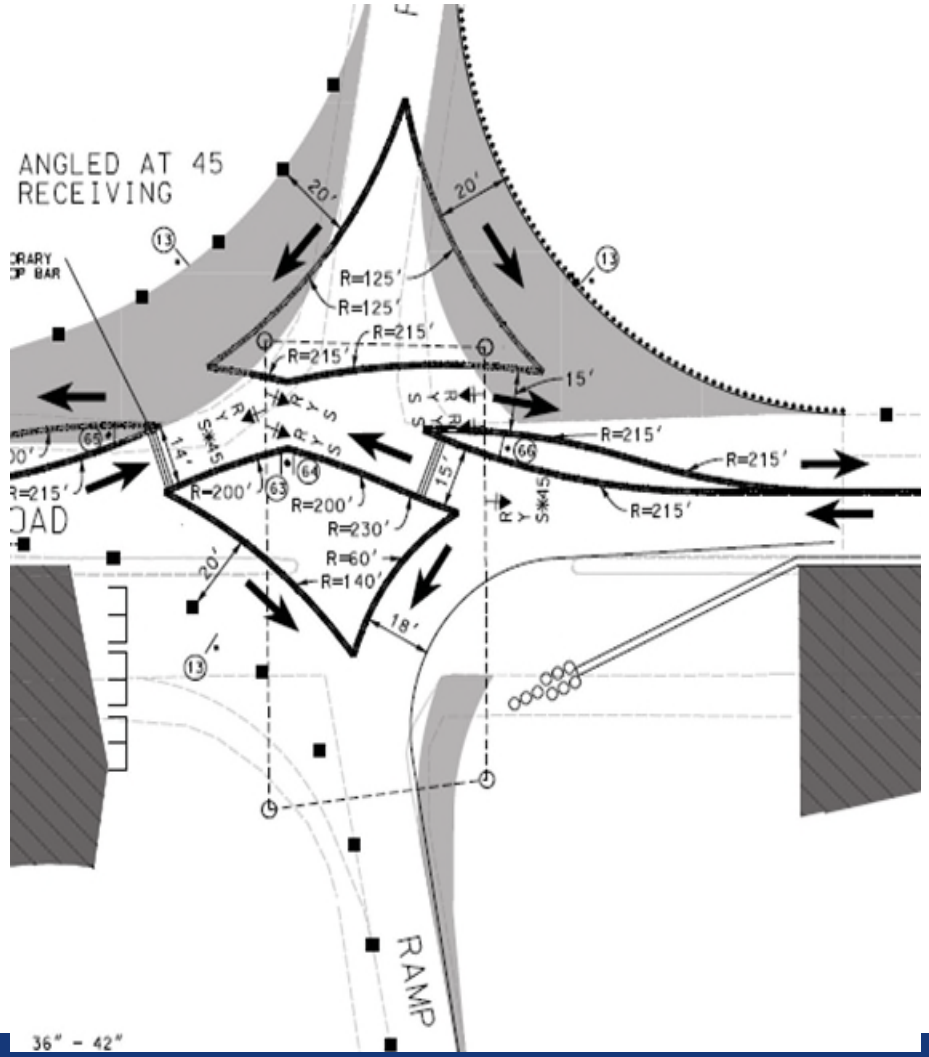
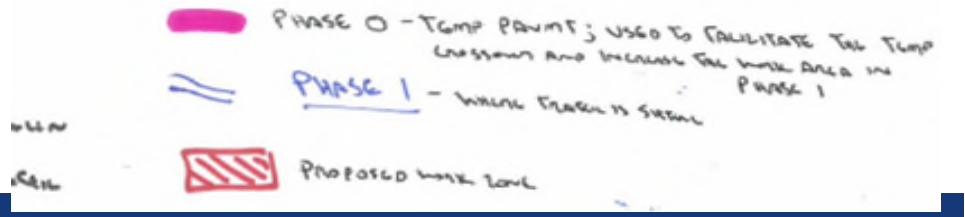
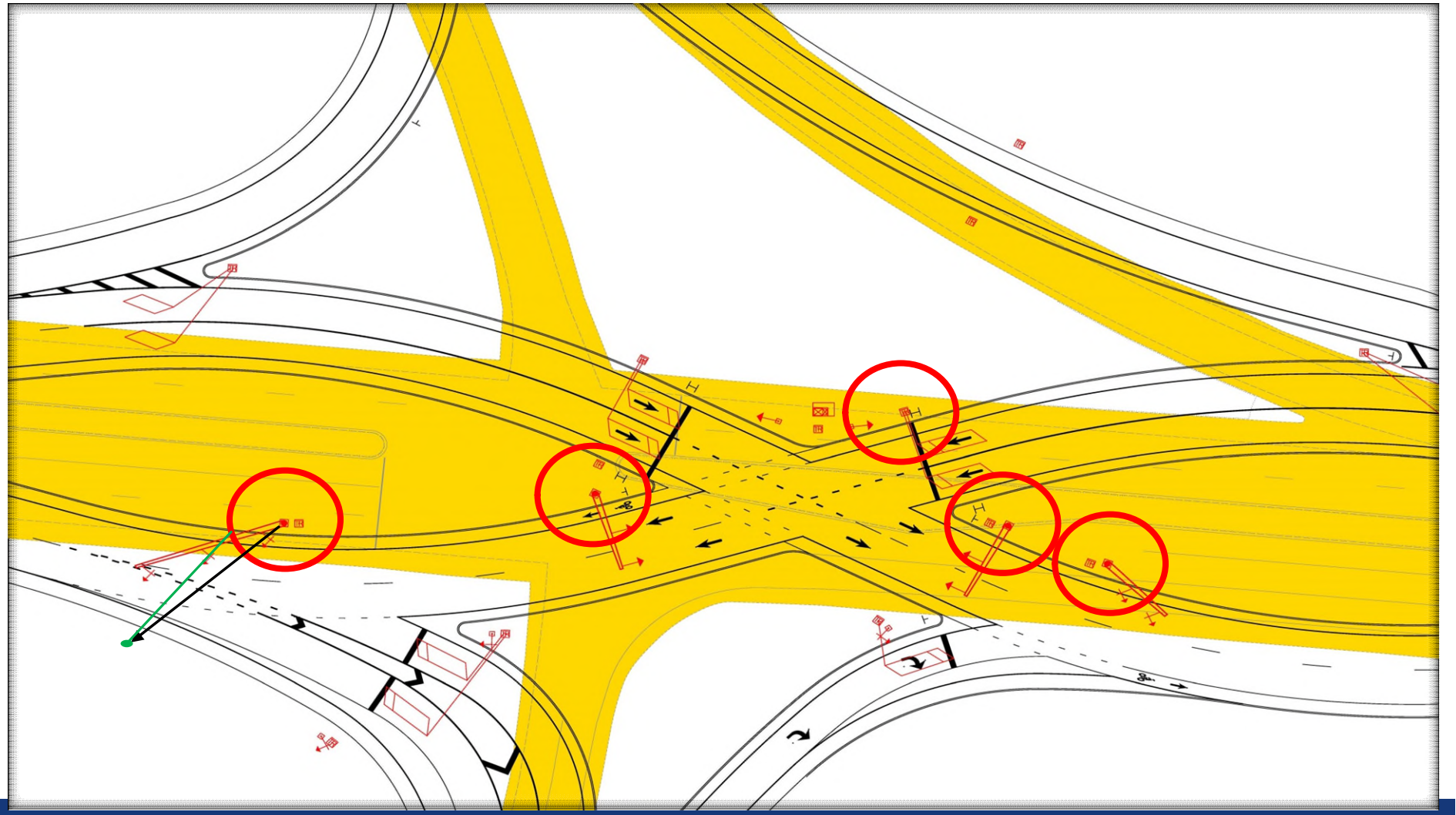




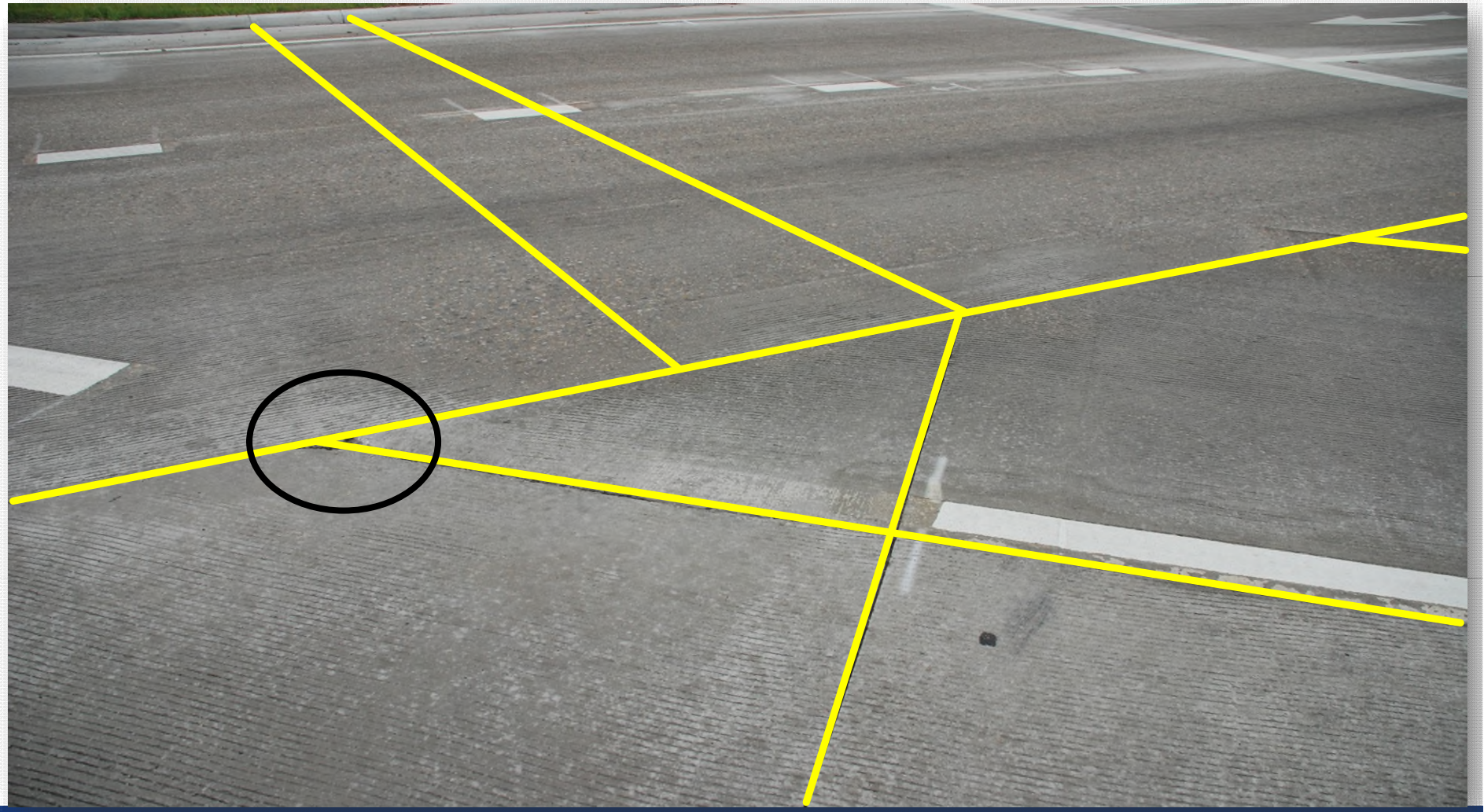
Constructability

- **Proposed vs Existing**
  - Proposed Signal Poles – avoid existing pavement if possible
  - Show existing pavement when developing design to avoid conflicts that can delay construction



Constructability

- **Pavement Joints**
  - Concrete Pavement
  - Acute angles create joint issues



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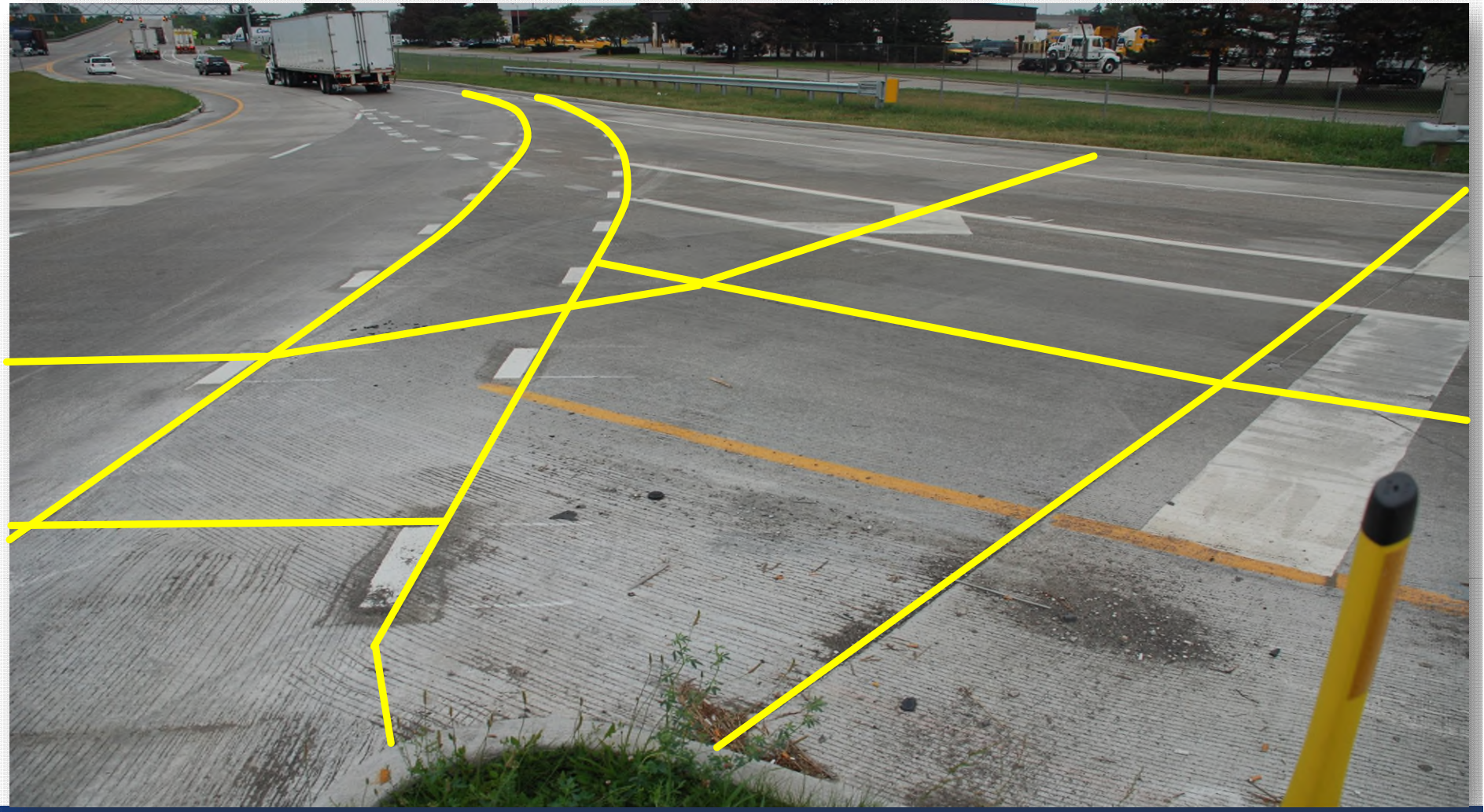

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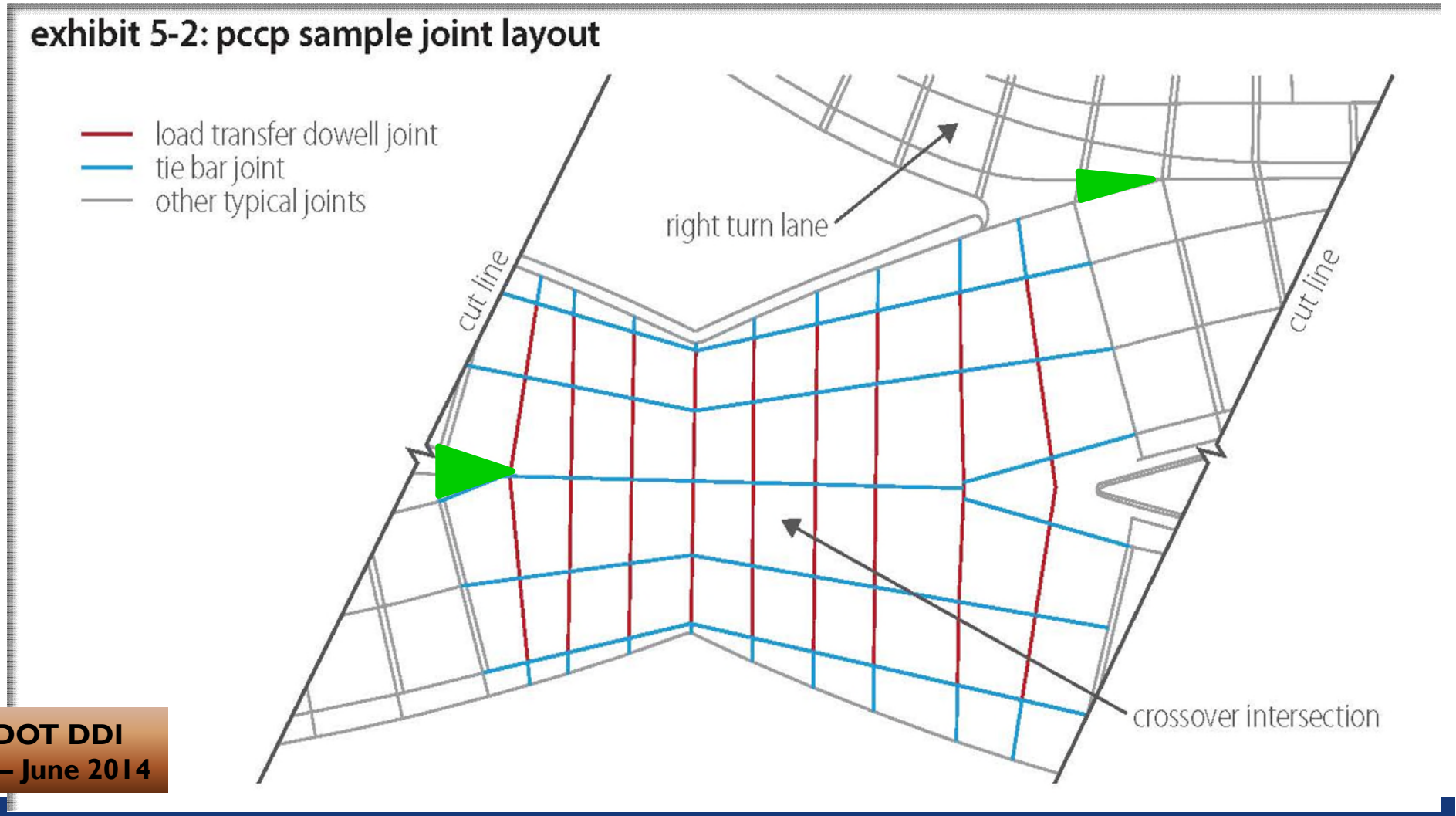
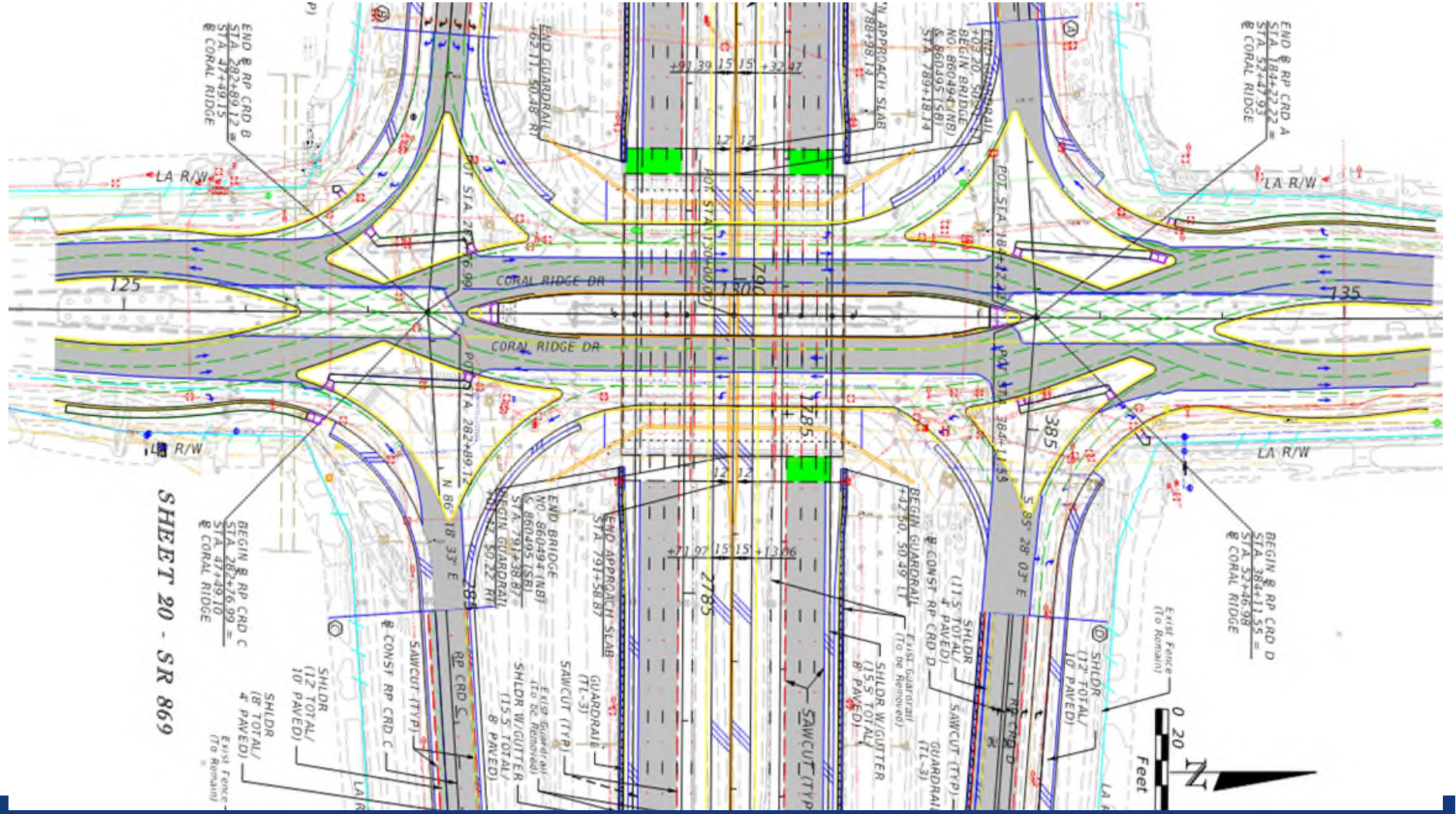


Source: UDOT DDI Guideline – June 2014

PLAN DETAILING

Plan Detailing

- **Plan Content**
  - Early Reviews
    - Horizontal and vertical geometry
    - Truck turn exhibits (see FDOT Developmental Design Criteria)
    - Traffic analysis
    - Signing plan
    - Large roll plot schematic – show entire DDI on one sheet



Plan Detailing

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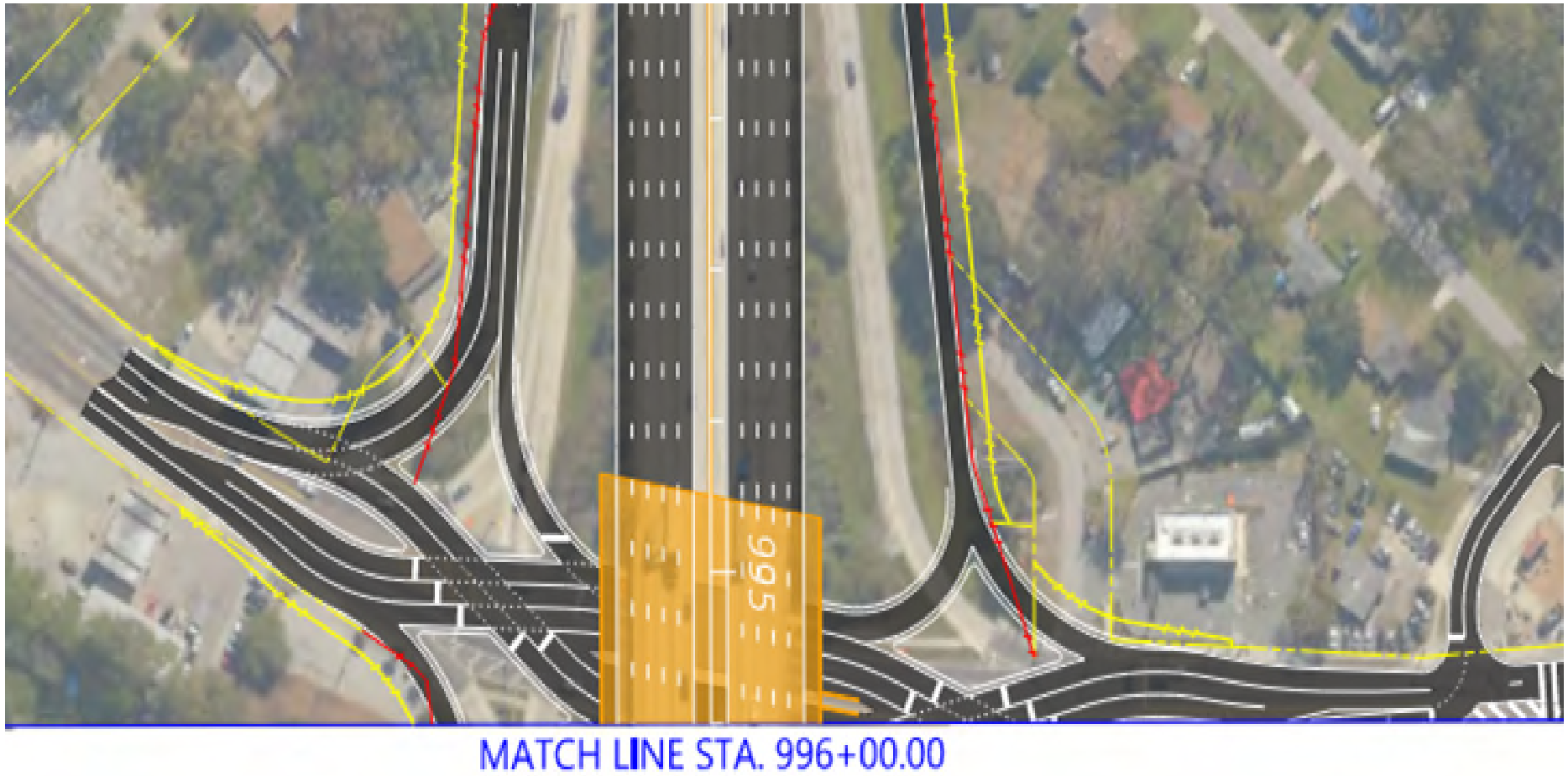

Plan Detailing

- **Plan Content**
  - Early Reviews
    - Horizontal and vertical geometry
    - Truck turn exhibits (see FDOT Developmental Design Criteria)
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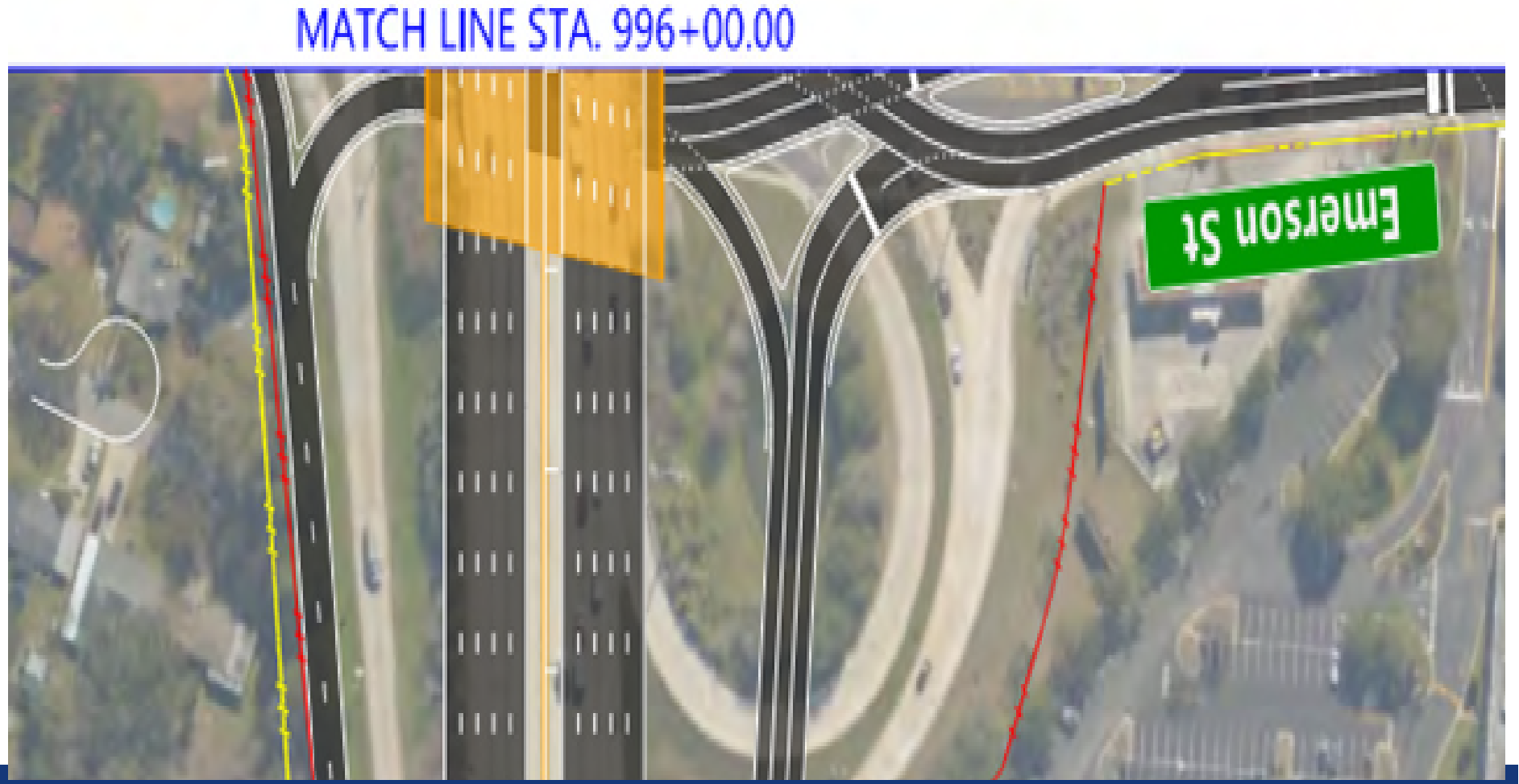
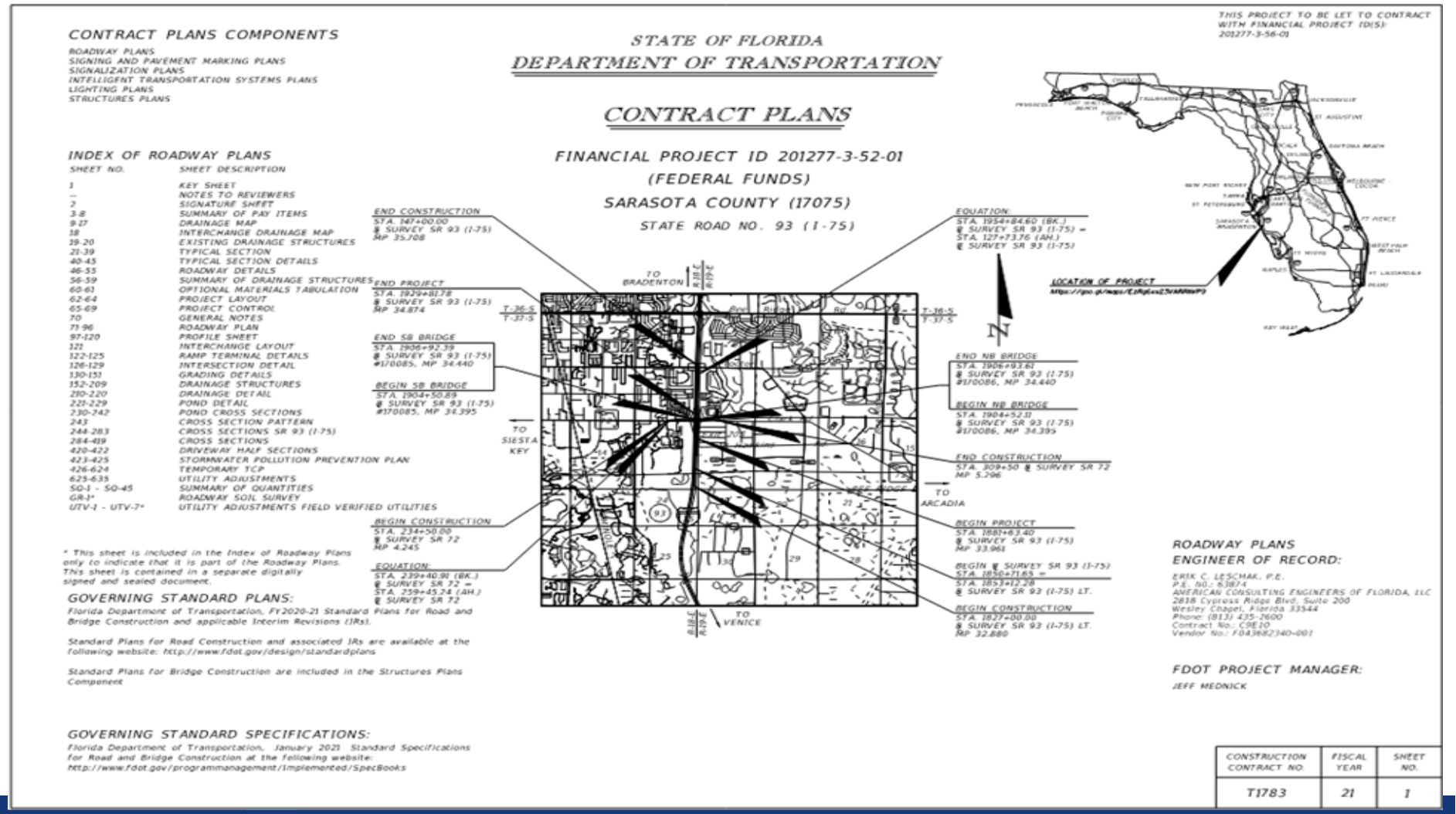


Plan Detailing

- **Plan Content**
  - Final Plans
    - Reduce duplication of information
    - Reduce confusion
    - Utilize proposed surfaces to convey grading, drainage, etc.



CONTRACT PLANS COMPONENTS

ROADWAY PLANS
SIGNING AND PAVEMENT MARKING PLANS
SIGNALIZATION PLANS
INTELLIGENT TRANSPORTATION SYSTEMS PLANS
LIGHTING PLANS
STRUCTURES PLANS

INDEX OF ROADWAY PLANS

SHEET NO.	SHEET DESCRIPTION
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--	NOTES TO REVIEWERS
2	SIGNATURE SHEET
3-8	SUMMARY OF PAY ITEMS
9-17	DRAINAGE MAP
18	INTERCHANGE DRAINAGE MAP
19-20	EXISTING DRAINAGE STRUCTURES
21-39	TYPICAL SECTION
40-45	TYPICAL SECTION DETAILS
46-55	ROADWAY DETAILS
56-59	SUMMARY OF DRAINAGE STRUCTURES
60-61	OPTIONAL MATERIALS TABULATION
62-64	PROJECT LAYOUT
65-69	PROJECT CONTROL
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243	CROSS SECTION PATTERN
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284-419	CROSS SECTIONS
420-422	DRIVEWAY HALF SECTIONS
423-425	STORMWATER POLLUTION PREVENTION PLAN
426-624	TEMPORARY TCP
625-635	UTILITY ADJUSTMENTS
SO-1 - SO-45	SUMMARY OF QUANTITIES
GR-1*	ROADWAY SOIL SURVEY
UTV-1 - UTV-7*	UTILITY ADJUSTMENTS FIELD VERIFIED UTILITIES

* This sheet is included in the Index of Roadway Plans only to indicate that it is part of the Roadway Plans. This sheet is contained in a separate digitally signed and sealed document.

GOVERNING STANDARD PLANS:
Florida Department of Transportation, FY2020-21 Standard Plans for Road and Bridge Construction and applicable Interim Revisions (IRs).

Standard Plans for Road Construction and associated IRs are available at the following website: http://www.fdot.gov/design/standardplans

Standard Plans for Bridge Construction are included in the Structures Plans Component

GOVERNING STANDARD SPECIFICATIONS:
Florida Department of Transportation, January 2021 Standard Specifications for Road and Bridge Construction at the following website: http://www.fdot.gov/programmanagement/Implemented/SpecBooks

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

CONTRACT PLANS

FINANCIAL PROJECT ID 201277-3-52-01
(FEDERAL FUNDS)
SARASOTA COUNTY (17075)
STATE ROAD NO. 93 (I-75)

THIS PROJECT TO BE LET TO CONTRACT WITH FINANCIAL PROJECT ID(S): 201277-3-56-01

END CONSTRUCTION
STA. 147+00.00
℄ SURVEY SR 93 (I-75)
MP 35.708

END PROJECT
STA. 1929+81.78
℄ SURVEY SR 93 (I-75)
MP 34.874

END SB BRIDGE
STA. 1906+92.39
℄ SURVEY SR 93 (I-75)
#170085, MP 34.440

BEGIN SB BRIDGE
STA. 1904+50.89
℄ SURVEY SR 93 (I-75)
#170085, MP 34.395

BEGIN CONSTRUCTION
STA. 234+50.00
℄ SURVEY SR 72
MP 4.245

EQUATION:
STA. 239+40.91 (BK.)
℄ SURVEY SR 72 =
STA. 259+45.24 (AH.)
℄ SURVEY SR 72

EQUATION:
STA. 1954+84.60 (BK.)
℄ SURVEY SR 93 (I-75) =
STA. 127+73.76 (AH.)
℄ SURVEY SR 93 (I-75)

END NB BRIDGE
STA. 1906+93.61
℄ SURVEY SR 93 (I-75)
#170086, MP 34.440

BEGIN NB BRIDGE
STA. 1904+52.11
℄ SURVEY SR 93 (I-75)
#170086, MP 34.395

END CONSTRUCTION
STA. 309+50 ℄ SURVEY SR 72
MP 5.296

BEGIN PROJECT
STA. 1881+83.40
℄ SURVEY SR 93 (I-75)
MP 33.961

BEGIN ℄ SURVEY SR 93 (I-75)
STA. 1850+71.65 =
STA. 1853+12.28
℄ SURVEY SR 93 (I-75) LT.

BEGIN CONSTRUCTION
STA. 1827+00.00
℄ SURVEY SR 93 (I-75) LT.
MP 32.880

TO BRADENTON
TO SIESTA KEY
TO ARCADIA
TO VENICE

LOCATION OF PROJECT

ROADWAY PLANS
ENGINEER OF RECORD:
ERIK C. LESCHAK, P.E.
P.E. NO.: 63874
AMERICAN CONSULTING ENGINEERS OF FLORIDA, LLC
2838 Cypress Ridge Blvd, Suite 200
Wesley Chapel, Florida 33544
Phone: (813) 435-2600
Contract No.: C9E10
Vendor No.: F043682340-001

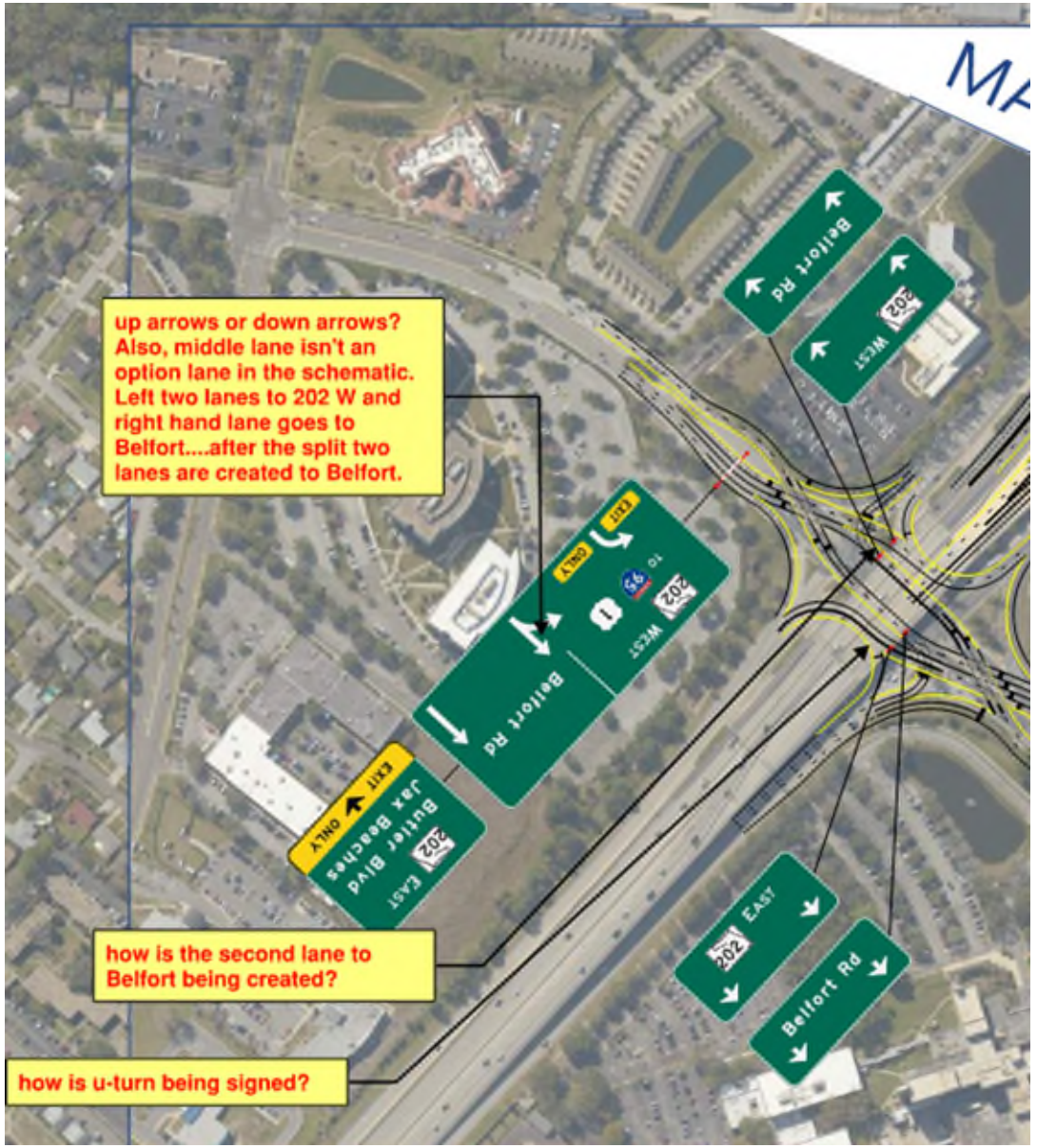
FDOT PROJECT MANAGER:
JEFF MEDNICK

CONSTRUCTION CONTRACT NO.	FISCAL YEAR	SHEET NO.
T1783	21	1

Plan Detailing

More Information on DDI Plan Detailing:

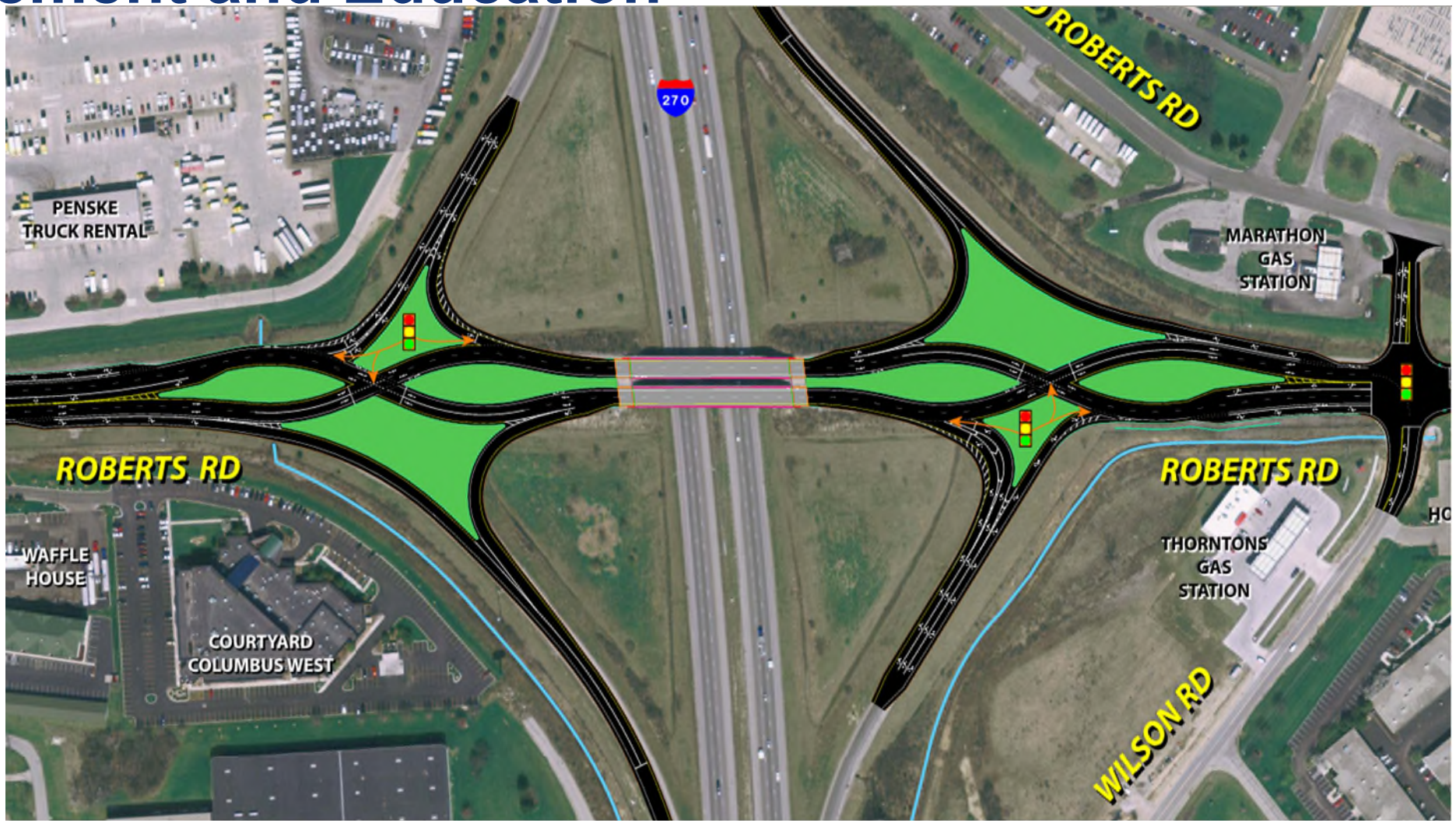
September 7, 2021 @ 2-3pm



PUBLIC INVOLVEMENT AND EDUCATION

Public Involvement and Education

- **Public Involvement**
  - Reduce confusion
  - Keep it simple!
    - Public is often not engineers or traffic analysts



Public Involvement and Education

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Public Involvement and Education

- **Public Involvement**
  - Reduce confusion
  - Keep it simple!
    - Public is often not engineers or traffic analysts
  - No substitute for videos and pictures from the driver's perspective

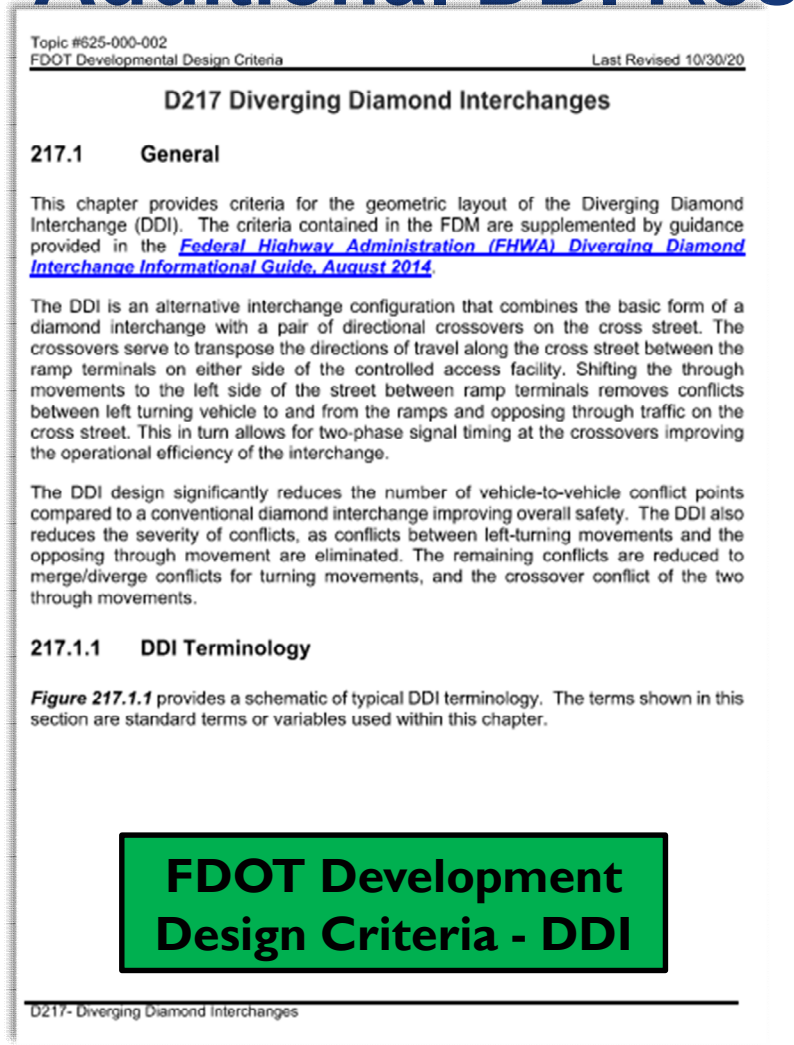
Public Involvement and Education

More Information on DDI Public Involvement:

September 7, 2021 @ 2-3pm

ADDITIONAL DDI RESOURCES

Additional DDI Resources



Topic #625-000-002
FDOT Developmental Design Criteria — Last Revised 10/30/20

D217 Diverging Diamond Interchanges

217.1 General

This chapter provides criteria for the geometric layout of the Diverging Diamond Interchange (DDI). The criteria contained in the FDM are supplemented by guidance provided in the *Federal Highway Administration (FHWA) Diverging Diamond Interchange Informational Guide, August 2014*.

The DDI is an alternative interchange configuration that combines the basic form of a diamond interchange with a pair of directional crossovers on the cross street. The crossovers serve to transpose the directions of travel along the cross street between the ramp terminals on either side of the controlled access facility. Shifting the through movements to the left side of the street between ramp terminals removes conflicts between left turning vehicle to and from the ramps and opposing through traffic on the cross street. This in turn allows for two-phase signal timing at the crossovers improving the operational efficiency of the interchange.

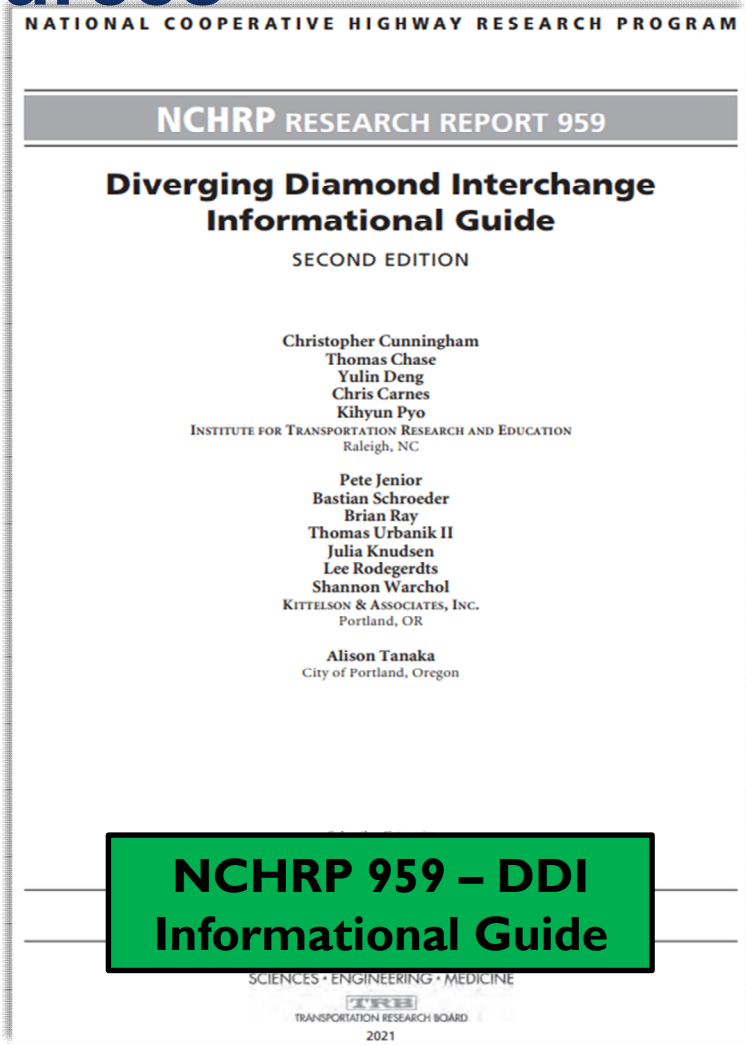
The DDI design significantly reduces the number of vehicle-to-vehicle conflict points compared to a conventional diamond interchange improving overall safety. The DDI also reduces the severity of conflicts, as conflicts between left-turning movements and the opposing through movement are eliminated. The remaining conflicts are reduced to merge/diverge conflicts for turning movements, and the crossover conflict of the two through movements.

217.1.1 DDI Terminology

Figure 217.1.1 provides a schematic of typical DDI terminology. The terms shown in this section are standard terms or variables used within this chapter.

D217- Diverging Diamond Interchanges

FDOT Development Design Criteria - DDI



NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP RESEARCH REPORT 959

Diverging Diamond Interchange Informational Guide

SECOND EDITION

Christopher Cunningham
Thomas Chase
Yulin Deng
Chris Carnes
Kihyun Pyo
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Raleigh, NC

Pete Jenior
Bastian Schroeder
Brian Ray
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NCHRP 959 – DDI Informational Guide

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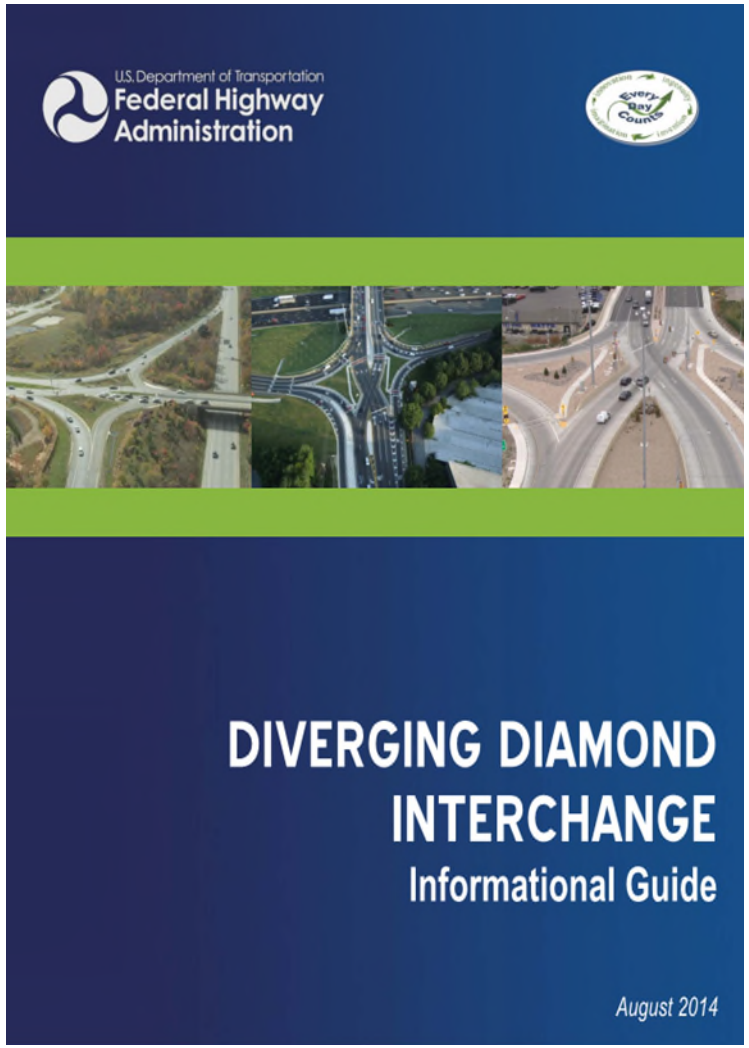

U.S. Department of Transportation
Federal Highway Administration

DIVERGING DIAMOND INTERCHANGE
Informational Guide

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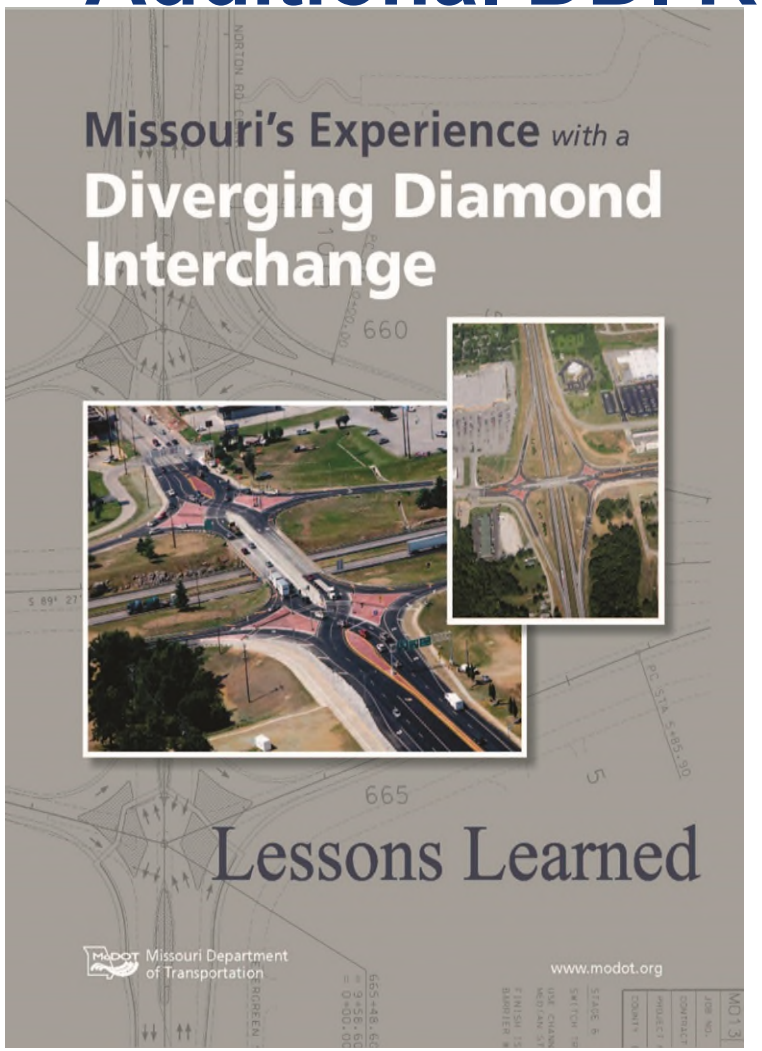
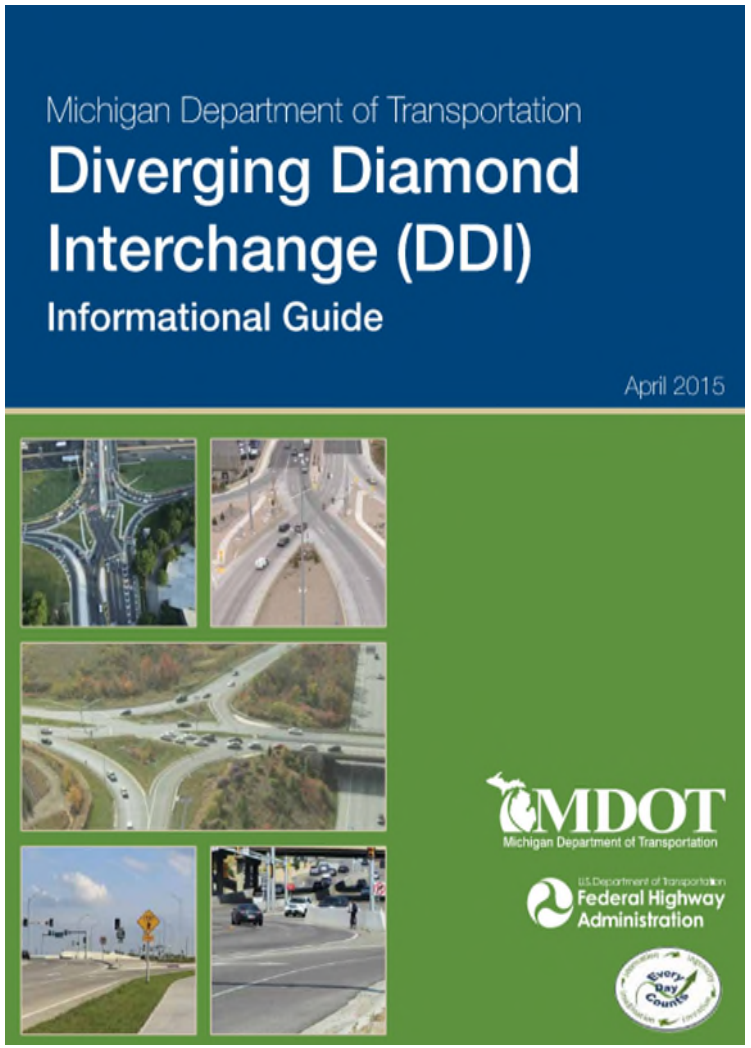
Additional DDI Resources





Additional DDI Resources

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UDOT DIVERGING DIAMOND INTERCHANGE (DDI) OBSERVATIONS AND EXPERIENCE

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