



# Diverging Diamond Interchange

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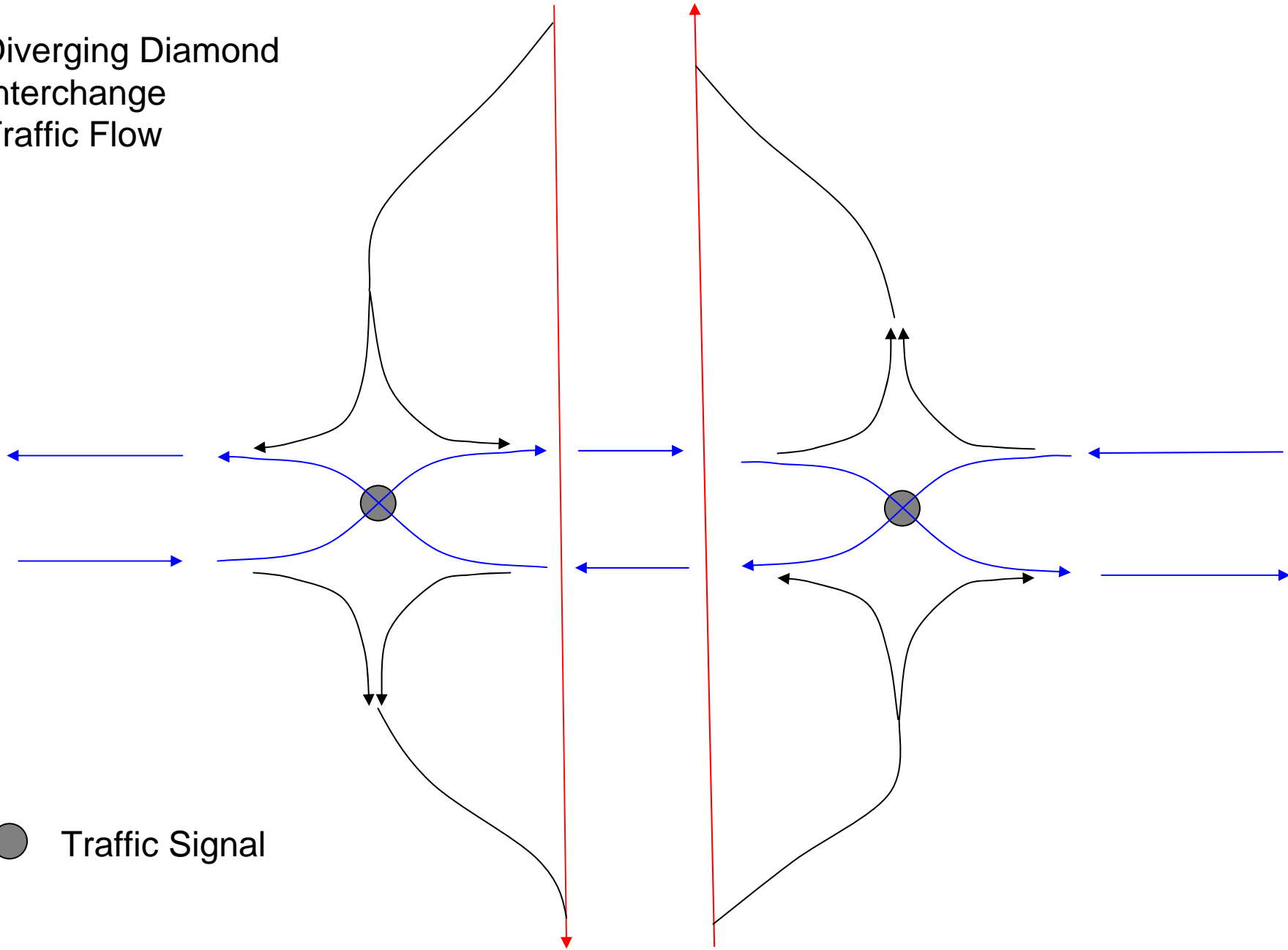
# History of DDI

- Presented at 2<sup>nd</sup> Urban Street Symposium
- Presented at 3<sup>rd</sup> International Street Symposium as Diverging Diamond Interchange and Double Crossover Intersection – Vehicle and Pedestrian Performance by FHWA and BMI-SG
- 1<sup>st</sup> proposed at HAN I-75 @ US 224 in 2004

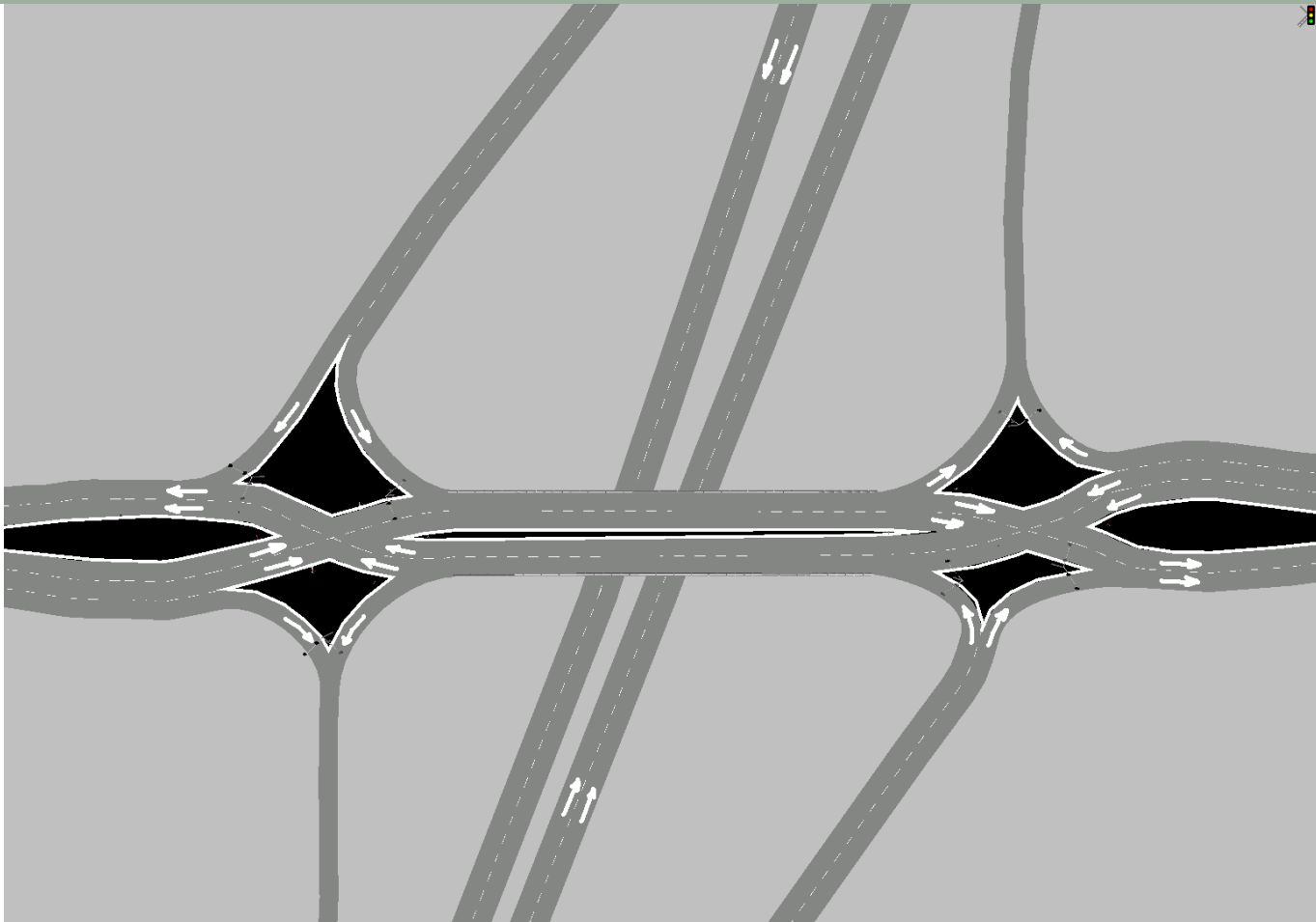
# Diverging Diamond Interchange (DDI)

- The diverging diamond interchange switches traffic over to the opposite side of the roadway within the interchange.
- This promotes left-turn movements and eliminates the left turn signal phase improving the interchange's efficiency.
- This simple switch improves capacity and minimizes the length of the queues which can normally cause failure within a diamond interchange.

Diverging Diamond  
Interchange  
Traffic Flow



# Plan view



# Benefits of DDI

- The DDI eliminates the need to widen bridge for turn lanes. (COST)
- The off ramps/on ramps operate more efficiently which minimizes the need for multiple turn lanes. Ramp capacity is up to 150% greater than a conventional diamond. (OPERATION/COST)
- The left/through lane capacity is increased up to 130% greater than a conventional diamond. (OPERATION/COST)
- The DDI greatly reduces traffic queues compared to conventional intersection for high volume flows. (OPERATION)
- The use of raised median islands discourages wrong-way movements. (SAFETY)

# Cons of DDI

- DDI violates driver expectation. The through movements must go left of opposing traffic. (SAFETY)
- DDI design does not allow through movements from off-to on-ramps. (OPERATION)
- High speed crossroads will have unacceptable intersection crossing angles. DDI must be used on 35mph or lower speed facilities. (SAFETY)
- DDI cannot be placed where signals/driveways are too closely spaced to the interchange. The queues from the nearby intersection might back up into the interchange causing it to fail. (SAFETY/OPERATION)

# DDI vs. Conventional Interchange

HAN 75 @ US 224

Comparison of DDI with conventional interim interchange

Year 2025 Traffic

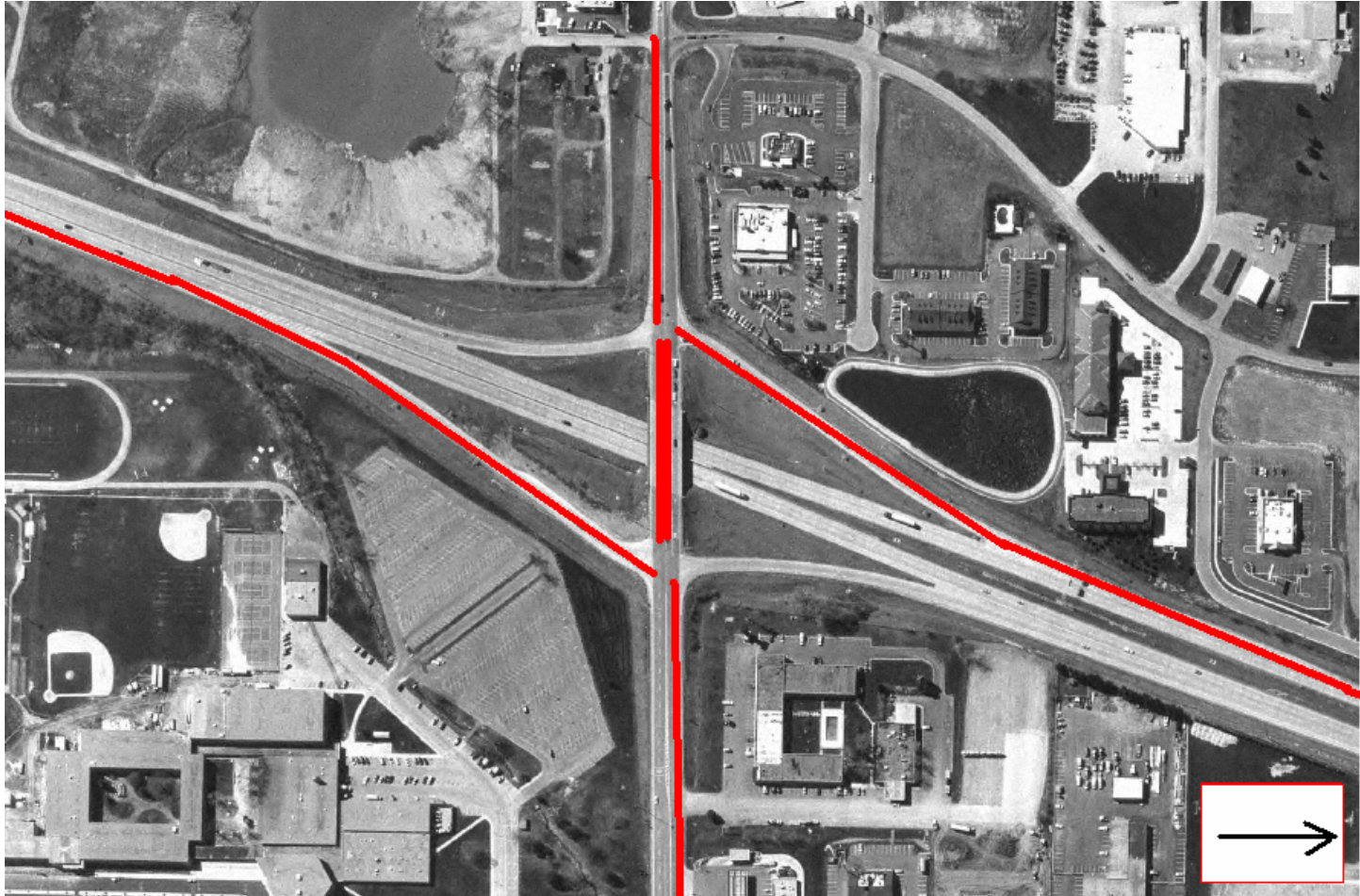
|                         | Diverging Diamond Interchange<br>(100 sec cycle) |                            |                         | Conventional - Synchro (90 sec cycle) |                      |                         |               |
|-------------------------|--|----------------------------|-------------------------|---------------------------------------|----------------------|-------------------------|---------------|
|                         | Avg. Queue<br>(ft) per hour                      | Max. Queue<br>(ft) in hour | # of<br>stops /<br>hour | Queue<br>length 50th                  | Queue<br>Length 95th | # of<br>stops /<br>hour |               |
| <b>Northbound Ramps</b> |  |                            |                         |                                       |                      |                         |               |
| I-71 NB Left            | 104  | 488                        | 453                     | 296                                   | 480                  | 598                     | near capacity |
| I-71 NB Right           | 120  | 510                        | 472                     | 455                                   | 655                  | 1298                    | near capacity |
| US 36 WB Thru           | 92   | 400                        | 774                     | 240                                   | 309                  | 711                     |               |
| US 36 WB Right          | 73   | 374                        | 622                     | 139                                   | 218                  | 219                     |               |
| US 36 EB Left/Thru      | 24   | 175                        | 218                     | 110+120                               | 168+138              | 235+329                 |               |
| <b>Southbound Ramps</b> |  |                            |                         |                                       |                      |                         |               |
| I-71 SB Left            | 49   | 281                        | 270                     | 212                                   | 386                  | 380                     |               |
| I-71 SB Right           | 60   | 298                        | 294                     | 187                                   | 350                  | 332                     |               |
| US 36 EB Right          | 67   | 381                        | 582                     | 213                                   | 337                  | 339                     |               |
| US 36 EB Thru           | 82   | 407                        | 681                     | 197                                   | 260                  | 580                     |               |
| US 36 WB Left/Thru      | 34   | 225                        | 301                     | 149+142                               | 234+172              | 280+432                 | metered       |

The max queue was developed using the worst case scenario for the DDI model.

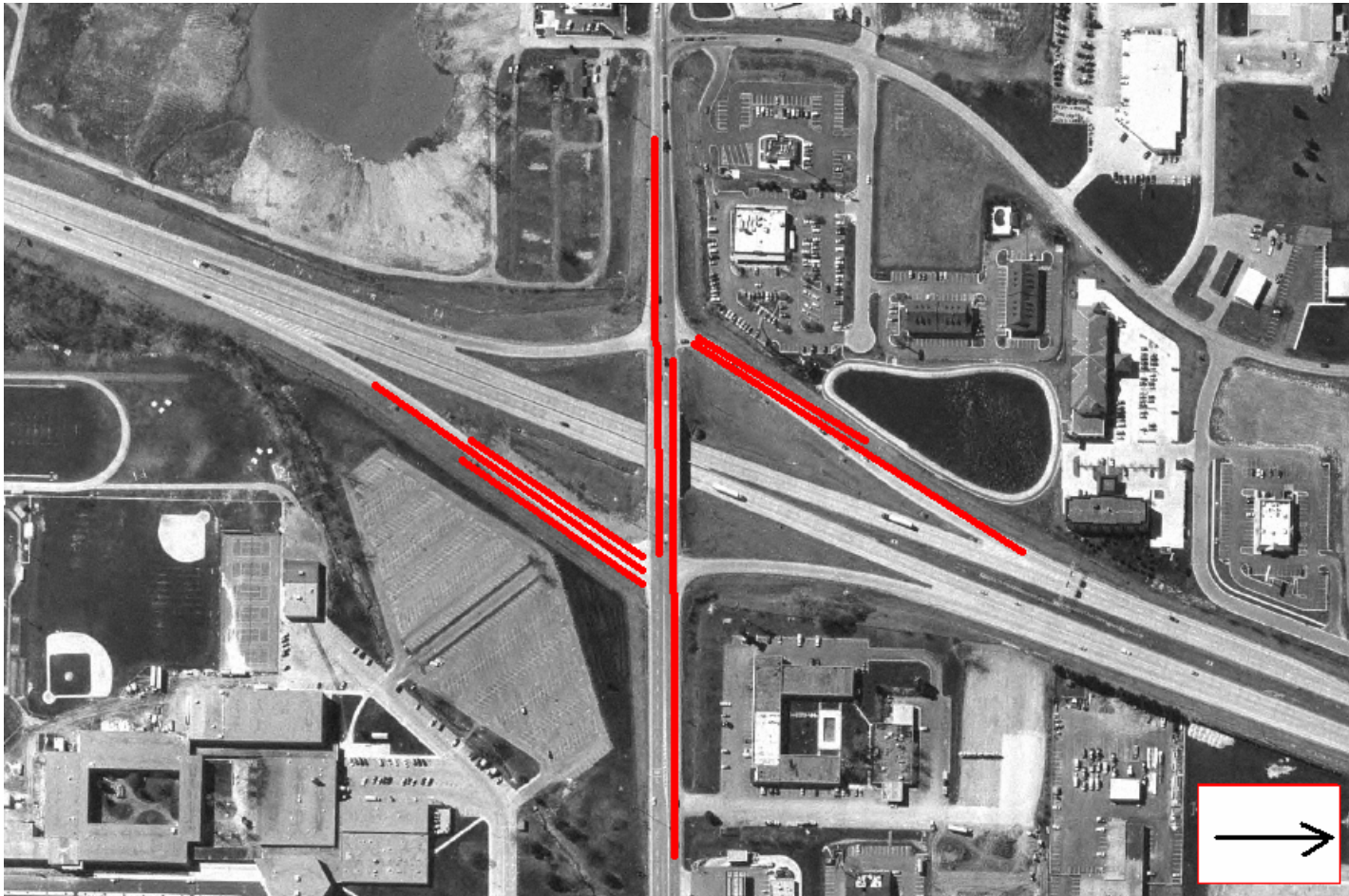
# Longevity of HAN US 224

|                  | LOS (AM/PM) @<br>Time of Failure |     | Year of<br>Failure | Reason                                 |
|------------------|----------------------------------|-----|--------------------|--|
| No Build         | C/D                              | C/F | 2006               | Queues onto<br>freeway                 |
| Minimal<br>Build | C/C                              | C/C | 2011               | Internal left turn<br>queue blocking   |
| DDI Build        | B/B                              | B/B | 2026+              | Configuration has<br>15% more capacity |

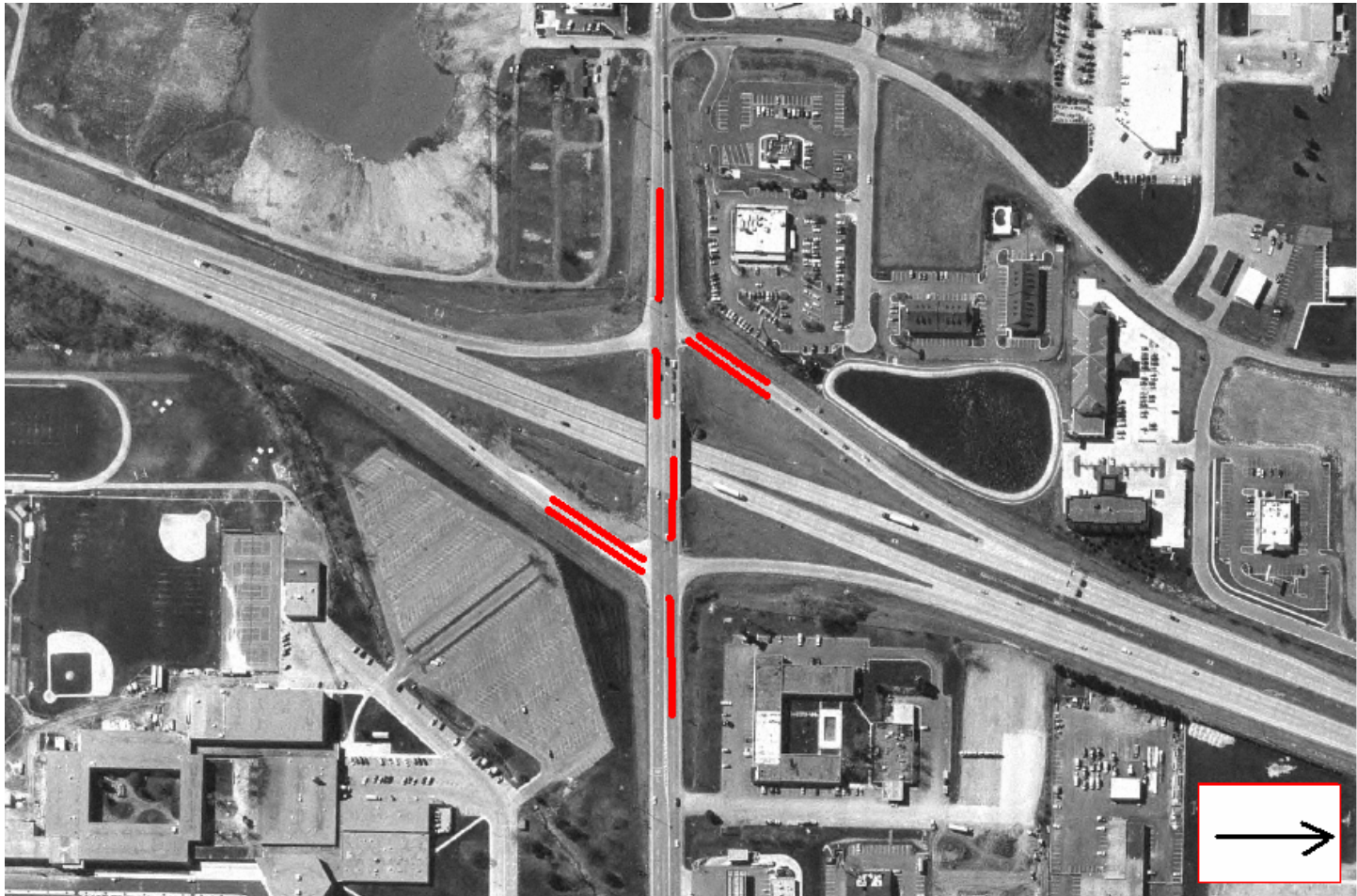
# HAN 224 – No Build Queues



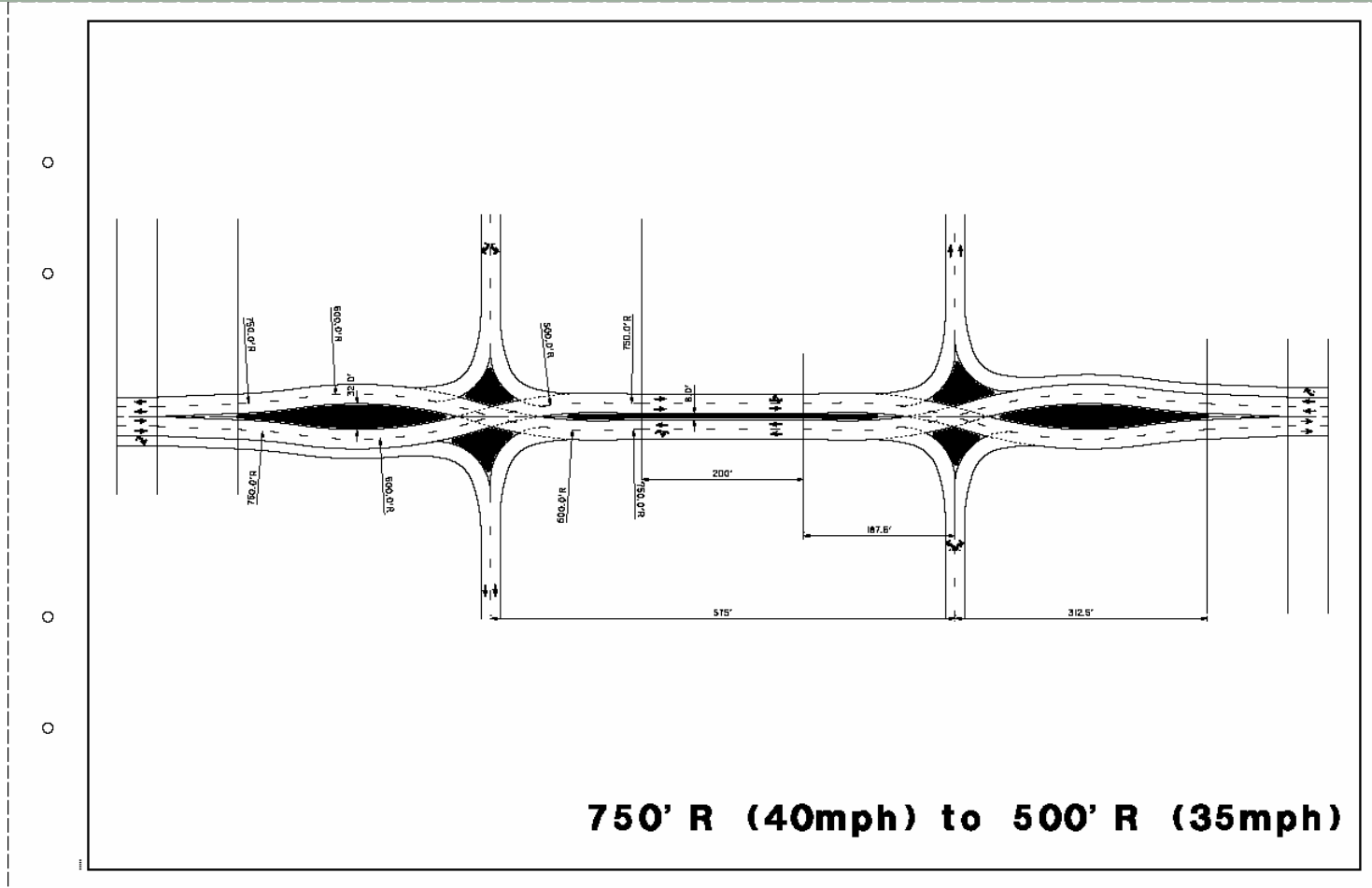
# HAN 224 – Minimal Build Queues



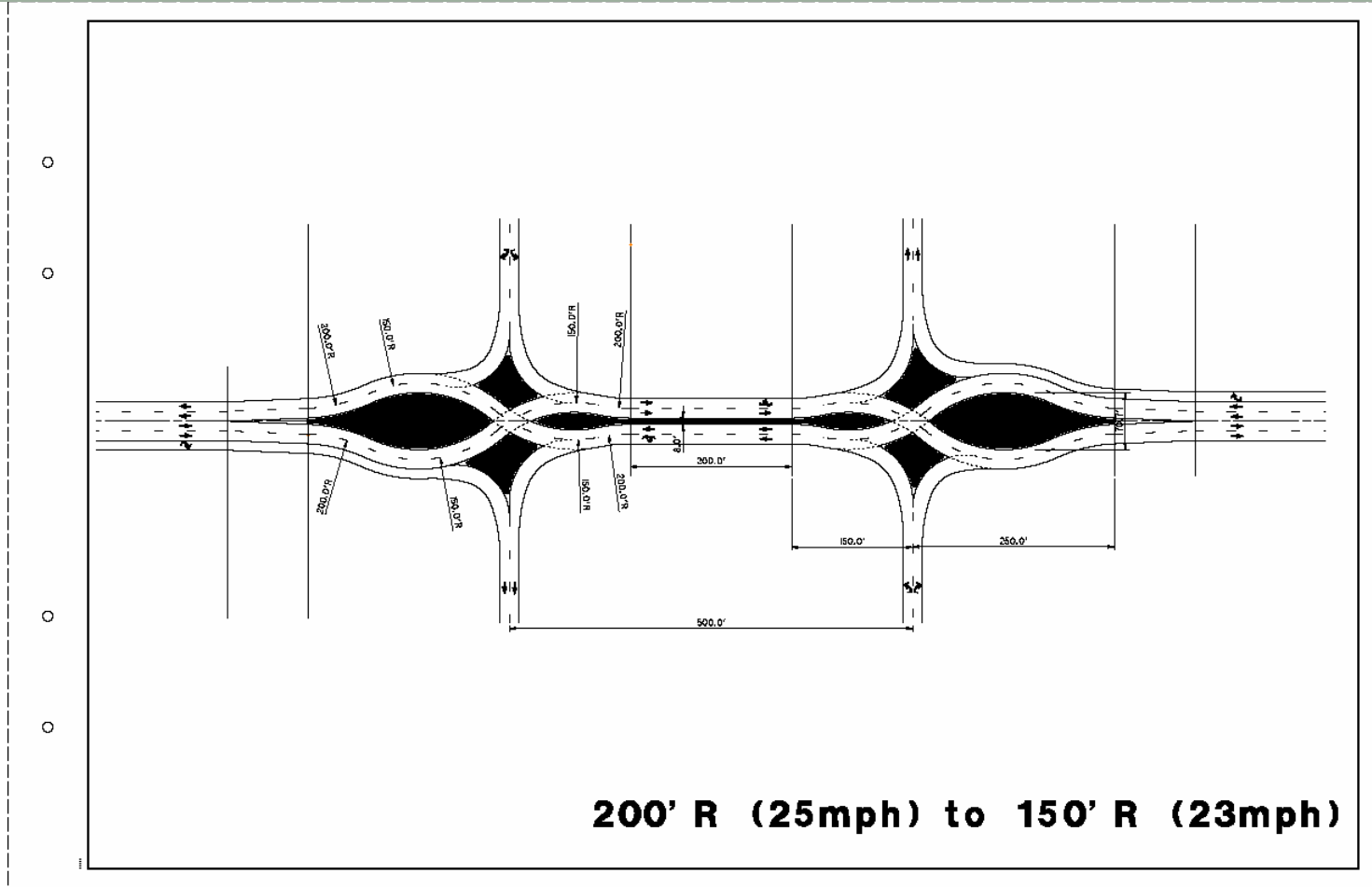
# HAN 224 –Build Queues - DDI



# Sample DDI layout for 40 mph – 35 mph



# Sample DDI layout for 25 mph – 23 mph



# Where have DDI's been examined in Ohio

- Union Centre Boulevard on I-75 in Butler County
- US 36 / SR 37 on I-71 in Delaware County
- Tiedeman on I-480 in Cuyahoga County

# Other states proposing / examining DDI's

- Missouri



- Oregon
- New Mexico
- Kentucky
- Maryland

# I-480/Tiedeman Road

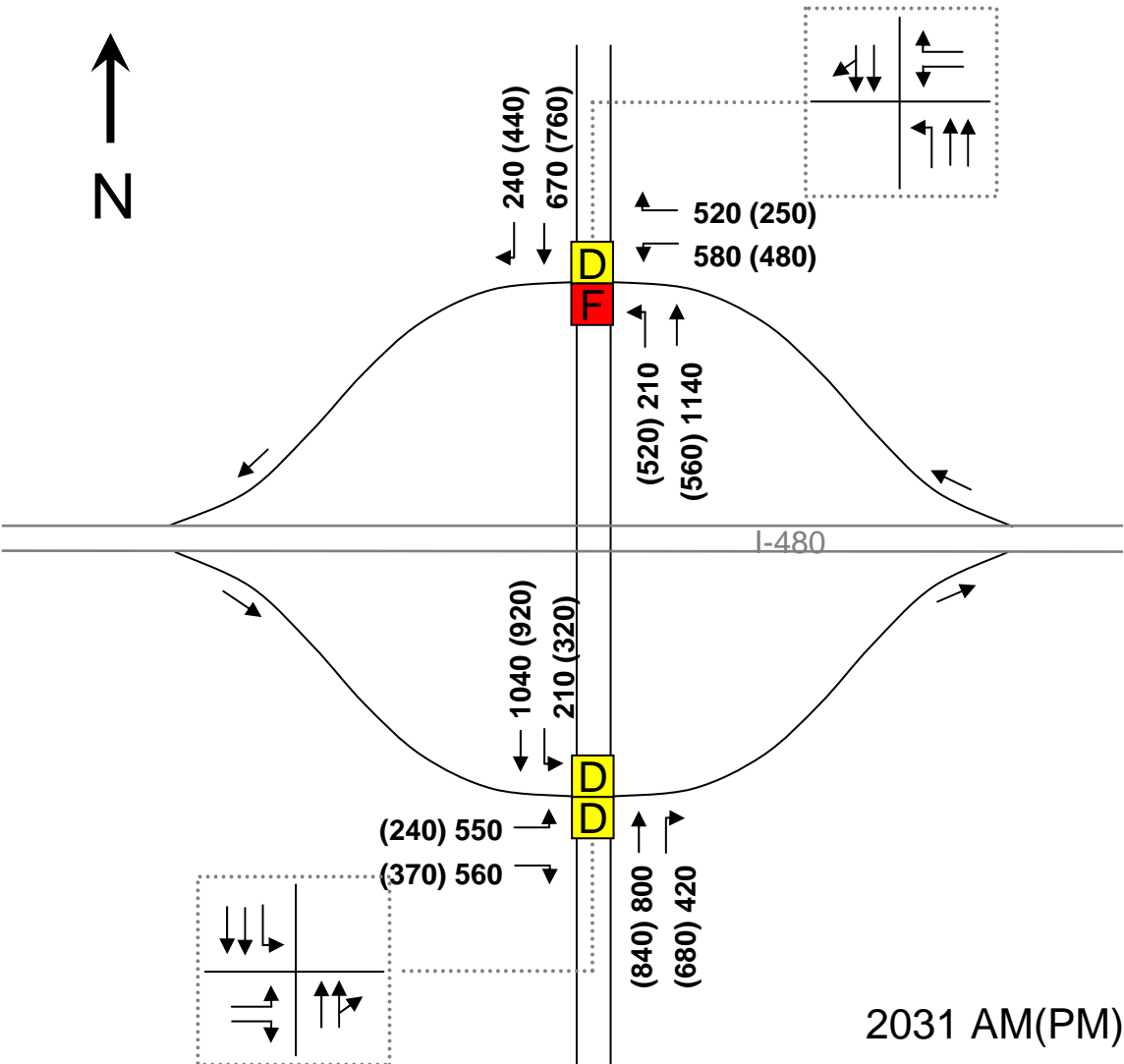


- Brooklyn, Ohio
- Original construction 1985
- SAFETEA-LU earmark received
- City led project, ODOT review
- Plain Dealer, Key Bank, hotels, restaurants

# Case Study – I-480/Tiedeman



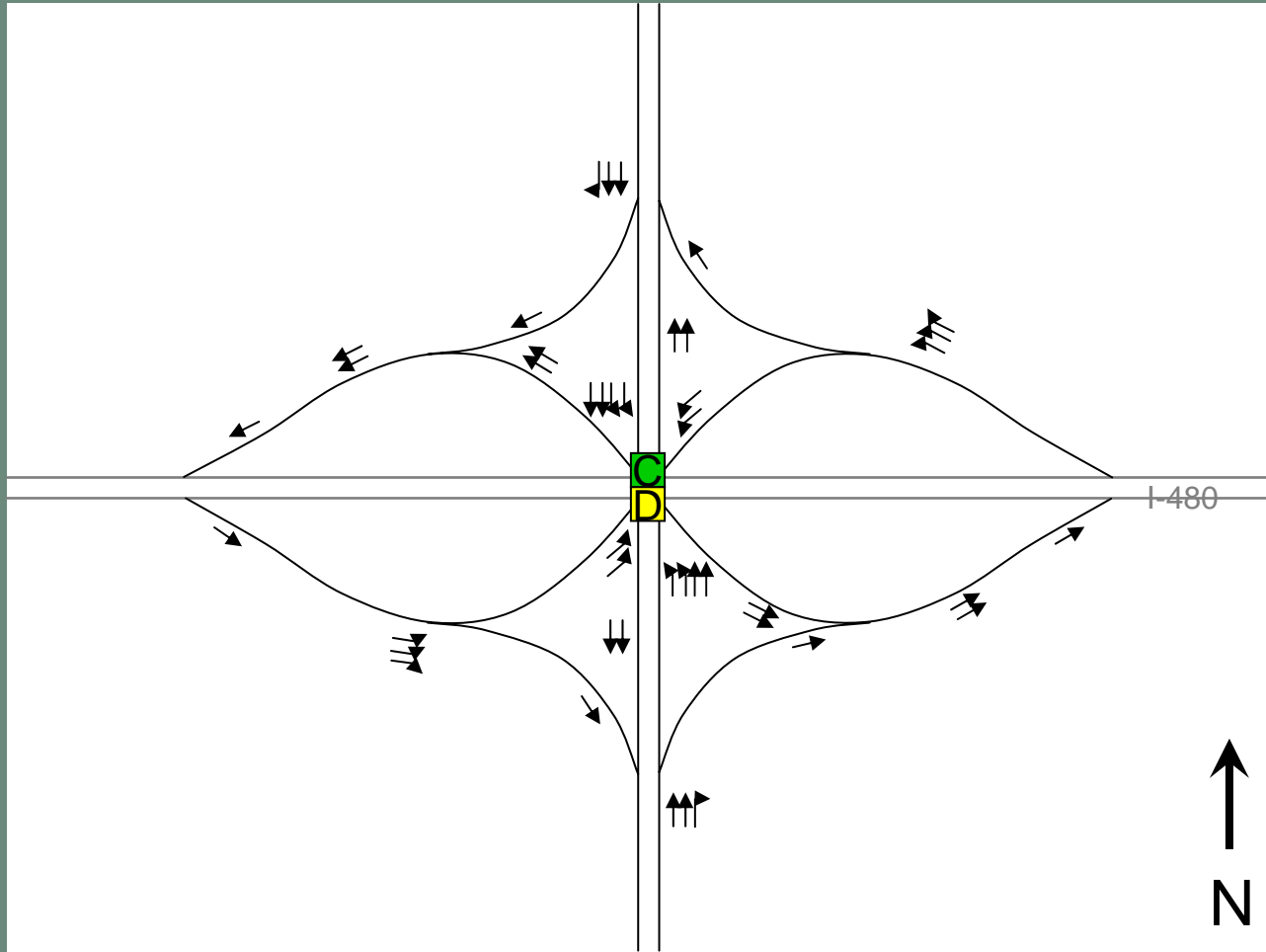
# Future Traffic on Existing Configuration



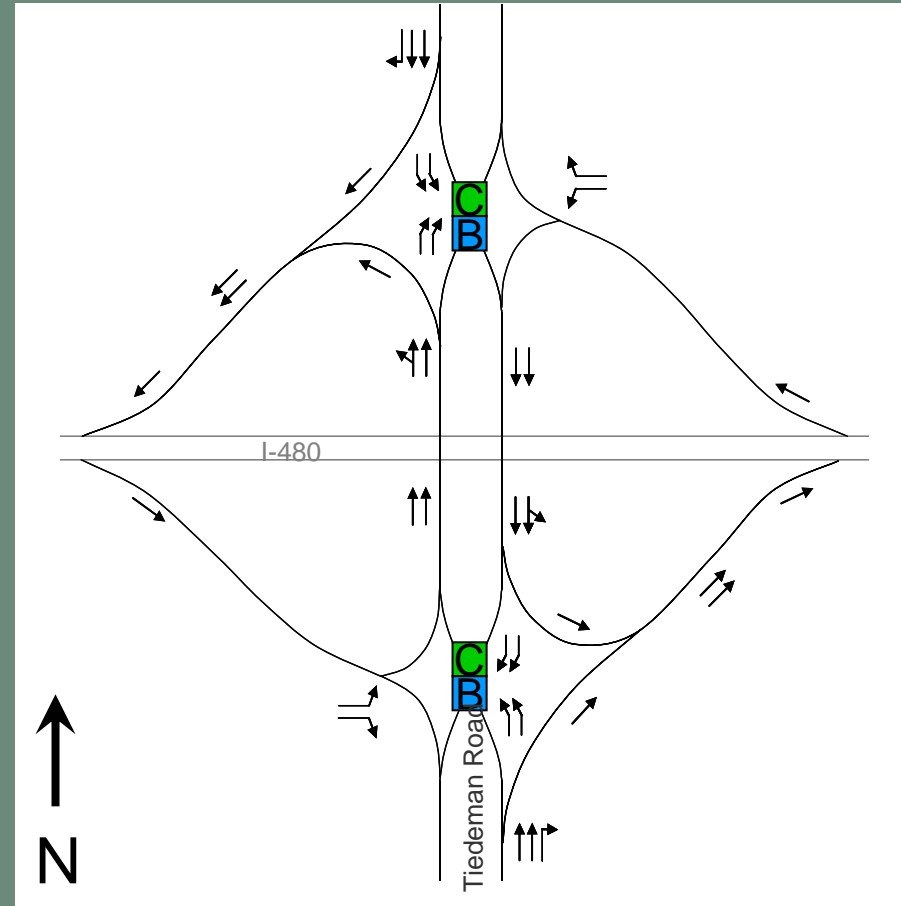
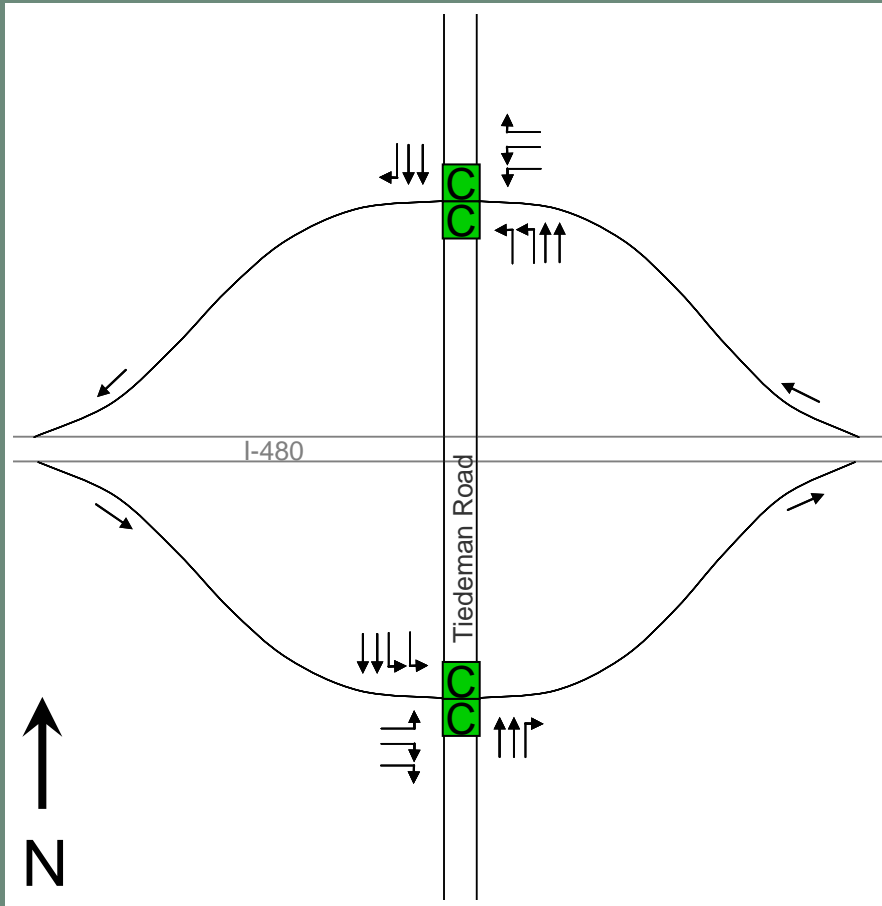
# Alternatives Examined

- *SPUI*
- Upgraded Diamond
- Diverging Diamond - DDI

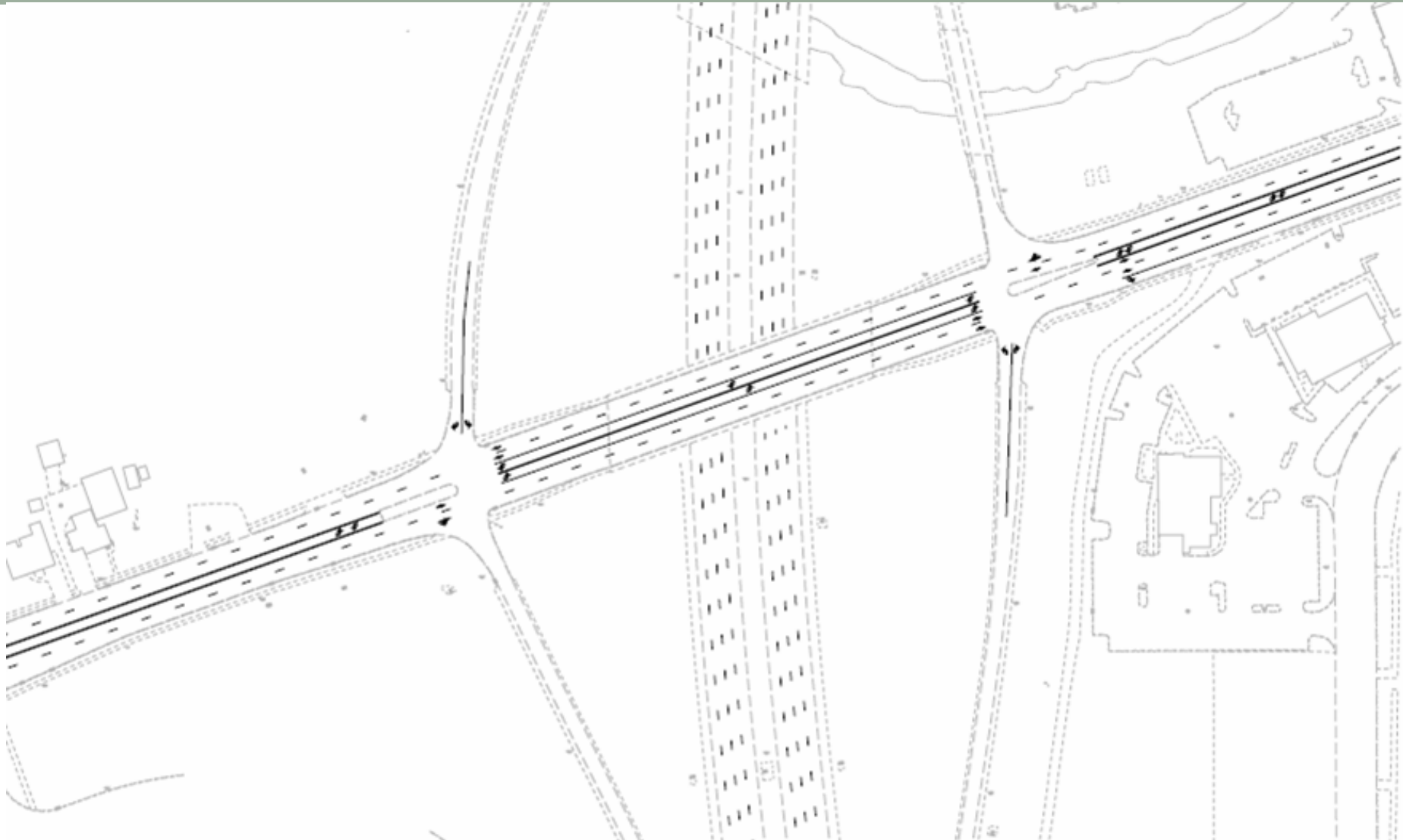
# SPUI



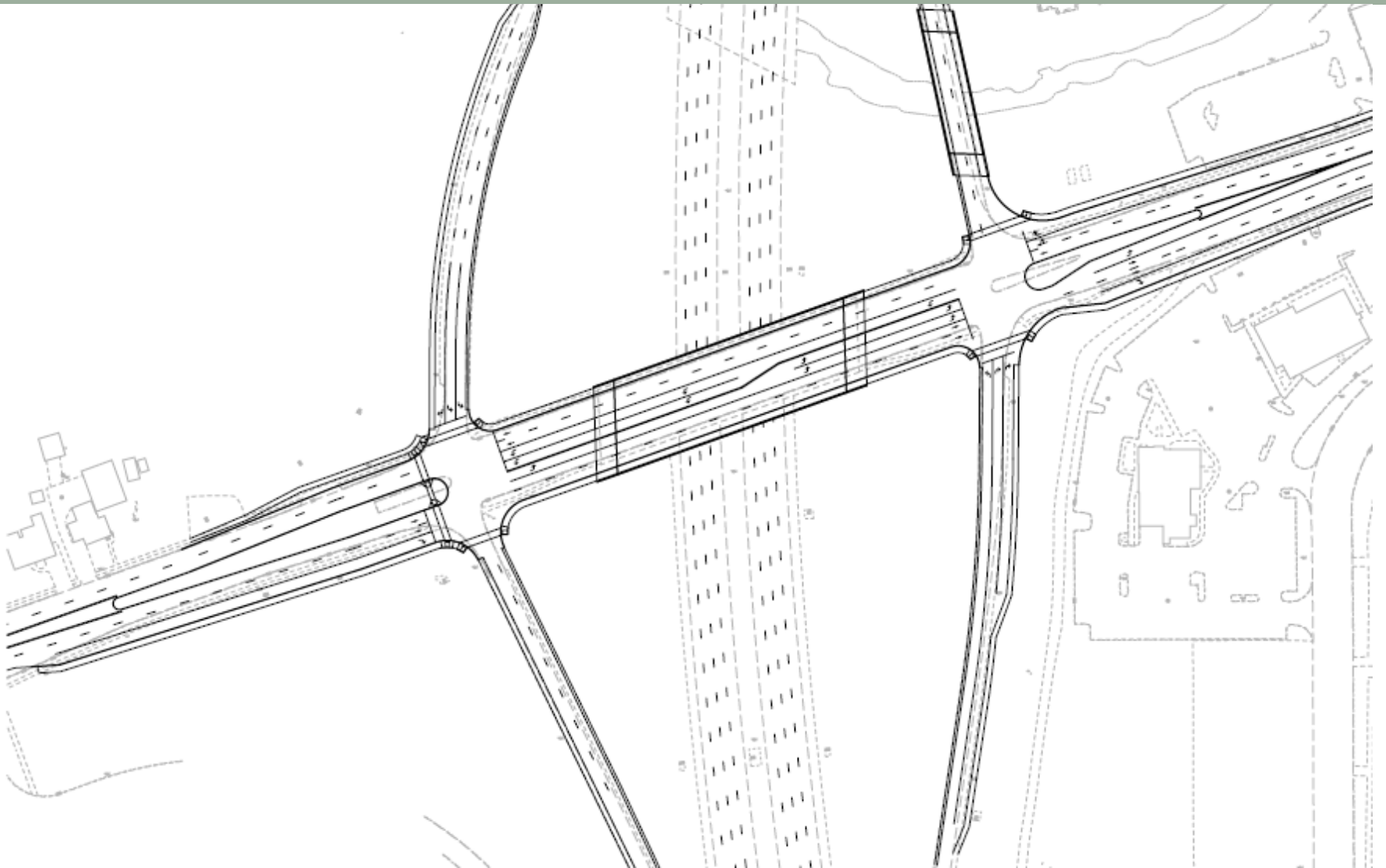
# Upgraded Diamond vs. DDI



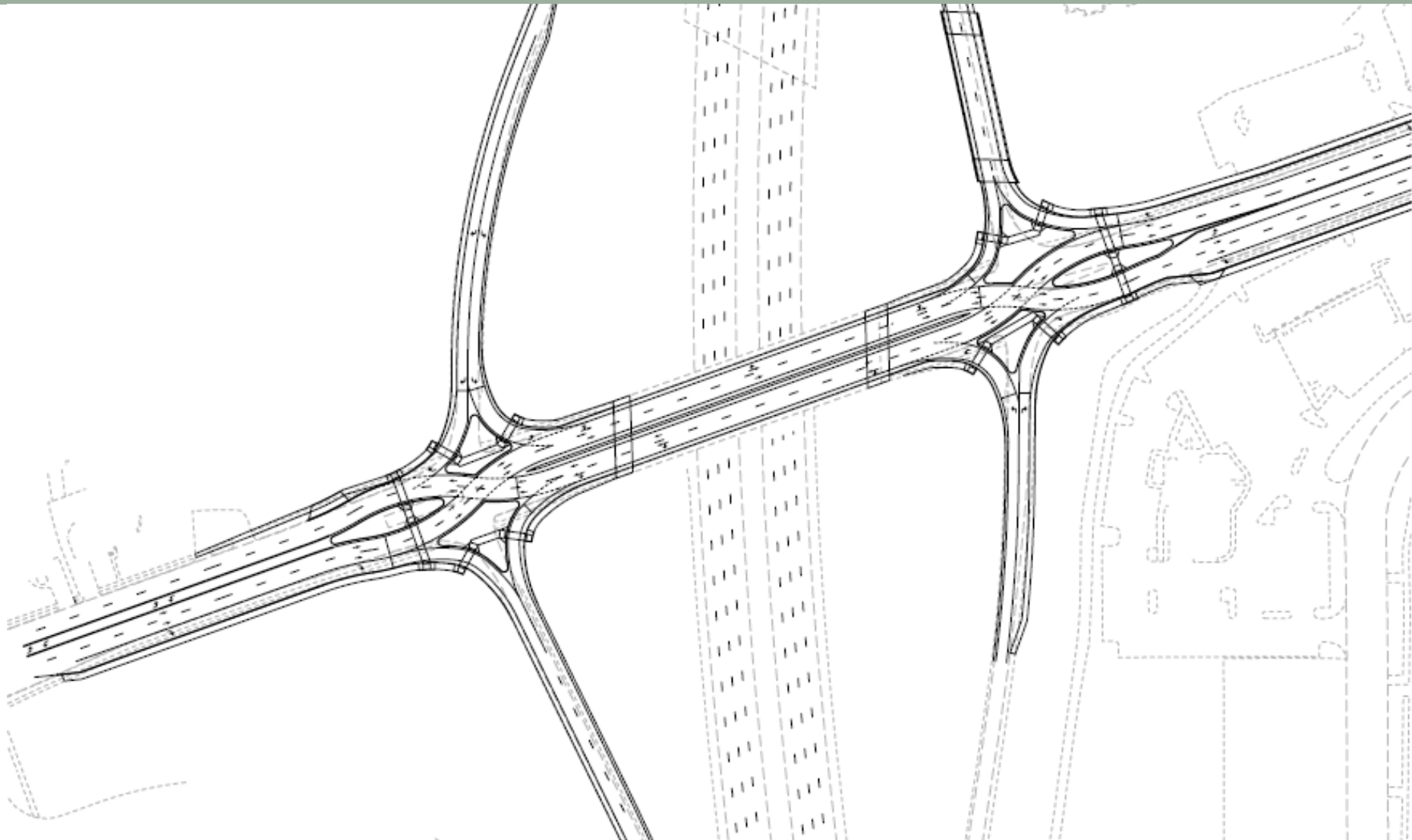
# Existing Configuration



# Upgraded Diamond



# DDI



# Summary

## Upgraded Diamond

- Cost - \$14.3 M
- Bridge Widening
- 2-lane entrance ramps
- 3-lane exit ramps
- LOS C

## DDI

- Cost - \$8.3 M
- Maintains current bridge width
- 2-lane exit/entrance ramps
- LOS C and B

# What Next?

- City is excited
- ODOT is supportive thus far
- Public involvement efforts continue