I-380 Interchanges at Tower Terrace Road and Boyson Road

Hiawatha, Linn County, Iowa

Interchange Justification Report (IJR)

Project Number
IM-380-6(224)25—13-57
Interstate Project

November 2018

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This document has been prepared to obtain FHWA approval to add a new interchange on the Interstate System.

Prepared by:

HNTB Corporation for:

The Iowa Department of Transportation

November 2018

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Joseph A Blasi Date: 11/28/18

Joseph A Blasi, PE, PTOE
License No: 22765
My renewal date is December 31, 2018.
Pages or sheets covered by this seal: All

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1.0 Introduction

The information contained in this Interchange Justification Report (IJR) provides the necessary background for justifying the proposed interchange at Tower Terrace Road on Interstate 380 (I-380) surrounding the municipalities of Cedar Rapids, Hiawatha and Robins, Iowa. The information included will help determine if the proposed interchange satisfies the requirements of the Federal Highway Administration (FHWA) policy concerning additional or revised access to the Eisenhower Interstate Highway System.

This FHWA policy was most recently set forth in "Policy on Access to the Interstate System," as published under Title 23, United States Code (U.S.C.), Section 111 on May 22, 2017. The ultimate intent of the policy is to ensure that the Interstate System provides the highest levels of safety and mobility to the traveling public. Adequate control of access is critical to providing this service.

The policy itself contains two specific requirements that new or revised interstate access points must meet in order to be approved. Though not mandated, the Iowa Department of Transportation (Iowa DOT) has elected to include additional material previously required in the last FHWA policy, Volume 74, Number 165 on August 27, 2009. The previous policy required that eight sections or "policy points" be satisfied prior to FHWA approval. Because initial drafting of this report occurred before the most recent policy was published, this report will follow the format of the previous FHWA policy while satisfying the requirements of the newest FHWA policy.

1.1 Project Description

At the time that I-380 was originally constructed within the study area of this IJR in the early 1980's, a section of right of way was reserved at Tower Terrace Road to accommodate future construction of an interchange.

In 2007, Iowa DOT completed an IJR for the existing Boyson Road and proposed Tower Terrace Road interchanges with I-380. This report identified the need for long-term improvements at the Boyson Road interchange and analyzed the need for a new interchange at Tower Terrace Road. The FHWA approved the long-term improvements at the Boyson Road interchange, but declined to approve the new interchange at Tower Terrace Road at that time, based upon the need to make further improvements to the supporting local transportation system.

In 2010, Iowa DOT worked with local agencies on an I-380 corridor feasibility study to evaluate potential solutions for corridor improvements. This provided a broad perspective on corridor issues and needs, and evaluated a range of concepts. The study identified that further investigation would be needed to evaluate improvements at Boyson Road with an interchange at Tower Terrace Road, and expanded capacity of I-380.

Additionally, the Tower Terrace Road Corridor Management Plan, prepared in 2010 for the Corridor Metropolitan Planning Organization (MPO), identified the need to preserve the proposed Tower Terrace Road alignment for a future eastward extension to Highway 13 at the eastern edge of the Cedar Rapids

metropolitan area. The study suggested an upgrade of Tower Terrace Road from a two-lane rural roadway to a modern five-lane arterial with raised medians and left turn lanes, and a speed limit of 35 or 40 mph, from I-380 east to Highway 13.

In 2011, the Iowa DOT initiated an IJR and Environmental Assessment (EA) for improvements at I-380 and Tower Terrace Road. These studies were not completed, as it was determined a larger study area that included potential improvements to I-380 from Collins Road to County Home Road, the Boyson Road interchange, and the local system needed to be considered.

In Spring of 2016, the Iowa DOT initiated this current study phase encompassing a larger study area than the 2011 study to address existing and forecasted future traffic congestion within the I-380 corridor. Two concurrent studies are being completed by Iowa DOT; this IJR and an EA that will be submitted for approval and reviewed by the FHWA.

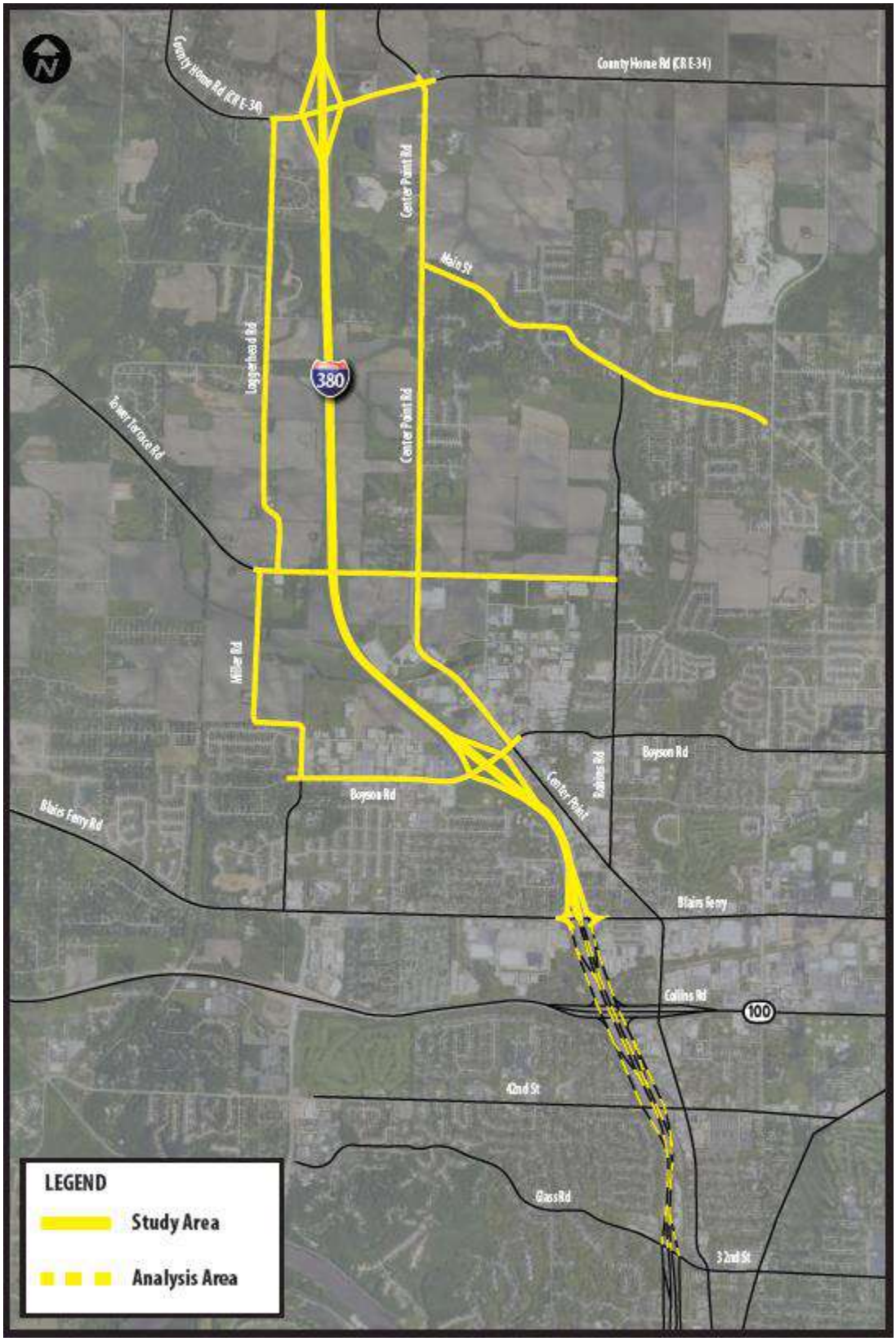
1.2 Project Location

The project is located in Linn County, Iowa, and borders the communities of Cedar Rapids, Hiawatha and Robins. The core study area on the I-380 corridor is approximately five miles in length. **Exhibit 1-1** displays the project limits. The core study area is defined as:

- South: the entirety of the Blairs Ferry Road interchange with I-380;
- North: the entirety of the County Home Road interchange with I-380;
- West: the Loggerhead Road, Miller Road/Edgewood Road corridor from County Home Road to Boyson Road, and;
- East: Center Point Road corridor from County Home Road to Boyson Road.

The study team expanded the area of analysis farther south to include I-380 down to the north-facing ramps of 32nd Street. This was done to better understand the impacts of expanding I-380 to six lanes through the study area. The analysis area is used for traffic operations only and is not included as part of the safety analysis. The analysis area can be seen in **Exhibit 1-1**. The study area is a part of the analysis area; however, the analysis area contains more than just the core study area.

EXHIBIT 1-1: REGIONAL LOCATION OF STUDY AREA



1.3 Purpose and Need

The purpose of the proposed action is to add capacity improvements along the four-lane divided Interstate 380 (I-380) from Collins Road (Iowa 100) to County Home Road, to construct a new interchange on I-380 at Tower Terrace Road, and reconstruct the existing interchange at Boyson Road. These improvements would be constructed to:

- Improve traffic operations at existing interchanges on I-380;
- Accommodate future traffic growth in the study area;
- Address geometric deficiencies; and
- Support regional travel needs for planned economic development and land use.

1.4 Design Criteria

Traffic analysis and geometric layouts of proposed interchange concepts will be based on geometric controls and criteria outlined in the documents 'A Policy on Design Standards Interstate System' (AASHTO, May 2016), 'A Policy on Geometric Design of Highways and Streets (Green Book)' (AASHTO, 2011), as well as preferred and acceptable design criteria based upon roadway type outlined in the 'Iowa DOT Design Manual'. Among several design parameters, the criteria establish basic thresholds to guide the development and evaluation of interchange concepts for this IJR. Traffic operations for I-380 and the interchange ramp terminals will be evaluated and designed to achieve a desired planning year LOS C or better. Arterial intersections will be evaluated based on a desired LOS D or better.

2.0 FHWA Policy

The FHWA has developed and issued a policy regarding requests for additional or revised access to the Eisenhower Interstate Highway System. The policy includes guidance for the justification and documentation needed for such requests. The policy's intent is to ensure that the Interstate System provides the highest levels of safety and mobility to the traveling public. Adequate control of access is critical to providing this service. This policy was originally issued in the Federal Register on October 22, 1990 and was revised as published in the Federal Register on February 11, 1998, and August 29, 2009. The most recent revision was approved on May 22, 2017. This revision reduced the number of policy points from eight to two. Changes to the FHWA guidelines came after the initial drafting stage of this document; therefore, the previous standard of eight policy points is how the document is organized. The required information needed to satisfy the newly mandated 2017 version is still included within the contents of this document. The eight requirements or "policy statements" are:

1. The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands (23 CFR 625.2(a)).

2. The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access (23 CFR 625.2(a)).

3. An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

4. The proposed access connects to a public road only and will provide for all traffic movements. Less than ``full interchanges'' may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.

5. The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93.

6. In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan (23 U.S.C. 109(d), 23 CFR 625.2(a), 655.603(d), and 771.111).

7. When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements (23 CFR 625.2(a) and 655.603(d)). The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point (23 CFR 625.2(a) and 655.603(d)).

8. The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing (23 CFR 771.111).

All of the requirements for the eight policy points are addressed in the sections 2.1 through 2.8.

2.1 FHWA Policy Statement One

The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands (23 CFR 625.2(a)).

2.1.1 Existing Conditions

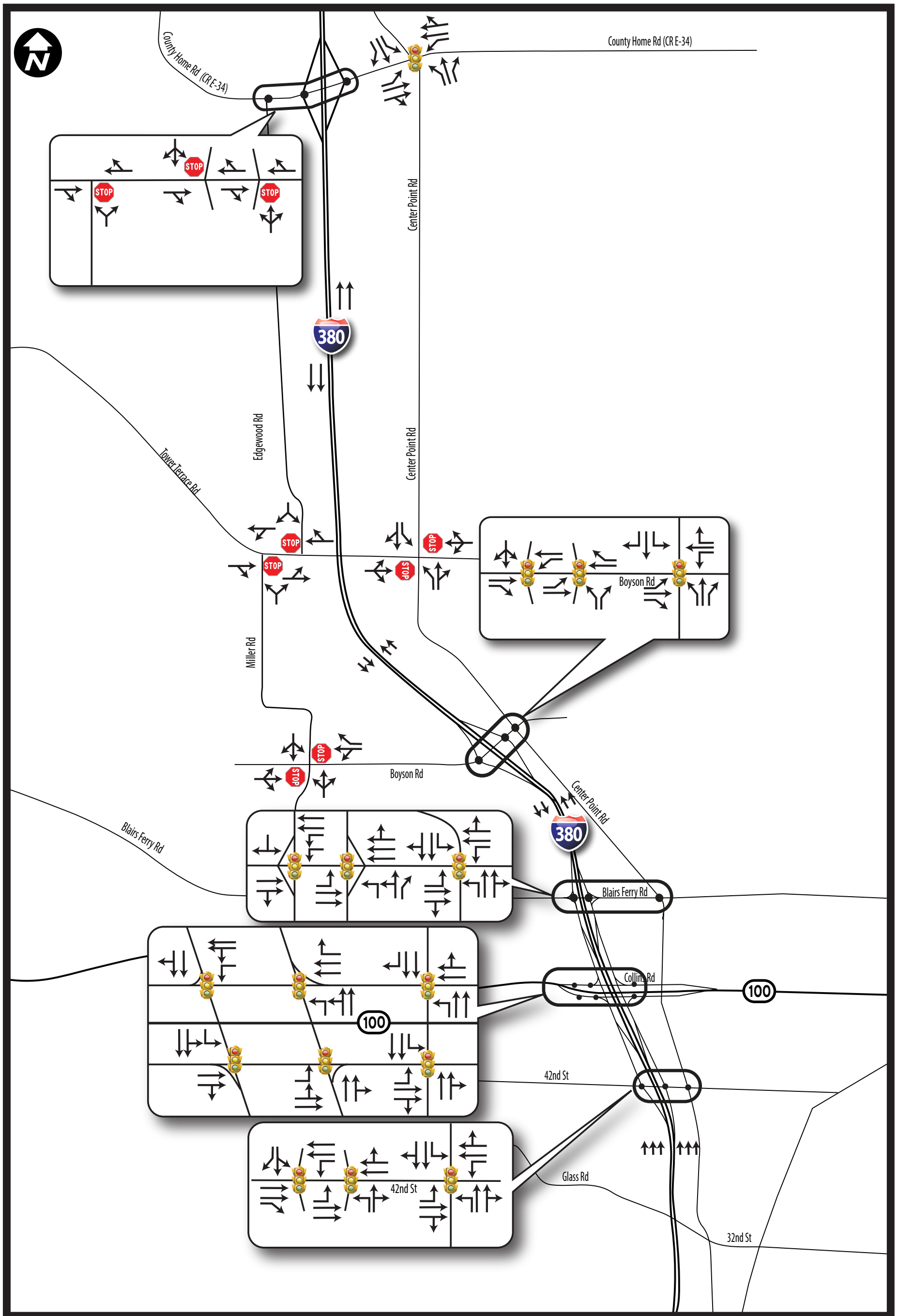
Exhibit 2.1-1 displays the current configuration and intersection movements in the core study area. Interstate 380 contains six-lanes of traffic (three lanes north and south) from 32nd Street up to the Blairs Ferry Interchange south ramps. After Blairs Ferry, I-380 drops to four lanes. Four lanes continue through the northern limits of the study area.

In the study area, Tower Terrace Road is a mainly stop-controlled two-lane minor arterial road that extends over I-380. It is approximately 1.25 miles north of Boyson Road and 2.3 miles south of County Home Road. Tower Terrace is mainly a local access roadway for residents living at the Tower Terrace Mobile Home Park. A gymnastics studio is also located along the western limits of the study area.

Boyson Road, within the study area limits west of I-380 is a stop-controlled two-lane minor arterial. East of I-380, it is a mainly signal controlled four-lane minor arterial that is regularly congested during the weekday morning and afternoon peak travel periods. The spacing between the northbound I-380 ramp terminal and Center Point Road coupled with the high volumes coming from I-380 create queueing at both intersections that can take commuters two or more traffic signal cycles to clear.

County Home Road is a two-lane roadway at I-380 which widens to four-lanes to the east, approaching Center Point Road. West of I-380, the roadway functions as a minor arterial, while east of I-380 it transitions to a major arterial. The intersection ramps at I-380 are stop sign controlled. Current development is mostly agricultural surrounding the interchange, but commercial development is expected to occur as the area continues to grow in population.

Federal requirements state that the nearest interchanges upstream and downstream from the proposed change in access must be analyzed. Although it extends beyond the NEPA study limits, the Study team decided to include the combined Blairs Ferry / Collins Road (Highway 100) / 42nd Street interchange and south to the two northern ramps at 32nd Street NE/Glass Road NE within the traffic analysis study limits. This was done to account for the expansion of I-380 to six lanes and to capture any operational impacts within the core study area. The northern limit on I-380 is just beyond the County Home Road interchange. Federal requirements also state that the nearest major arterial intersections must also be analyzed. Center Point Road runs parallel of I-380 to the east and is considered the closest major intersection for the roadways running east-west. For roads running east-west to the west of I-380, Edgewood Road and Miller Road (south of Boyson Road) are considered the closest major intersections.



EXHIBIT

2.1-1

Tower Terrace Road IJR - Lanes and Turning Movements

2.1.2 Crash Analysis

Existing traffic safety conditions were evaluated within the study area to identify vehicle crash patterns and potential safety deficiencies that should be considered as part of the Tower Terrace IJR. Crash data for a five-year evaluation period, 2011 to 2015, was obtained from the Iowa DOT SAVER database identifying various crash characteristics pertaining to the intersections, ramps and roadway segments within the study area. These characteristics include crash type, crash frequency, crash severity and weather conditions at the time of the crash.

Mainline I-380 Crash Analysis

An approximate seven-mile segment of I-380 from the County Home Road Interchange to the 32nd Street interchange during the evaluation period 2011 to 2015 was analyzed. During this time, 224 crashes were reported, resulting in two fatalities. **Table 2.1-A** summarizes the crash and fatality rates for the seven segments analyzed on the I-380 mainline.

Table 2.1-A: I-380 Mainline Crash Rates

Segment	Average Daily Two-Way Traffic	Average Annual Crashes (11-15)	Average Annual Fatal Crashes (11-15)	Crash Rate (HMVMT)	Fatal Crash Rate (HMVMT)
County Home Interchange	25,100	7.2	0.2	77.0	2.1
Between County Home and Boyson	30,700	14.0	0.0	47.1	0.0
Boyson Road Interchange	30,700	7.8	0.2	69.7	1.8
Blairs Ferry Interchange	41,500	4.6	0.0	44.0	0.0
Collins Rd Interchange	41,500	2.6	0.0	34.3	0.0
42nd Street Interchange	41,500	3.0	0.0	40.4	0.0
32nd St Interchange	75,300	5.6	0.0	29.5	0.0
		*Statewide Crash Rates		86.0	0.5

* Statewide Crash Rates calculated as the 5-year average of yearly crash rates for 2011 to 2015 on Municipal Interstates in Iowa
Source: Iowa DOT SAVER database

The County Home Interchange and Boyson Road Interchange experienced fatal crash rates higher than the statewide average. These interchange segments include the merge/diverge portions of the entrance and exit ramps as well as the segment between the ramp gores. No mainline segments experienced total crash rates higher than the statewide average for the period analyzed.

Exhibit 2.1-2 displays the crash severity. Of the 224 reported incidents experienced on I-380, approximately 77 percent of all crashes resulted in property damage only, while approximately nine percent of crashes resulted in a confirmed injury. **Exhibit 2.1-3** displays the crashes by type. Most reported incidents consisted of single vehicle crashes (43 percent), followed by rear end collisions (19 percent) and sideswipe in the same direction (12 percent). Although weather conditions have the potential to be a leading cause in traffic collisions, approximately 20 percent of incidents occurred during rain or snow events.

Exhibit 2.1-2: Crash Severity

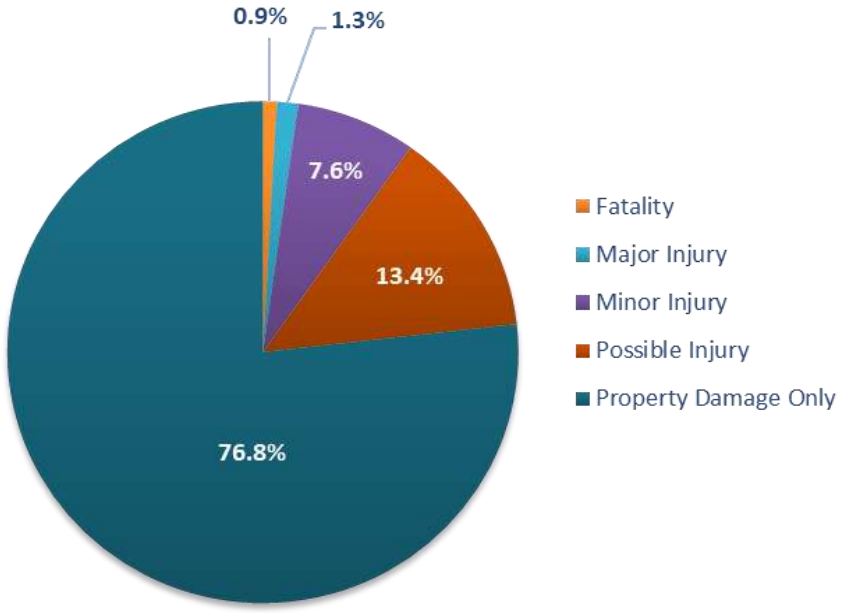
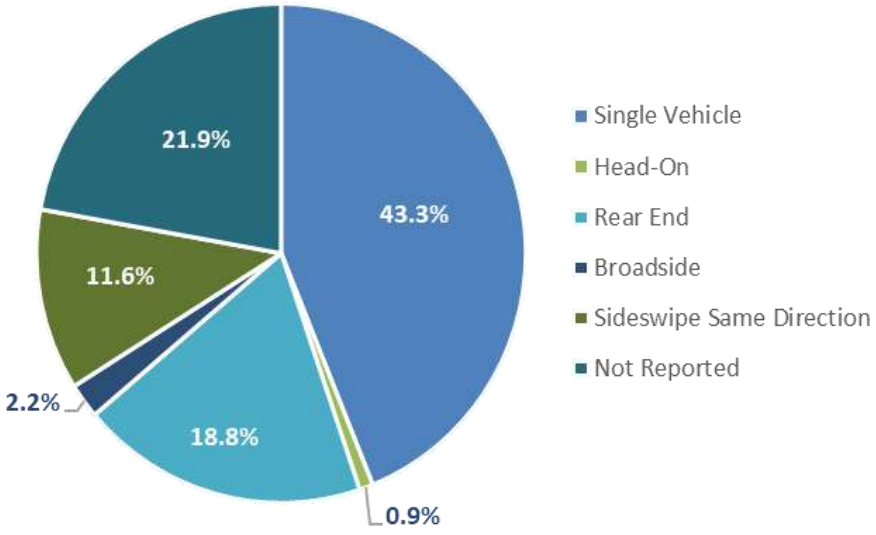


Exhibit 2.1-3: Crash Type



Source: Iowa DOT SAVER database

Arterial Street Crash Analysis

Seven arterial streets were evaluated east and west of I-380, generally from 1,000 feet west of Edgewood Road or Miller Road to 1,000 feet east of Center Point Road. Of the seven arterial streets evaluated, it was determined that Blairs Ferry Road experienced the greatest amount of traffic incidents with 170 reported crashes, followed by Collins Road with 68 reported crashes. This is reasonable because these are two of the more congested roadways in the study area. **Table 2.1-B** summarizes the crash and fatality crash rates for all seven arterial streets evaluated.

Table 2.1-B: Arterial Street Crash Rates

Arterial	Average Daily Two-Way Traffic	Average Annual Crashes (11-15)	Average Annual Fatal Crashes (11-15)	Crash Rate (HMVMT)	Fatal Crash Rate (HMVMT)
County Home Road	9,600	0.8	0.0	34.6	0.0
Tower Terrace Road	3,040	1.3	0.0	92.4	0.0
Blairs Ferry Road	21,700	34.0	0.0	517.2	0.0
Boyson Road	12,700	6.4	0.0	134.0	0.0
Collins	37,900	13.4	0.0	52.4	0.0
42nd Street	13,900	4.0	0.0	231.9	0.0
32nd Street	13,600	2.4	0.0	109.9	0.0
			*Statewide Crash Rates	377.2	0.9

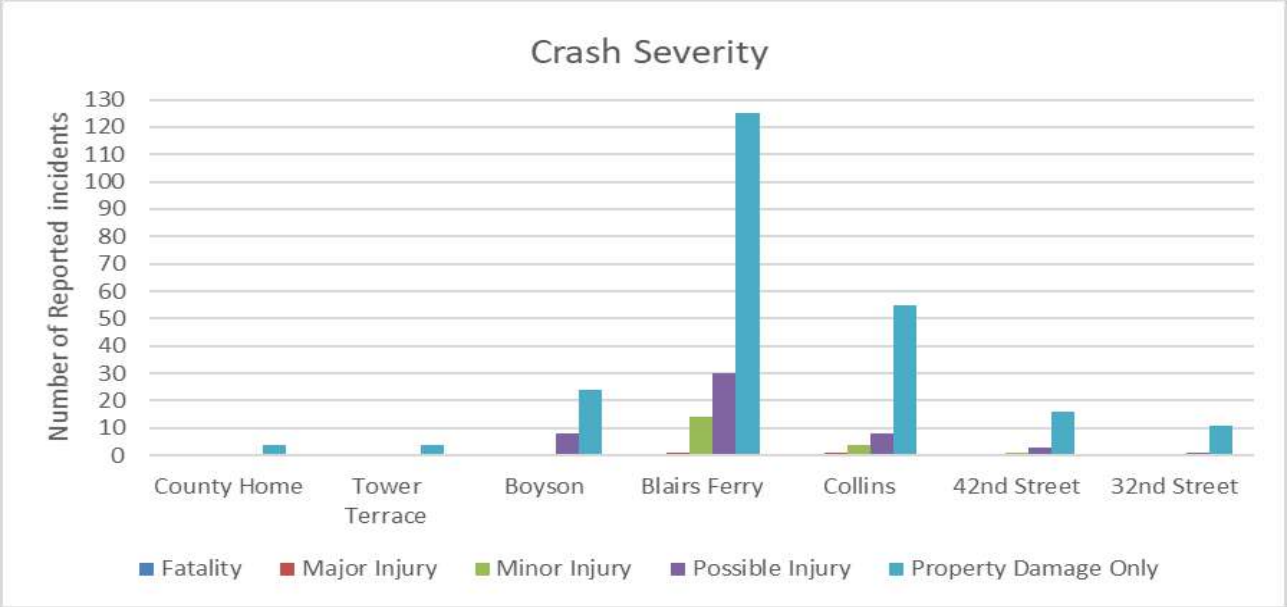
* Statewide Crash Rates calculated as the 5-year average of yearly crash rates for 2011 to 2015 on City Streets in Iowa
Source: Iowa DOT SAVER database

Blairs Ferry Road is the only arterial street with a total crash rate higher than the statewide average. Of the 170 reported incidents experienced on Blairs Ferry Road, approximately 74 percent of all crashes resulted in property damage only, while approximately nine percent of crashes resulted in some sort of confirmed injury to vehicle occupants. Forty-four percent of crashes experienced on Blairs Ferry Road were rear end collisions. The next closest percentage of incidents consisted of broadside (23 percent) and angle collisions (18 percent). Ninety-four percent of all traffic incidents occurred under no adverse weather conditions.

When analyzing the crashes experienced on Collins Road, it was determined that approximately 80 percent of crashes resulted in property damage only. Seven percent of crashes resulted in a confirmed injury to vehicle occupants. Most of crashes on Collins Road were rear end collisions (61 percent) followed by broadside collisions (22 percent). Approximately 88 percent of crashes on Collins Road occurred under no adverse weather conditions.

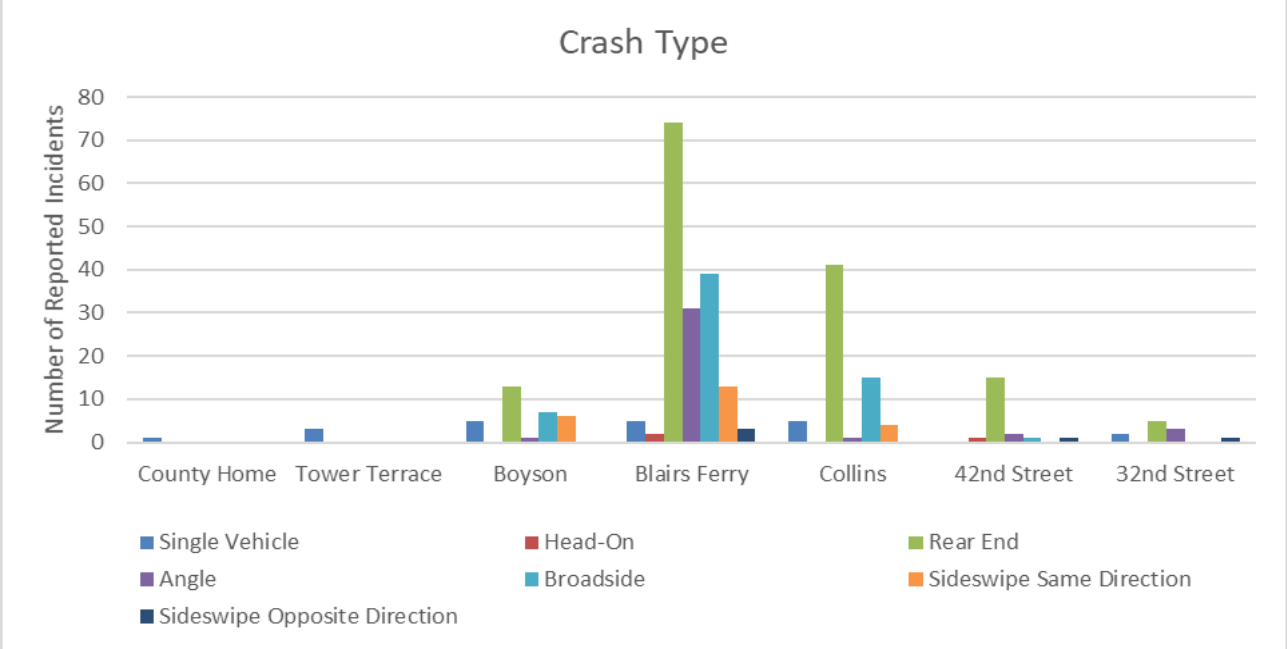
Exhibit 2.1-4 and 2.1-5 further summarize crash severity and type for all arterial streets.

Exhibit 2.1-4 Crash Severity – Arterial Streets



Source: Iowa DOT SAVER database

Exhibit 2.1-5 Crash Type – Arterial Streets



Source: Iowa DOT SAVER database

Intersection Crash Analysis

An analysis was conducted at 28 major intersections within the study area for the evaluation period 2011 to 2015. **Table 2.1-C** summarizes the crash and fatal crash rates for intersections within the study area.

Table 2.1-C: Intersection Crash Rates

Intersection	Average Daily Entering Traffic	Average Annual Crashes (11-15)	Average Annual Fatal Crashes (11-15)	Crash Rate (HMEV)	Fatal Crash Rate (HMEV)
County Home-East	14,180	1.8	0.0	34.8	0.0
County Home-West	9,400	0.6	0.0	17.5	0.0
Boyson Road-East	21,900	5.2	0.0	65.1	0.0
Boyson Road-West	22,100	0.8	0.0	9.9	0.0
Blairs Ferry - East	38,300	17.0	0.0	121.6	0.0
Blairs Ferry - West	40,800	6.0	0.0	0.0	0.0
Collins SB Off	13,240	2.6	0.2	53.8	4.1
Collins SB On	13,160	2.8	0.2	58.3	4.2
Collins NB Off	11,410	2.8	0.0	67.2	0.0
Collins NB On	9,960	1.0	0.0	27.5	0.0
42nd Street - East	15,800	3.8	0.0	65.9	0.0
42nd Street - West	13,900	3.0	0.0	59.1	0.0
32nd Street - East	13,600	3.0	0.0	60.4	0.0
32nd Street - West	8,800	2.2	0.0	68.5	0.0
County Home/Edgewood	2,910	0.4	0.0	37.7	0.0
County Home/Center Point	13,560	2.6	0.0	52.5	0.0
Tower Terrace/Miller	2,800	0.4	0.0	39.1	0.0
Tower Terrace/Loggerhead	3,170	0.0	0.0	0.0	0.0
Tower Terrace/Center Point	10,980	1.4	0.0	34.9	0.0
Boyson/Miller	8,670	1.4	0.0	44.2	0.0
Boyson/Center Point	26,700	7.0	0.0	71.8	0.0
Blairs Ferry/Blairs Forest	27,500	7.0	0.0	69.7	0.0
Blairs Ferry/Center Point	38,300	16.4	0.2	117.3	1.4
Access Road/Center Point South	23,200	7.6	0.0	89.7	0.0
Access Road/Center Point North	23,700	3.2	0.0	37.0	0.0
Collins/Council	57,000	6.2	0.0	29.8	0.0
42nd/Center Point	28,800	6.8	0.0	64.7	0.0
32nd/Center Point	26,900	7.0	0.2	71.3	2.0

Note: East are the northbound intersection ramp terminals of I-380, west are the southbound ramp terminals
Source: Iowa DOT SAVER database

The intersection with the greatest number of crashes experienced during the evaluation period is Blairs Ferry at the I-380 northbound ramp terminal, followed by the Blairs Ferry Road and Center Point Road intersection. Both exceed the statewide average rate of 100 crashes/HMEV. Of the 85 incidents reported on Blairs Ferry at I-380 northbound, 72 percent of crashes resulted in property damage only. Forty-eight percent of crashes were rear end collisions. There were 82 incidents reported on Blairs Ferry Road at Center Point Road and 78 percent of the crashes resulted in property damage only. Fifty-seven percent of crashes were rear end collisions. Rear end crashes are usually an indication of recurring congestion. This is reasonable given that Blairs Ferry is one of the more congested roadways in the study area.

Existing Safety Analysis Conclusion

Safety is not a primary factor addressed in the following IJR's purpose and need. Few segments within the study area exceed the statewide average crash rates. Along the I-380 mainline, two segments (County

Home Road and Boyson Road interchanges) have five-year fatal crash rates that exceed the statewide average (because each experienced one fatal crash) and no segments exceed the statewide average for total crashes. Blairs Ferry Road was the only arterial analyzed that had a total crash rate exceeding the statewide average. Along the I-380 mainline, during the five-year analysis period, over 75 percent of all crashes were property damage only. The primary crash types were single vehicle, rear-end and sideswipe.

2.1.3 Traffic Forecasts

The methodology described below is consistent with the guidance provided by *NCHRP 255 – Highway Traffic Data for Urbanized Area Project Planning and Design*.

Traffic forecasts were developed from a combination of peak hour counts, historical growth rates and growth rates developed from the Corridor MPO travel demand model. Traffic counts were collected at two locations on the I-380 mainline and at the interstate ramp terminals and the major arterial intersections within the defined study area. The volumes came from a combination of local traffic counts collected by the cities of Cedar Rapids, Hiawatha and Robins, coupled with counts taken on I-380 from the Iowa DOT. The base year for model development is 2016. Volumes collected before 2016 were inflated to that base year. Inflated volumes were calculated by considering historical growth rates for the local area and comparing them to Corridor MPO travel demand model growth rates.

The volumes for all intersections and freeway segments were then analyzed to determine the a.m. and p.m. peak hours and peak hour volumes for the study area. Weekdays (Monday through Friday) were used in the analysis. The a.m. and p.m. peak hours were determined to be 7:00 – 8:00 am and 5:00 – 6:00 pm.

After calculating the intersection and mainline peak hour volumes, the volumes were input into Synchro and balanced. Because counts taken at various intersections, ramps and freeways are rarely collected during the same day and time, volumes will never precisely add up between roadway segments. Balancing is a practice used in traffic analysis to smooth out inconsistencies between roadway volumes. If a segment requires balancing, volumes are generally added to the movements with lower volumes. This is a conservative approach that yields higher predicted volumes for the study area.

After the intersection and freeway volumes were balanced, the peak period 2040 volumes were forecasted by utilizing the growth from the Corridor MPO travel demand model. This was done by applying the growth to the existing peak hour volume. Generally, the absolute change in volume (as opposed to percentage change) from the model was applied to the peak hour volume; then the results were checked for reasonableness and adjusted using professional judgement.

The calculation and balancing of movements were completed for the 2040 no-build and build alternative scenarios. **Exhibits 2.1-6** through **2.1-8** show the ADT, existing peak hour, and 2040 no-build peak hour volumes for the study area and analysis area. Future volumes were rounded according to AASHTO standards, which provide guidance on level of precision when rounding numbers depending on the magnitude of the number.

Legend

X,XXX	Existing (2016)
X,XXX	Future No-Build (2040)
X,XXX	Preferred Build (2040)

*Volumes may not balance due to rounding

*Rounded to AASHTO Standards

County Home Rd (CR E-34)

29,500
43,500
43,500

County Home Rd (CR E-34)

2,200
5,000
4,500

1,250
2,600
1,300

7,400
13,000
12,500

1,250
2,600
1,200

10,500
18,500
16,000

3,900
7,500
8,100

4,600
8,300
8,000

34,500
54,000
57,000

Center Point Rd

Main St

1,900
3,900
3,600

1,650
3,800
3,600

14,500
23,000
22,000

16,500
26,500
22,500

5,500
21,000
19,500

6,900
8,100
4,200

5,900
7,700
4,400

Center Point Rd

380

(Only Preferred Build Alternative)

4,300

5,000

14,000

12,500

3,100
18,500
28,500

Tower Terrace Rd

3,100
18,500
29,000

Miller Rd

4,600
5,500
7,400

5,500
6,700
8,600

30,000
33,000
32,500

29,000
33,000
33,000

28,000
31,500
30,500

34,500
54,000
74,000

Boyson Rd

10,500
12,500
12,000

10,000
14,200
12,000

8,000
8,700
7,100

8,500
9,700
7,400

2,500
3,900
4,900

1,500
4,500
4,600

3,700
5,400
5,100

11,000
12,500
13,000

51,500
68,500
74,000

44,600
62,000
75,500

Center Point Rd

Blairs Ferry Rd

Collins Rd

100

16,500
18,500
17,000

17,000
18,500
18,500

19,500
22,500
22,500

6,700
7,300
7,100

42nd St

3,700
5,400
5,100

11,000
12,500
13,000

11,500
12,900
12,500

9,100
11,700
10,500

5,200
5,900
5,300

2,200
4,000
4,300

81,000
101,000
105,000

14,000
14,000
14,500

3,400
4,300
4,800

8,300
9,500
9,000

9,600
10,000
9,600

1,900
2,800
2,900

850
2,100
1,750

Glass Rd

10,500
10,500
10,500

16,500
16,500
17,000

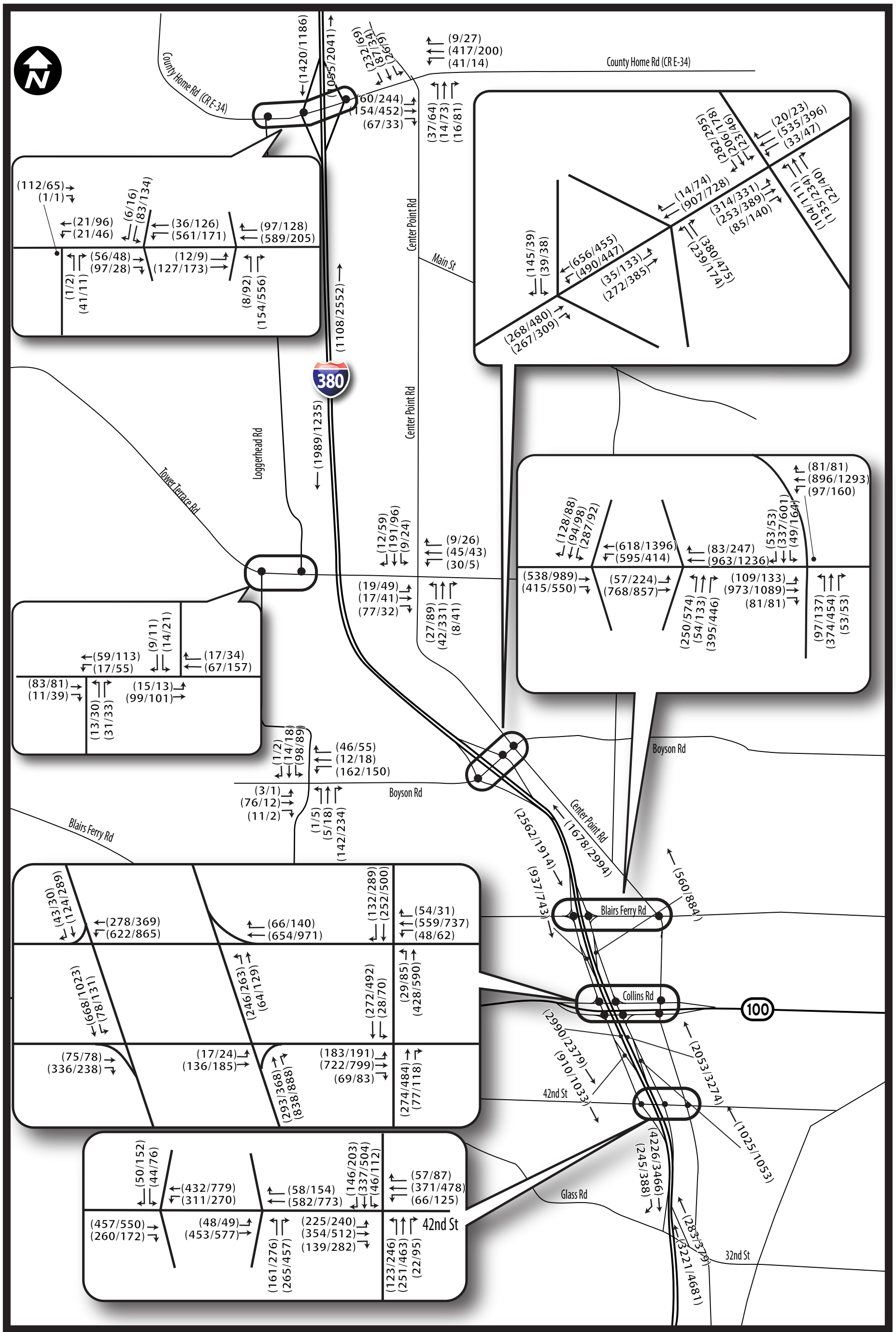
32nd St

70,500
88,000
92,500

74,000
93,000
96,000

EXHIBIT 2.1-6

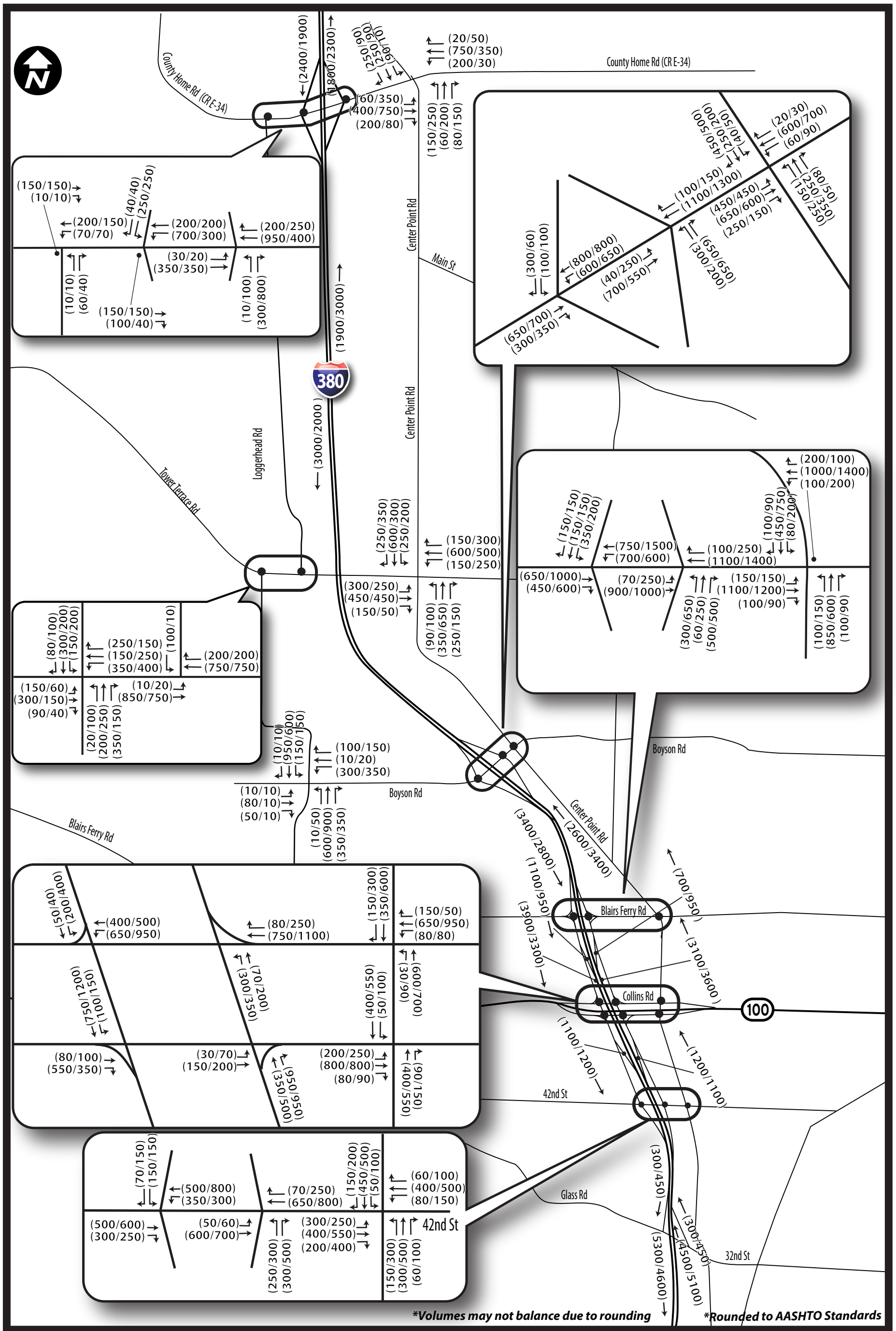
Tower Terrace
Existing, No-Build, and Preferred Build Daily Volumes



EXHIBIT

2.1-7

Tower Terrace
Existing Volumes 2017 AM/PM



*Volumes may not balance due to rounding

*Rounded to AASHTO Standards

EXHIBIT

2.1-8

Tower Terrace
No-Build Volumes 2040 AM/PM

2.1.4 System Analysis

Traffic operations analysis was conducted using methods from the Highway Capacity Manual Version Six (HCM) published by the Transportation Research Board in 2016. The fundamental HCM parameter describing relative ease of traffic flow is level of service (LOS), with an 'A' (best) through 'F' (worst) ranking scale. For this study, LOS C is considered the minimum acceptable LOS on freeways for the design year based upon the Acceptable Design Criteria defined by Iowa DOT for urban areas. For freeway elements, LOS is assigned based on density, defined as the number of passenger cars per mile per lane (pc/mi/ln) and freeway segment type (mainline, merge/diverge, or weave). For intersections, LOS is based on the average control delay in seconds per entering vehicle and intersection type (signalized or unsignalized). Control delay includes not only stops at intersections, but also slower speeds as vehicles advance in queue or decelerate upstream of an intersection. **Table 2.1-D** shows the LOS ranges used to evaluate the types of freeway lanes, signalized intersections, and unsignalized intersections for this study.

Table 2.1-D: Level of Service Thresholds

LOS	Freeways Mainline max Density (pc/mi/ln)	Freeways Merge/Diverge max Density (pc/mi/ln)	Freeways Weaving Segment (pc/mi/ln)	Signalized Interchanges Avg. Delay (sec/veh)	Signalized Intersections Avg. Delay (sec/veh)	Unsignalized Intersections Avg. Delay (sec/veh)
A	<11	<10	<10	<15	<10	<10
B	>11-18	>10-20	>10-20	>15-30	>10-20	>10-15
C	>18-26	>20-28	>20-28	>30-55	>20-35	>15-25
D	>26-35	>28-35	>28-35	>55-85	>35-55	>25-35
E	>35-45	>35	>35-43	>85-120	>55-80	>35-50
F	>45, Demand Exceeds Capacity	Demand Exceeds Capacity	>43, Demand Exceeds Capacity	>120	>80	>50

Source: Highway Capacity Manual 2010

Traffic Operations Modeling

Simulation modeling is a process that is conducted to evaluate existing conditions of a corridor and then forecast what conditions may be in the future. Results of the simulation models are then assigned a LOS (described above) and compared. The traffic simulation program, VISSIM, was used to evaluate the roadway operations for the IJR. An existing, a no-build and five build alternatives were modeled. Existing network operations were calibrated to reflect how the network is currently performing. A detailed explanation of how the models were calibrated can be found in the calibration memorandum in **Appendix A**. After calibration was completed, the models were run ten times and the results of each run were averaged.

The calibrated existing a.m. and p.m. models were used as a base to develop 2040 no-build models. The forecasted 2040 volumes, described in **Section 2.1.3**, were input into the models. The models were then run and the results were averaged to predict 2040 no-build operations. System improvements are not included in the no-build scenario.

2.1.5 System Operations – Existing and 2040 No-Build

The operational performance of the existing and 2040 no-build networks are described below. **Tables 2.1-E through 2.1-F and Exhibits 2.1-9 through 2.1-12** show the operational performance of the existing and no-build models. Operations for the build alternatives can be found in **Section 2.3**.

2.1.5.1 Existing

A.M.

The a.m. peak period traffic conditions operate at a LOS C or better on both I-380 and at all arterial intersections.

P.M.

The northbound direction of I-380 at the Boyson Road off-ramp operates at a LOS E during the p.m. peak. All other segments on I-380 perform at acceptable levels. The intersection of Boyson Road and Center Point Road currently operates at a LOS F. The queue for this intersection extends west and down onto the I-380 northbound off ramp. A LOS F is also located at the unsignalized I-380 northbound and County Home Road ramp terminal.

2.1.5.2 No-Build 2040

A.M.

No changes to the I-380 mainline and its supporting arterial road intersections (other than a minor committed improvement to the Boyson northbound ramp terminal and Center Point Road intersection – see Section 2.1.6), coupled with steady growth in the region, will result in severe decay of the system by the year 2040. Southbound I-380 from County Home Road to Boyson Road will operate at a LOS F. Northbound, LOS F is forecasted from the southern limits of the analysis area to the Boyson Road off-ramp.

Eight intersections are forecasted to perform at suboptimal levels:

- Boyson Road and Center Point Road – LOS F
- Boyson Road and I-380 southbound ramp terminal – LOS F
- Boyson Road and I-380 northbound ramp terminal – LOS F
- County Home Road and I-380 southbound ramp terminal – LOS F
- Tower Terrace Road and Center Point Road – LOS F
- Tower Terrace Road and Edgewood Road – LOS F
- Tower Terrace Road and Miller Road – LOS F
- Boyson Road and Miller Road – LOS F

P.M.

During the p.m. peak period, I-380 northbound is forecasted to have a LOS F from the southern limits of the analysis area up to the Boyson Road off-ramp. Level of service F is also expected on I-380 at the exit to County Home Road. Southbound, the off-ramp to Boyson Road is forecasted to be a LOS F.

Ten intersections perform at a LOS F and one performs at a LOS E:

- Blairs Ferry Road and I-380 southbound ramp terminal – LOS F
- Blairs Ferry Road and I-380 northbound ramp terminal – LOS F
- Boyson Road and Center Point Road – LOS F
- Boyson Road and I-380 southbound ramp terminal – LOS F
- Boyson Road and I-380 northbound ramp terminal – LOS F
- County Home Road and I-380 northbound ramp terminal – LOS F
- Blairs Ferry Road and Center Point Road – LOS F
- Tower Terrace Road and Center Point Road – LOS F
- Tower Terrace Road and Edgewood Road – LOS F
- Tower Terrace Road and Miller Road – LOS E
- Boyson Road and Miller Road – LOS F

Table 2.1-E: Freeway Operations and LOS – Existing and No-Build

Description	Type	2016 Existing				2040 No-Build			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS
Southbound I-380									
SB County Home Rd Off-Ramp	diverge	12.7	B	8.8	A	22.9	C	14.2	B
SB Between County Home Rd Ramps	basic	11.9	B	7.7	A	50.1	F	12.1	B
SB County Home Rd On-Ramp	merge	14.6	B	7.7	A	104.7	F*	12.7	B
SB County Home Rd On-Ramp to Boyson Rd Off-Ramp	basic	16.8	B	9.1	A	172.6	F	14.9	B
SB Boyson Rd Off-Ramp	diverge	19.2	B	10.3	B	193.0	F*	152.6	F*
SB Between Boyson Rd Ramps	basic	17.3	B	9.7	A	21.2	C	15.2	B
SB Boyson Rd On-Ramp to Blairs Ferry Rd Off-Ramp	weave	25.3	C	15.0	B	37.0	E	23.6	C
SB Between Blairs Ferry Rd Ramps	basic	18.6	C	13.4	B	23.7	C	19.4	C
SB Blairs Ferry Rd On-Ramp	basic	16.8	B	12.2	B	20.9	C	17.0	B
SB Blairs Ferry Rd On-Ramp to Collins Rd On-Ramp	basic	17.5	B	12.8	B	21.7	C	17.7	B
SB Collins Rd On-Ramp	merge	22.7	C	19.4	B	31.6	D	26.1	C
SB Collins Rd On-Ramp to 42nd St On-Ramp	basic	1.9	A	4.7	A	15.2	B	16.2	B
SB 42nd St On-Ramp to Glass Rd Off-Ramp	weave	20.0	C	16.1	B	27.6	C	22.4	C
SB Between Glass Rd Ramps	basic	24.2	C	19.1	C	29.8	D	25.2	C
Northbound I-380									
NB 29th St Off-Ramp to Glass Rd On-Ramp	basic	20.9	C	27.7	D	60.0	F	107.8	F
NB Glass Rd On-Ramp to 42nd St Off-Ramp	weave	18.2	B	33.6	D	79.7	F	132.5	F
NB Collins Rd Off-Ramp	diverge	23.3	C	32.8	D	99.5	F*	147.4	F*
NB Collins Rd Off-Ramp to Blairs Ferry Rd Off-Ramp	basic	12.7	B	19.3	C	104.9	F	142.7	F
NB Blairs Ferry Rd Off-Ramp	diverge	12.5	B	18.0	B	125.4	F	148.0	F
NB Between Blairs Ferry Rd Ramps	basic	12.6	B	20.8	C	155.8	F	164.8	F
NB Blairs Ferry Rd On-Ramp to Boyson Rd Off-Ramp	merge	14.2	B	39.3	E	173.5	F*	179.4	F*
NB Between Boyson Rd Ramps	basic	9.5	A	19.5	C	11.7	B	20.4	C
NB Boyson Rd On-Ramp	merge	8.3	A	17.9	B	10.1	B	20.3	C
NB Boyson Rd On-Ramp to County Home Rd Off-Ramp	basic	9.3	A	20.1	C	11.3	B	31.1	D
NB County Home Rd Off-Ramp	diverge	9.2	A	19.8	B	11.2	B	104.7	F*
NB Between County Home Rd Ramps	basic	7.8	A	14.7	B	9.7	A	15.4	B
NB County Home Rd On-Ramp	merge	7.1	A	13.1	B	9.5	A	14.0	B

Source: VISSIM

* HCM defines LOS F for merges and diverges as when volume exceeds capacity. Here LOS F is assigned if density >45.

Table 2.1-F: Arterial Intersection Operations and LOS – Existing and No-Build

Description	Control Type	2016 Existing				2040 No-Build			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
32nd St SB	Signalized	8.3	A	8.9	A	12.8	B	11.2	B
32nd St & Center Point Rd	Signalized	26.4	C	23.9	C	26.5	C	23.8	C
42nd St & Center Point Rd	Signalized	19.9	B	24.5	C	21.5	C	29.5	C
42nd St NB	Signalized	6.7	A	11.7	B	9.8	A	30.0	C
42nd St SB	Signalized	6.1	A	6.8	A	9.0	A	7.7	A
EB Collins Rd SB	Signalized	6.2	A	5.5	A	13.0	B	7.7	A
EB Collins Rd & Center Point Rd	Signalized	21.4	C	26.3	C	16.5	B	16.1	B
EB Collins Rd NB	Signalized	20.9	C	23.6	C	23.1	C	25.3	C
WB Collins Rd SB	Signalized	10.5	B	11.2	B	10.7	B	13.1	B
WB Collins Rd & Center Point Rd	Signalized	13.7	B	14.9	B	15.1	B	15.6	B
WB Collins Rd NB	Signalized	15.6	B	52.1	D	13.6	B	23.1	C
Blairs Ferry Rd SB	Signalized	24.3	C	16.4	B	32.4	C	>120	F
Blairs Ferry Rd NB	Signalized	11.0	B	22.0	C	14.1	B	>120	F
Boyson Rd & Center Point Rd	Signalized	17.7	B	92.6	F	>120	F	>120	F
Boyson Rd SB	Signalized	8.9	A	7.2	A	>120	F	>120	F
Boyson Rd NB	Signalized	16.7	B	52.4	D	>120	F	>120	F
County Home Rd NB	Unsignalized	12.8	B	64.9	F	19.7	C	>120	F
County Home Rd SB	Unsignalized	7.9	A	6.8	A	>120	F	12.9	B
Blairs Ferry Rd & Center Point Rd	Signalized	23.4	C	36.7	D	37.1	D	>120	F
32nd St NB	Signalized	8.6	A	13.6	B	9.5	A	17.1	B
Collins Rd & Council St	Signalized	22.5	C	28.0	C	33.3	C	50.0	D
County Home Rd & N. Center Point Rd	Signalized	7.2	A	6.4	A	12.6	B	11.4	B
County Home Rd & Edgewood Rd	Unsignalized	6.9	A	7.0	A	9.6	A	8.5	A
Tower Terrace & Center Point Rd	Unsignalized	11.8	B	12.4	B	>120	F	>120	F
Tower Terrace and Edgewood Rd	Unsignalized	1.3	A	1.9	A	>120	F	>120	F
Tower Terrace & Miller Rd	Unsignalized	4.4	A	4.4	A	>120	F	35.5	E
Boyson & Miller	Unsignalized	0.0	A	0.0	A	>120	F	>120	F

Source: VISSIM

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

A or B

C

D

E

F

>120

>120

STUDY AREA

County Home Rd (CR E-34)

Center Point Rd

Main St

Edgewood Rd

Tower Terrace Rd

Robins Rd

Boyson Rd

Miller Rd

Blairs Ferry Rd

Collins Rd

Council St

42nd St

32nd St

Glass Rd

380

100

STOP

EXHIBIT 2.1-9

Tower Terrace Existing AM 2017 Level of Service

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

A or B

C

D

E

F

>120

>120

STUDY AREA

County Home Rd (CR E-34)

Tower Terrace Rd

Edgewood Rd

Miller Rd

Center Point Rd

Main St

Robins Rd

Boyson Rd

Blairs Ferry Rd

Collins Rd

Council St

42nd St

32nd St

Glass Rd

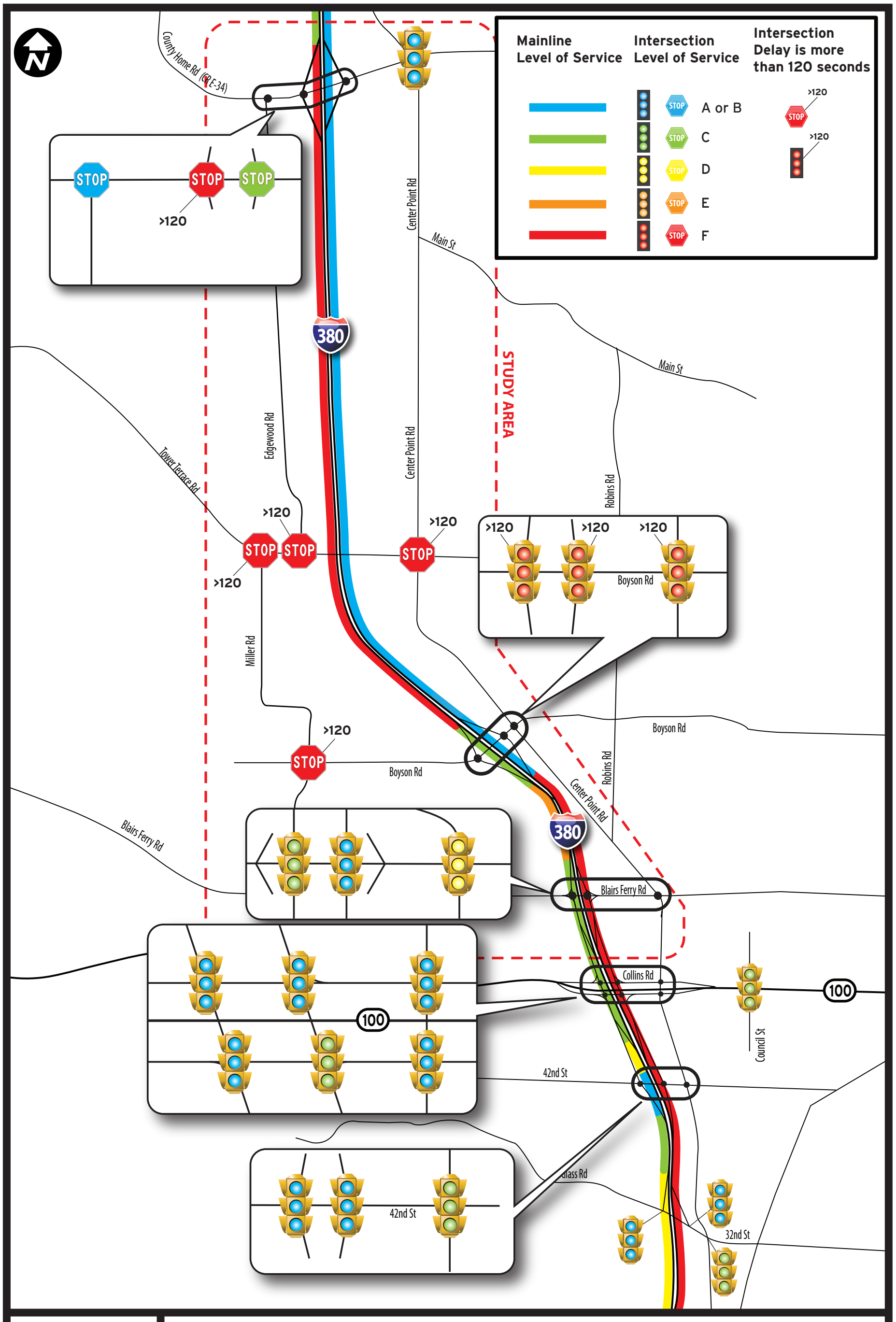
380

100

STOP

EXHIBIT 2.1-10

Tower Terrace Existing PM 2017 Level of Service



EXHIBIT

2.1-11

Tower Terrace
No-Build AM 2040
Level of Service

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

A or B

C

D

E

F

>120

STOP

County Home Rd (CR E-34)

Center Point Rd

Main St

STUDY AREA

380

Edgewood Rd

Tower Terrace Rd

Miller Rd

Robins Rd

Boyson Rd

Blairs Ferry Rd

Collins Rd

100

Council St

42nd St

Glass Rd

32nd St

EXHIBIT 2.1-12

Tower Terrace No-Build PM 2040 Level of Service

2.1.6 Local System Improvements

Local system projects within the study area boundaries, independent of the improvements proposed in this IJR, are accounted for in the 2040 no-build alternative VISSIM models. The known construction projects that were included are the following:

- Widen the northbound I-380 off-ramp at Boyson Road beginning approximately 900 feet from the ramp terminal, creating two lanes: one left turn lane and one right turn lane
- Reconfigure westbound lanes at Boyson Road, beginning 200 feet east of Center Point Road, to create two through lanes with a right turn option. The two through lanes extend past Center Point Road and through the I-380 northbound intersection. One through lane becomes the left turn lane at the I-380 southbound ramp intersection.

These improvements are also accounted for in each of the build alternative scenarios. Other projects that are scheduled to occur outside the study area are accounted for in the Corridor MPO traffic demand model; the same model which was used to generate future demand volumes within the corridor. Additional local system improvements were assumed in the build alternatives described in **Sections 2.2 and 2.3**.

2.1.7 Policy Statement One Summary

Interstate 380 at Boyson Road, as it exists today, is performing at a suboptimal level. Crash data collected for the study area revealed that most of the study area is below the statewide crash rate. There were areas, however, that exceed the fatal crash rate. Unless improvements are made to the system, the I-380 study area will severely decay prior to 2040. Improvements are needed within the I-380 study area to ensure adequate operations and to maintain safe roadways. Requirements for Policy Point One have been satisfied.

2.2 FHWA Policy Statement Two

The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access (23 CFR 625.2(a)).

2.2.1 Alternative Evaluation

Build alternatives were created and tested based on the need to add capacity to the I-380 corridor, construct a new interchange at Tower Terrace Road and reconstruct the Boyson Road interchange. A universe of alternatives was developed to address these needs. The alternatives were modeled using VISSIM software, and the results of each simulation can be found in **Section 2.3**. The improvements listed in **Table 2.2-A** are defined as follows:

- **I-380 Four-Lane** – I-380 will remain four-lanes (two in each direction) from the Blairs Ferry Road south ramps to the County Home Road south ramps.
- **I-380 Six-Lane** – I-380 will expand to six-lanes (three lanes in each direction) from the Blairs Ferry Road south ramps to the County Home Road south ramps.
- **Boyson Road Diverging Diamond Interchange (DDI)** – The standard diamond interchange currently at Boyson Road will be upgraded to a DDI. The benefit of a DDI is that it eliminates the yielding that traditionally occurs when turning left at a standard diamond interchange.
- **Tower Terrace Road Standard Diamond** – A standard diamond interchange will be constructed with signalization at each ramp terminal. Roundabout ramp terminals were also considered.
- **Tower Terrace Road DDI** – A DDI will be constructed with signalization at each ramp terminal.
- **Recently Completed Improvements** – These include:
    - Widening the northbound I-380 ramp terminal approximately 900 feet at Boyson, creating two lanes: one left turn lane and one right turn lane
    - Reconfiguring westbound lanes at Boyson Road, beginning 200 feet east of Center Point Road, to create two through lanes with a right turn option. The two through lanes extend past Center Point Road and through the I-380 northbound intersection. One through lane will become the left turn lane at the I-380 southbound ramp intersection.
- **Signalized County Home Road Ramp Intersections** – Currently, the northbound and southbound ramp terminals at County Home Road are controlled by a stop sign. Both intersections will include additional turn lanes and traffic signal installation. It also widens County Home Road to four-lanes east of the NB ramp terminal.
- **Additional Intersection Improvements** – These include:
    - Realigning Edgewood Road and Miller Road at Tower Terrace Road and adding a signal, plus turn lanes
    - Signalizing the intersection of Boyson Road and Miller Road and adding turn lanes
    - Signalizing the intersection of Tower Terrace Road and Center Point Road and adding turn lanes

- Widening Tower Terrace Road to 4-lanes east of Edgewood Road
- Adding dual northeast left-turns at Boyson / Center Point Road
- Adding dual southbound left-turns at Blairs Ferry SB Ramp terminal

Table 2.2-A: Universe of Alternatives

Scenario	I-380 Four-Lane	I-380 Six-Lane	Boyson Road DDI	Tower Terrace Road Standard Diamond	Tower Terrace Road DDI	Recently Completed Improvements	Signalized County Home Road Ramp Intersections	Additional Intersection Improvements
Existing 2016	x							
No-Build 2040	x					x		
Build Alternative 1		x				x	x	x
Build Alternative 2	x		x			x	x	x
Build Alternative 3	x				x	x	x	x
Build Alternative 4		x	x			x	x	x
Build Alternative 5a		x	x	x		x	x	x
Build Alternative 5b - Preferred Alternative		x	x		x	x	x	x

Source: HNTB Corporation

Alternatives Five A and Five B are considered similar alternatives because they both add an interchange at Tower Terrace Road while also widening I-380 to six-lanes, constructing a DDI at Boyson Road, signalizing the ramp intersections at County Home Road and upgrading other local intersections. The only difference is that Five A utilizes a Standard Diamond Interchange at Tower Terrace while Five B employs the use of a DDI. The minimum suggested spacing for urban interchanges is one mile according to the AASHTO Interstate Access Guide. Both a standard diamond or DDI would meet the requirements. **Section 2.3** shows the results of the operational analysis.

2.2.2 Evaluation Factors

All the 2040 future build alternatives were evaluated based on the following factors:

1. Traffic operations on the I-380 corridor, measured by LOS
2. Total congestion relieved on Boyson Road and other surrounding interchanges at the I-380 ramp terminals and at Center Point Road, measured by peak hour volumes and LOS
3. Future traffic operations along Tower Terrace Road, measured by LOS
4. Predicted crash rates for the I-380 study area, measured with IHSDM crash software

2.2.3 Alternative Modal Solutions

As part of the assessment of alternatives to accommodate the regional travel needs, this IJR study first considered congestion reduction strategies, including Transportation System Management (TSM) and the enhanced use of ITS technologies and signal timing, along with Travel Demand Management and such elements as enhanced transit, carpooling and ridesharing, and telecommuting.

Through this study, as well as the study efforts of the I-380 Urban Corridor Feasibility for the Corridor MPO region, it was expected that Transportation System Management (TSM) strategies primarily would benefit the I-380 corridor in terms of reducing nonrecurring congestion caused by incidents. The TSM can offer cost-effective enhancements when combined with traditional roadway capacity enhancements that address recurring congestion caused by bottlenecks. Steps in this regard already are underway.

The Iowa DOT has added ITS technologies, including traffic cameras and message boards which provide advanced notifications of roadway and travel conditions, throughout the Cedar Rapids region with focus on the I-380 study corridor. In addition, the Iowa DOT, along with regional stakeholders in the Cedar Rapids urban area, have developed a traffic incident management program. While certainly beneficial to maintaining reliable travel throughout the region, these measures will have limited impact on available capacity and recurring congestion resulting from capacity bottlenecks.

It was also expected that Travel Demand Management strategies provide small benefits by reducing vehicle miles of travel. These can include congestion relief, vehicle emissions reductions and energy savings and thus can be implemented along with capacity enhancements to provide some demand-side improvements. Similarly, small benefit can be expected from creating commuter lots, encouraging carpooling or promoting telecommuting or four-day work weeks due to number of users and employment/marketplace constraints.

Multimodal options, TSM nor TDM would be effective enough to improve the LOS at specific areas of the corridor or address the project's purpose and need. However, these solutions are not being precluded with any proposed action, as they should complement the preferred alternative to provide added benefit to the study area.

2.2.4 Policy Statement Two Summary

Five build alternatives were considered as the Preferred Alternative. The Preferred Alternative will be selected based on a defined set of evaluation factors which will be measured using LOS, peak hour volume and predicted crash rates. Alternative transportation solutions such as TSM, TDM and multimodal alone will not satisfy the project's purpose and need; however, these solutions will not be precluded with any proposed action. Requirements for Policy Point Two have been satisfied.

2.3 FHWA Policy Statement Three

An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

2.3.1 Planning Year Traffic Forecasts

Future build volumes were created using the same methodology described in **Section 2.1.3**. Like in the no-build alternative, future projects surrounding the study area were included in the forecasts. In addition, the build alternatives assume improving and signalizing the County Home Road Interchange and other intersection improvements at nearby study area intersections as described in **Section 2.2.1**. Each build alternative then considers a combination of improvements at Tower Terrace Road, Boyson Road, and along I-380. Future volumes were rounded according to AASHTO standards.

2.3.2 Traffic Operations for Build Alternatives

The subsections below highlight the operational performances of five build alternatives that were taken into consideration for the Preferred Alternative. **Table 2.2-1** in **Section 2.2** shows the difference between each alternative.

2.3.2.1 Build Alternative One

Build alternative one includes widening I-380 from the Blairs Ferry Road south ramps to the south-facing ramps at County Home Road to six-lanes. **Tables 2.3-A through 2.3-B and Exhibits 2.3-1 through 2.3-2** display the operational performance of build alternative one.

A.M.

The operational analysis reveals that widening I-380 to six lanes does not completely mitigate the delays on I-380 at the southbound and northbound Boyson Road off-ramps. Both segments perform at a LOS F. The backups are caused by failing ramp terminals at Boyson Road which queue traffic onto the mainline. The Boyson Road and I-380 ramp terminals are the only intersections in the study area with failing LOS.

Level of service E can also be found on the northbound segment of I-380 before the Collins Road off ramp. When six lanes are added, more vehicles are pulled to I-380. This is the root cause for poor LOS at Collins Road. Due to the congestion at Boyson Road, some vehicles are diverting to exits at Blairs Ferry Road or Collins Road. Vehicles travelling northbound destined for the off-ramp at Blairs Ferry Road are positioning in the outside lane, preparing to exit, while also competing for space with vehicles wanting to exit at Collins Road.

P.M.

Northbound, during the p.m. peak, there are two segments on I-380 with unacceptable levels of service. The first extends from the southern limits of the study area up to Collins Road. For the same reason as in the a.m. peak, vehicles are competing for space in the outermost lane to exit at either Collins Road or Blairs Ferry Road. The second segment is between Blairs Ferry Road and Boyson Road. As is the case in the a.m., the failing LOS at the Boyson Road ramp terminal causes queuing onto the I-380 mainline.

There are nine intersections that perform at a LOS E or F in the p.m. peak:

- Collins Road eastbound and Center Point Road – LOS F
- Collins Road eastbound and NB-I-380 ramp terminal – LOS E
- Blairs Ferry Road and I-380 northbound ramp terminal – LOS E
- Boyson Road and Center Point Road – LOS F
- Boyson Road and I-380 northbound ramp terminal – LOS F
- Blairs Ferry Road and Center Point Road – LOS E
- Collins Road and Council Street – LOS F
- Tower Terrace Road and Center Point Road – LOS E
- Boyson Road and Miller Road – LOS E

By 2040, Highway 100/Collins Road will be extended to connect with Highway 30 to the west. This will increase demand along the Highway 100/Collins Road corridor. This is the contributing factor for the poor LOS at Collins Road and Council Street. In the No-Build Alternative, both directions of I-380 are congested, which limits the rate at which vehicles can access Collins Road from I-380 resulting in a LOS D in the p.m. peak.

Conclusion

Although a lane is added in each direction of I-380, poor LOS still exists at the Boyson Road interchange and at Collins Road. A six-lane I-380 option must be considered as a piece of the overall solution within the study area, but cannot be proposed as the only solution.

Table 2.3-A: 2040 Build Alternative 1 Freeway LOS

Description	Type	2040 No-Build				2040 Build Alternative 1			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS
Southbound I-380									
SB County Home Rd Off-Ramp	diverge	22.9	C	14.2	B	18.1	B	11.6	B
SB Between County Home Rd Ramps	basic	50.1	F	12.1	B	20.0	C	12.2	B
SB County Home Rd On-Ramp	merge	104.7	F*	12.7	B	18.0	B	9.9	A
SB County Home Rd On-Ramp to Boyson Rd Off-Ramp	basic	172.6	F	14.9	B	22.1	C	10.1	A
SB Boyson Rd Off-Ramp	diverge	193.0	F*	152.6	F*	109.6	F*	10.4	B
SB Between Boyson Rd Ramps	basic	21.2	C	15.2	B	17.5	B	10.3	A
SB Boyson Rd On-Ramp to Blairs Ferry Rd Off-Ramp	weave	37.0	E	23.6	C				
SB Boyson Rd On-Ramp	merge					20.0	B	14.0	B
SB Blairs Ferry Rd Off-Ramp	diverge					18.0	B	12.6	B
SB Between Blairs Ferry Rd Ramps	basic	23.7	C	19.4	C	18.4	C	12.4	B
SB Blairs Ferry Rd On-Ramp	basic	20.9	C	17.0	B	17.3	B	12.6	B
SB Blairs Ferry Rd On-Ramp to Collins Rd On-Ramp	basic	21.7	C	17.7	B	24.3	C	17.3	B
SB Collins Rd On-Ramp	merge	31.6	D	26.1	C	31.6	D	26.1	C
SB Collins Rd On-Ramp to 42nd St On-Ramp	basic	15.2	B	16.2	B	24.2	C	19.9	C
SB 42nd St On-Ramp to Glass Rd Off-Ramp	weave	27.6	C	22.4	C	26.0	C	21.4	C
SB Between Glass Rd Ramps	basic	29.8	D	25.2	C	32.3	D	25.6	C
Northbound I-380									
NB 29th St Off-Ramp to Glass Rd On-Ramp	basic	60.0	F	107.8	F	30.9	D	81.6	F
NB Glass Rd On-Ramp to 42nd St Off-Ramp	weave	79.7	F	132.5	F	28.5	D	78.6	F
NB Collins Rd Off-Ramp	diverge	99.5	F*	147.4	F*	38.8	E	71.4	F*
NB Collins Rd Off-Ramp to Blairs Ferry Rd Off-Ramp	basic	104.9	F	142.7	F	21.4	C	21.1	C
NB Blairs Ferry Rd Off-Ramp	diverge	125.4	F	148.0	F	15.6	B	15.8	B
NB Between Blairs Ferry Rd Ramps	basic	155.8	F	164.8	F	14.8	B	14.2	B
NB Blairs Ferry Rd On-Ramp to Boyson Rd Off-Ramp	merge	173.5	F*	179.4	F*				
NB Blairs Ferry Rd On-Ramp	merge					32.6	D	42.3	E
NB Boyson Rd Off-Ramp	diverge					77.0	F*	84.6	F*
NB Between Boyson Rd Ramps	basic	11.7	B	20.4	C	10.2	A	14.5	B
NB Boyson Rd On-Ramp	merge	10.1	B	20.3	C	8.9	A	13.7	B
NB Boyson Rd On-Ramp to County Home Rd Off-Ramp	basic	11.3	B	31.1	D	10.3	A	15.3	B
NB County Home Rd Off-Ramp	diverge	11.2	B	104.7	F*	10.3	A	15.5	B
NB Between County Home Rd Ramps	basic	9.7	A	15.4	B	12.9	B	16.4	B
NB County Home Rd On-Ramp	merge	9.5	A	14.0	B	12.2	B	15.1	B

Source: VISSIM

Table 2.3-B: 2040 Build Alternative 1 Intersection LOS

Description	Control Type	2040 No-Build				2040 Build Alternative 1			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
32nd St SB	Signalized	12.8	B	11.2	B	11.0	B	10.4	B
32nd St & Center Point Rd	Signalized	26.5	C	23.8	C	12.8	B	14.2	B
42nd St & Center Point Rd	Signalized	21.5	C	29.5	C	21.4	C	28.4	C
42nd St NB	Signalized	9.8	A	30.0	C	10.0	B	22.1	C
42nd St SB	Signalized	9.0	A	7.7	A	8.9	A	8.1	A
EB Collins Rd SB	Signalized	13.0	B	7.7	A	11.0	B	7.3	A
EB Collins Rd & Center Point Rd	Signalized	16.5	B	16.1	B	19.5	B	102.2	F
EB Collins Rd NB	Signalized	23.1	C	25.3	C	21.7	C	68.1	E
WB Collins Rd SB	Signalized	10.7	B	13.1	B	10.9	B	12.6	B
WB Collins Rd & Center Point Rd	Signalized	15.1	B	15.6	B	14.7	B	21.3	C
WB Collins Rd NB	Signalized	13.6	B	23.1	C	12.8	B	38.6	D
Blairs Ferry Rd SB	Signalized	32.4	C	>120	F	25.5	C	22.3	C
Blairs Ferry Rd NB	Signalized	14.1	B	>120	F	23.1	C	64.3	E
Boyson Rd & Center Point Rd	Signalized	>120	F	>120	F	35.3	D	80.5	F
Boyson Rd SB	Signalized	>120	F	>120	F	102.0	F	15.9	B
Boyson Rd NB	Signalized	>120	F	>120	F	87.3	F	99.8	F
County Home Rd NB	Unsignalized	19.7	C	>120	F				
County Home Rd SB	Unsignalized	>120	F	12.9	B				
County Home Rd NB	Signalized					8.3	A	10.2	B
County Home Rd SB	Signalized					19.1	B	12.5	B
Blairs Ferry Rd & Center Point Rd	Signalized	37.1	D	>120	F	38.7	D	63.8	E
32nd St NB	Signalized	9.5	A	17.1	B	11.2	B	15.1	B
Collins Rd & Council St	Signalized	33.3	C	50.0	D	40.5	D	91.7	F
County Home Rd & N. Center Point Rd	Signalized	12.6	B	11.4	B	11.6	B	12.2	B
County Home Rd & Edgewood Rd	Unsignalized	9.6	A	8.5	A	9.9	A	9.1	A
Tower Terrace & Center Point Rd	Unsignalized	>120	F	>120	F				
Tower Terrace & Center Point Rd	Signalized					51.1	D	56.6	E
Tower Terrace and Edgewood Rd	Unsignalized	>120	F	>120	F				
Tower Terrace and Edgewood Rd	Signalized					29.8	C	35.3	D
Tower Terrace & Miller Rd	Unsignalized	>120	F	35.5	E				
Boyson & Miller	Unsignalized	>120	F	>120	F				
Boyson & Miller	Signalized					41.8	D	65.9	E

Source: VISSIM

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

A or B

C

D

E

F

>120

>120

STOP

County Home Rd (CR E-34)

Center Point Rd

Main St

STUDY AREA

Edgewood Rd

Tower Terrace Rd

Robins Rd

Boyson Rd

Miller Rd

Blairs Ferry Rd

Collins Rd

Council St

42nd St

Glass Rd

32nd St

380

100

EXHIBIT 2.3-1

Tower Terrace
Build Alternative 1 AM 2040
Level of Service

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

A or B

C

D

E

F

>120

>120

STOP

County Home Rd (CR E-34)

Center Point Rd

Main St

STUDY AREA

Main St

Edgewood Rd

Tower Terrace Rd

Robins Rd

380

Boyson Rd

Miller Rd

Boyson Rd

Boyson Rd

Robins Rd

Center Point Rd

Blairs Ferry Rd

Blairs Ferry Rd

Collins Rd

100

Council St

42nd St

Glass Rd

32nd St

42nd St

100

EXHIBIT 2.3-2

Tower Terrace
Build Alternative 1 PM 2040
Level of Service

2.3.2.2 Build Alternative Two

Build Alternative Two converts the Boyson Road interchange from a standard diamond to a DDI, but keeps I-380 as a four-lane interstate. **Tables 2.3-C through 2.3-D and Exhibits 2.3-3 through 2.3-4** display the operational performance of Build Alternative Two.

A.M.

The merge at southbound County Home Road onto I-380 is a LOS E. Level of service D covers much of the southbound lanes. Higher volumes mean greater lane density in the southbound direction, which is the reason for the LOS D and E. The Iowa DOT's desired LOS for urban interstates is a C or better. The operational analysis shows that the Boyson Road interchange clears up significantly compared to Alternative One. The addition of the DDI results in a LOS C or better on the Boyson Road intersections. Boyson Road at Miller Road is the only intersection with a LOS F. This LOS F is driven by demand on Boyson once the DDI built, but when there is no Tower Terrace Interchange to relieve the pressure. Build Alternative Four calls for a DDI at Boyson Road and no Tower Terrace Interchange and has the same issue.

P.M.

Both north and southbound directions of I-380 perform at a LOS D or better. Without a Tower Terrace Road interchange and without widening I-380, the demand on I-380 is lower than other alternatives, especially north of the Boyson Road Interchange. There are two intersections with underperforming LOS:

- Blairs Ferry Road and Center Point Road – LOS F
- Collins Road and Council Street – LOS E

By 2040, Highway 100/Collins Road will be extended to connect with Highway 30 to the west. This will increase demand along the Highway 100/Collins Road corridor. This is the contributing factor for the poor LOS at Collins Road and Council Street. In the No-Build Alternative, both directions of I-380 are congested, which limits the rate at which vehicles can access Collins Road from I-380 resulting in a LOS D in the p.m. peak.

Conclusion

Level of service D spans most of the southbound direction during the a.m. peak. The Iowa DOT's desired LOS for urban interstates is a LOS C or better. By 2040, greater southbound demand in the a.m. peak will increase the lane density, leading to slower traffic. The addition of a DDI at Boyson Road will improve the overall operations surrounding the interchange.

Table 2.3-C: 2040 Build Alternative 2 Freeway LOS

Description	Type	2040 No-Build				2040 Build Alternative 2			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS
Southbound I-380									
SB County Home Rd Off-Ramp	diverge	22.9	C	14.2	B	18.2	B	11.6	B
SB Between County Home Rd Ramps	basic	50.1	F	12.1	B	19.4	C	12.1	B
SB County Home Rd On-Ramp	merge	104.7	F*	12.7	B	37.7	E	13.3	B
SB County Home Rd On-Ramp to Boyson Rd Off-Ramp	basic	172.6	F	14.9	B	26.2	D	15.1	B
SB Boyson Rd Off-Ramp	diverge	193.0	F*	152.6	F*	24.4	C	14.2	B
SB Between Boyson Rd Ramps	basic	21.2	C	15.2	B	25.3	C	15.6	B
SB Boyson Rd On-Ramp to Blairs Ferry Rd Off-Ramp	weave	37.0	E	23.6	C				
SB Boyson Rd On-Ramp	merge					31.8	D	20.2	C
SB Blairs Ferry Rd Off-Ramp	diverge					28.2	D	19.0	B
SB Between Blairs Ferry Rd Ramps	basic	23.7	C	19.4	C	28.1	D	19.7	C
SB Blairs Ferry Rd On-Ramp	basic	20.9	C	17.0	B	23.2	C	16.9	B
SB Blairs Ferry Rd On-Ramp to Collins Rd On-Ramp	basic	21.7	C	17.7	B	23.7	C	17.3	B
SB Collins Rd On-Ramp	merge	31.6	D	26.1	C	30.1	D	24.8	C
SB Collins Rd On-Ramp to 42nd St On-Ramp	basic	15.2	B	16.2	B	24.0	C	19.4	C
SB 42nd St On-Ramp to Glass Rd Off-Ramp	weave	27.6	C	22.4	C	25.8	C	20.7	C
SB Between Glass Rd Ramps	basic	29.8	D	25.2	C	32.4	D	25.0	C
Northbound I-380									
NB 29th St Off-Ramp to Glass Rd On-Ramp	basic	60.0	F	107.8	F	30.2	D	29.6	D
NB Glass Rd On-Ramp to 42nd St Off-Ramp	weave	79.7	F	132.5	F	23.7	C	23.9	C
NB Collins Rd Off-Ramp	diverge	99.5	F*	147.4	F*	30.5	D	28.7	D
NB Collins Rd Off-Ramp to Blairs Ferry Rd Off-Ramp	basic	104.9	F	142.7	F	20.7	C	20.8	C
NB Blairs Ferry Rd Off-Ramp	diverge	125.4	F	148.0	F	21.9	C	21.9	C
NB Between Blairs Ferry Rd Ramps	basic	155.8	F	164.8	F	21.9	C	21.2	C
NB Blairs Ferry Rd On-Ramp to Boyson Rd Off-Ramp	merge	173.5	F*	179.4	F*				
NB Blairs Ferry Rd On-Ramp	merge					22.0	C	25.7	C
NB Boyson Rd Off-Ramp	diverge					21.7	C	24.2	C
NB Between Boyson Rd Ramps	basic	11.7	B	20.4	C	15.7	B	20.8	C
NB Boyson Rd On-Ramp	merge	10.1	B	20.3	C	14.8	B	20.0	C
NB Boyson Rd On-Ramp to County Home Rd Off-Ramp	basic	11.3	B	31.1	D	16.4	B	22.2	C
NB County Home Rd Off-Ramp	diverge	11.2	B	104.7	F*	14.3	B	19.8	B
NB Between County Home Rd Ramps	basic	9.7	A	15.4	B	13.0	B	15.7	B
NB County Home Rd On-Ramp	merge	9.5	A	14.0	B	12.3	B	14.9	B

Source: VISSIM

Table 2.3-D: 2040 Build Alternative 2 Intersection LOS

Description	Control Type	2040 No-Build				2040 Build Alternative 2			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
32nd St SB	Signalized	12.8	B	11.2	B	10.1	B	10.6	B
32nd St & Center Point Rd	Signalized	26.5	C	23.8	C	12.7	B	14.2	B
42nd St & Center Point Rd	Signalized	21.5	C	29.5	C	21.6	C	29.7	C
42nd St NB	Signalized	9.8	A	30.0	C	9.7	A	21.9	C
42nd St SB	Signalized	9.0	A	7.7	A	8.9	A	7.5	A
EB Collins Rd SB	Signalized	13.0	B	7.7	A	11.4	B	7.8	A
EB Collins Rd & Center Point Rd	Signalized	16.5	B	16.1	B	20.5	C	16.2	B
EB Collins Rd NB	Signalized	23.1	C	25.3	C	22.5	C	23.4	C
WB Collins Rd SB	Signalized	10.7	B	13.1	B	10.7	B	13.7	B
WB Collins Rd & Center Point Rd	Signalized	15.1	B	15.6	B	15.0	B	14.1	B
WB Collins Rd NB	Signalized	13.6	B	23.1	C	13.3	B	18.0	B
Blairs Ferry Rd SB	Signalized	32.4	C	>120	F	24.4	C	21.6	C
Blairs Ferry Rd NB	Signalized	14.1	B	>120	F	38.3	D	31.7	C
Boyson Rd & Center Point Rd	Signalized	>120	F	>120	F	28.1	C	37.7	D
Boyson Rd SB	Signalized	>120	F	>120	F	11.3	B	11.7	B
Boyson Rd NB	Signalized	>120	F	>120	F	20.7	C	20.2	C
County Home Rd NB	Unsignalized	19.7	C	>120	F				
County Home Rd SB	Unsignalized	>120	F	12.9	B				
County Home Rd NB	Signalized					7.8	A	8.8	A
County Home Rd SB	Signalized					18.8	B	13.0	B
Blairs Ferry Rd & Center Point Rd	Signalized	37.1	D	>120	F	40.1	D	101.4	F
32nd St NB	Signalized	9.5	A	17.1	B	10.1	B	14.6	B
Collins Rd & Council St	Signalized	33.3	C	50.0	D	40.2	D	58.2	E
County Home Rd & N. Center Point Rd	Signalized	12.6	B	11.4	B	11.7	B	12.6	B
County Home Rd & Edgewood Rd	Unsignalized	9.6	A	8.5	A	9.0	A	8.3	A
Tower Terrace & Center Point Rd	Unsignalized	>120	F	>120	F				
Tower Terrace & Center Point Rd	Signalized					51.5	D	49.9	D
Tower Terrace and Edgewood Rd	Unsignalized	>120	F	>120	F				
Tower Terrace and Edgewood Rd	Signalized					29.5	C	37.2	D
Tower Terrace & Miller Rd	Unsignalized	>120	F	35.5	E				
Boyson & Miller	Unsignalized	>120	F	>120	F				
Boyson & Miller	Signalized					95.6	F	35.6	D

Source: VISSIM

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

A or B

C

D

E

F

>120

>120

STOP

County Home Rd (CR E-34)

Center Point Rd

Main St

STUDY AREA

Edgewood Rd

Tower Terrace Rd

Robins Rd

Boyson Rd

Miller Rd

Blairs Ferry Rd

Collins Rd

Council St

42nd St

Glass Rd

32nd St

380

100

EXHIBIT 2.3-3

Tower Terrace
Build Alternative 2 AM 2040
Level of Service

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

A or B

C

D

E

F

>120

>120

STOP

County Home Rd (CR E-34)

Center Point Rd

Main St

STUDY AREA

Edgewood Rd

Tower Terrace Rd

Miller Rd

Robins Rd

Boyson Rd

Blairs Ferry Rd

Collins Rd

Council St

42nd St

Glass Rd

32nd St

380

100

EXHIBIT 2.3-4

Tower Terrace
Build Alternative 2 PM 2040
Level of Service

2.3.2.3 Build Alternative Three

Build Alternative Three keeps I-380 operating with four-lanes and adds an interchange at Tower Terrace Road. Boyson Road is kept as a standard diamond interchange. **Tables 2.3-E through 2.3-F and Exhibits 2.3-5 through 2.3-6** display the operational performance of Build Alternative Three.

A.M.

Similar to Build Alternative One, the north and southbound directions of I-380 approaching the Boyson Road Interchange perform at a LOS E or F. In the southbound direction, more vehicles are using the Tower Terrace Interchange to enter and exit I-380, which increases the density between the ramps from Tower Terrace Road to Boyson Road. The failing ramp terminal intersection at northbound I-380 and Boyson contributes to the queuing that occurs back to Blairs Ferry Road.

P.M.

The mainline of I-380 in the p.m. has similar problems to the a.m. with Boyson Road causing queuing onto the interstate. Level of service F is forecasted in both the north and southbound directions leading up to the interchange.

Six intersections perform at a LOS E or F:

- Boyson Road and Center Point Road – LOS F
- Boyson Road and I-380 northbound ramp terminal – LOS F
- Boyson Road and I-380 southbound ramp terminal – LOS F
- Blairs Ferry Road and Center Point Road – LOS F
- Collins Road and Council Street – LOS E
- Boyson Road and Miller Road – LOS E

The intersections on Boyson Road are a result of a standard diamond interchange failing to meet the traffic demand in that area. By 2040, Highway 100/Collins Road will be extended to connect with Highway 30 to the west. This will increase demand along the Highway 100/Collins Road corridor. This is the contributing factor for the poor LOS at Collins Road and Council Street. In the No-Build Alternative, both directions of I-380 are congested, which limits the rate at which vehicles can access Collins Road from I-380 resulting in a LOS D in the p.m. peak.

Conclusion

Even with the addition of a Tower Terrace Road interchange, Boyson Road and the surrounding I-380 interstate will perform at unacceptable levels by the year 2040. Improving Boyson Road must be a part of the overall solution.

Table 2.3-E: 2040 Build Alternative 3 Freeway LOS

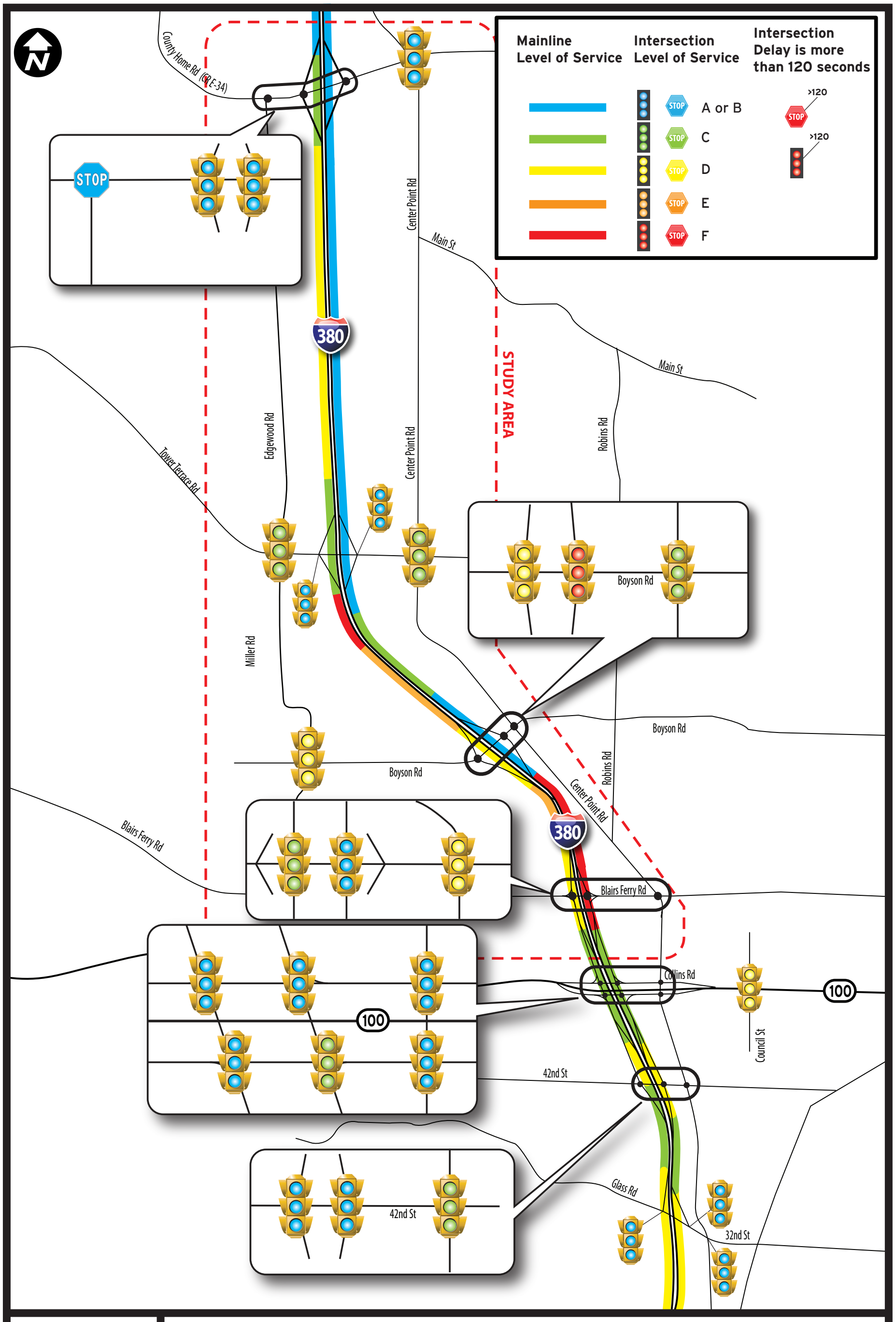
Description	Type	2040 No-Build				2040 Build Alternative 3			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS
Southbound I-380									
SB County Home Rd Off-Ramp	diverge	22.9	C	14.2	B	18.2	B	11.6	B
SB Between County Home Rd Ramps	basic	50.1	F	12.1	B	20.0	C	12.8	B
SB County Home Rd On-Ramp	merge	104.7	F*	12.7	B	28.5	D	13.2	B
SB County Home Rd On-Ramp to Boyson Rd Off-Ramp	basic	172.6	F	14.9	B				
SB County Home Rd On-Ramp to Tower Terrace Rd Off-Ramp	basic					26.0	D	15.0	B
SB Tower Terrace Rd Off-Ramp	diverge					21.5	C	13.3	B
SB Between Tower Terrace Rd Ramps	basic					22.7	C	25.4	C
SB Tower Terrace Rd On-Ramp	merge					53.6	F*	45.4	F*
SB Tower Terrace On-Ramp to Boyson Off-Ramp	basic					39.8	E	51.0	F
SB Boyson Rd Off-Ramp	diverge	193.0	F*	152.6	F*	37.4	E	53.4	F*
SB Between Boyson Rd Ramps	basic	21.2	C	15.2	B	32.9	D	20.1	C
SB Boyson Rd On-Ramp to Blairs Ferry Rd Off-Ramp	weave	37.0	E	23.6	C				
SB Boyson Rd On-Ramp	merge					35.5	E	25.1	C
SB Blairs Ferry Rd Off-Ramp	diverge					34.3	D	22.6	C
SB Between Blairs Ferry Rd Ramps	basic	23.7	C	19.4	C	30.4	D	22.4	C
SB Blairs Ferry Rd On-Ramp	basic	20.9	C	17.0	B	23.9	C	18.1	B
SB Blairs Ferry Rd On-Ramp to Collins Rd On-Ramp	basic	21.7	C	17.7	B	24.4	C	18.5	C
SB Collins Rd On-Ramp	merge	31.6	D	26.1	C	30.5	D	25.5	C
SB Collins Rd On-Ramp to 42nd St On-Ramp	basic	15.2	B	16.2	B	24.4	C	20.2	C
SB 42nd St On-Ramp to Glass Rd Off-Ramp	weave	27.6	C	22.4	C	25.7	C	21.3	C
SB Between Glass Rd Ramps	basic	29.8	D	25.2	C	32.4	D	25.7	C
Northbound I-380									
NB 29th St Off-Ramp to Glass Rd On-Ramp	basic	60.0	F	107.8	F	30.5	D	30.1	D
NB Glass Rd On-Ramp to 42nd St Off-Ramp	weave	79.7	F	132.5	F	23.9	C	27.9	C
NB Collins Rd Off-Ramp	diverge	99.5	F*	147.4	F*	30.7	D	30.4	D
NB Collins Rd Off-Ramp to Blairs Ferry Rd Off-Ramp	basic	104.9	F	142.7	F	23.2	C	25.7	C
NB Blairs Ferry Rd Off-Ramp	diverge	125.4	F	148.0	F	27.9	C	26.8	C
NB Between Blairs Ferry Rd Ramps	basic	155.8	F	164.8	F	50.6	F	35.7	E
NB Blairs Ferry Rd On-Ramp to Boyson Rd Off-Ramp	merge	173.5	F*	179.4	F*				
NB Blairs Ferry Rd On-Ramp	merge					83.6	F*	53.3	F*
NB Boyson Rd Off-Ramp	diverge					109.3	F*	53.8	F*
NB Between Boyson Rd Ramps	basic	11.7	B	20.4	C	17.6	B	27.9	D
NB Boyson Rd On-Ramp	merge	10.1	B	20.3	C	15.7	B	31.1	D
NB Boyson Rd On-Ramp to County Home Rd Off-Ramp	basic	11.3	B	31.1	D				
NB Boyson On-Ramp to TT Off-Ramp	basic					18.3	C	31.4	D
NB TT Rd Off-Ramp	diverge					14.9	B	25.9	C
NB Between TT Rd Ramps	basic					13.3	B	18.5	C
NB TT Rd On-Ramp	merge					13.2	B	21.6	C
NB TT On-Ramp to County home Off-Ramp	basic					15.6	B	24.0	C
NB County Home Rd Off-Ramp	diverge	11.2	B	104.7	F*	12.8	B	21.1	C
NB Between County Home Rd Ramps	basic	9.7	A	15.4	B	13.2	B	17.1	B
NB County Home Rd On-Ramp	merge	9.5	A	14.0	B	11.7	B	15.3	B

Source: VISSIM

Table 2.3-F: 2040 Build Alternative 3 Intersection LOS

Description	Control Type	2040 No-Build				2040 Build Alternative 3			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
32nd St SB	Signalized	12.8	B	11.2	B	12.4	B	11.0	B
32nd St & Center Point Rd	Signalized	26.5	C	23.8	C	12.6	B	14.2	B
42nd St & Center Point Rd	Signalized	21.5	C	29.5	C	21.8	C	29.4	C
42nd St NB	Signalized	9.8	A	30.0	C	10.2	B	20.3	C
42nd St SB	Signalized	9.0	A	7.7	A	9.3	A	8.1	A
EB Collins Rd SB	Signalized	13.0	B	7.7	A	11.9	B	8.0	A
EB Collins Rd & Center Point Rd	Signalized	16.5	B	16.1	B	19.4	B	16.6	B
EB Collins Rd NB	Signalized	23.1	C	25.3	C	21.3	C	22.6	C
WB Collins Rd SB	Signalized	10.7	B	13.1	B	11.7	B	15.0	B
WB Collins Rd & Center Point Rd	Signalized	15.1	B	15.6	B	14.0	B	13.4	B
WB Collins Rd NB	Signalized	13.6	B	23.1	C	12.9	B	16.5	B
Blairs Ferry Rd SB	Signalized	32.4	C	>120	F	26.6	C	37.4	D
Blairs Ferry Rd NB	Signalized	14.1	B	>120	F	14.8	B	47.1	D
Boyson Rd & Center Point Rd	Signalized	>120	F	>120	F	28.2	C	>120	F
Boyson Rd SB	Signalized	>120	F	>120	F	48.6	D	>120	F
Boyson Rd NB	Signalized	>120	F	>120	F	108.4	F	>120	F
County Home Rd NB	Unsignalized	19.7	C	>120	F				
County Home Rd SB	Unsignalized	>120	F	12.9	B				
County Home Rd NB	Signalized					5.9	A	8.0	A
County Home Rd SB	Signalized					14.8	B	9.8	A
Blairs Ferry Rd & Center Point Rd	Signalized	37.1	D	>120	F	36.7	D	101.0	F
32nd St NB	Signalized	9.5	A	17.1	B	10.8	B	14.9	B
Collins Rd & Council St	Signalized	33.3	C	50.0	D	40.1	D	62.8	E
County Home Rd & N. Center Point Rd	Signalized	12.6	B	11.4	B	11.1	B	10.7	B
County Home Rd & Edgewood Rd	Unsignalized	9.6	A	8.5	A	10.7	B	9.0	A
Tower Terrace & Center Point Rd	Unsignalized	>120	F	>120	F				
Tower Terrace & Center Point Rd	Signalized					33.9	C	51.4	D
Tower Terrace and Edgewood Rd	Unsignalized	>120	F	>120	F				
Tower Terrace and Edgewood Rd	Signalized					33.0	C	33.3	C
Tower Terrace & Miller Rd	Unsignalized	>120	F	35.5	E				
Boyson & Miller	Unsignalized	>120	F	>120	F				
Boyson & Miller	Signalized					36.7	D	78.3	E
Tower Terrace SB	Signalized					16.3	B	21.0	C
Tower Terrace NB	Signalized					17.7	B	19.9	B

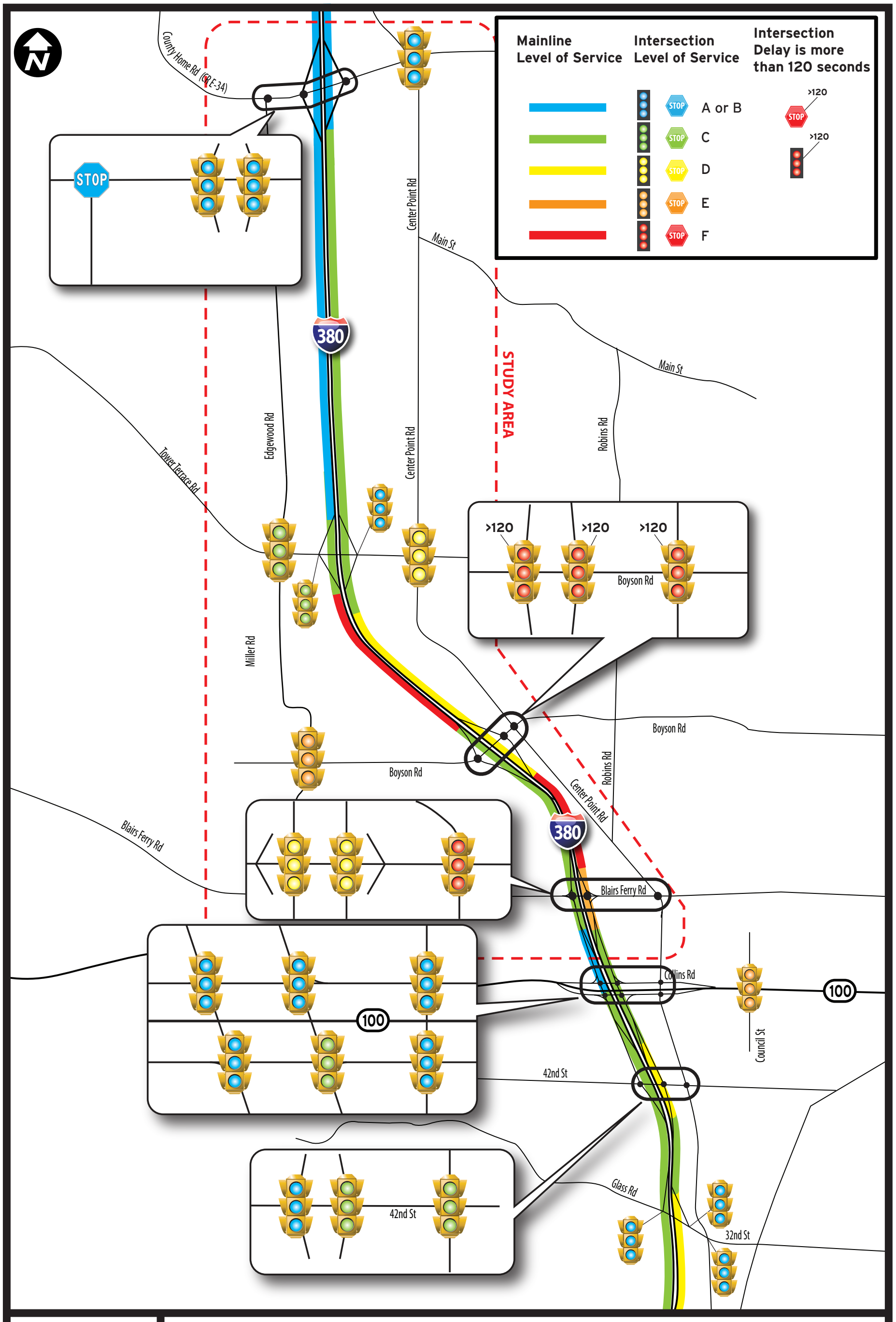
Source: VISSIM



EXHIBIT

2.3-5

Tower Terrace
Build Alternative 3 AM 2040
Level of Service



EXHIBIT

2.3-6

Tower Terrace
Build Alternative 3 PM 2040
Level of Service

2.3.2.4 Build Alternative Four

Build Alternative Four widens I-380 to six lanes and converts the Boyson Road interchange from a standard diamond to a DDI. **Tables 2.3-G through 2.3-H and Exhibits 2.3-7 through 2.3-8** display the operational performance of Build Alternative Four.

A.M.

The modelling simulations revealed that the DDI at Boyson Road and widening of I-380 will create an overall benefit for the corridor. Both directions of I-380 from Collins Road to the northern limits of the study area perform at a LOS C or better. The intersections of Boyson Road at the I-380 ramp terminals and Boyson Road at Center Point Road perform at a LOS C or better. The only intersection that performs at a failing LOS is at Boyson and Miller Road. This LOS F is driven by demand on Boyson once the DDI built. Build Alternative Two calls for a DDI at Boyson and has the same challenge.

As was the case in Build Alternative One, LOS E can be found on the northbound segment on I-380 before the Collins Road exit ramp. When six lanes are added, more vehicles are pulled to I-380. This is the root cause for poor LOS at Collins Road. The distance between the Collins Road off-ramp and the Blairs Ferry off-ramp is approximately one-half mile which causes challenges for vehicles trying to position for their exit. Vehicles travelling northbound destined for the off-ramp at Blairs Ferry Road are positioning in the outside lane preparing to exit while also competing for space with vehicles wanting to exit at Collins Road.

P.M.

Level of service A and B extend northbound and southbound within the study area north of Collins Road. Level of Service F does extend northbound from the Collins Road exit ramp southward beyond the analysis area. As is the case in the a.m. peak, demand at the Blairs Ferry Road and Collins Road exits cause backups to occur. Since northbound is the peak direction in the p.m., the issue is more severe.

There are six intersections that perform at a LOS E or F:

- Eastbound Collins Road and Center Point Road – LOS F
- Eastbound Collins Road and I-380 northbound ramp terminal – LOS E
- Blairs Ferry Road and I-380 northbound ramp terminal – LOS E
- Blairs Ferry Road and Center Point Road – LOS E
- Collins Road & Council Street – LOS F
- Tower Terrace and Center Point Road – LOS E

Poor LOS at the Blairs Ferry and Collins Road intersections are due to the high traffic volumes coming from I-380 and utilizing the two roadways. By 2040, Highway 100/Collins Road will be extended to connect with Highway 30 to the west. This will increase demand along the Highway 100/Collins Road corridor. This is the contributing factor for the poor LOS at Collins Road and Council Street. In the No-Build Alternative,

both directions of I-380 are congested, which limits the rate at which vehicles can access Collins Road from I-380 resulting in a LOS D in the p.m. peak.

Conclusion

When comparing the a.m. and p.m. Build Alternative Four results on I-380 within the core study area (north of Collins Road) to Build Alternatives one through three, Build Alternative Four has the better LOS. However, when expanding the network to include the full analysis area (south to Glass Road), LOS F does exist in the northbound direction during the p.m. peak. Widening I-380 creates additional demand beginning in the southern portion of the study area. Even with the improved operations at Boyson Road, the demand to exit at Collins and Blairs Ferry is still high and vehicles begin to position early for their exit, creating a poor LOS. The addition of an interchange at Tower Terrace Road, examined in **Subsection 2.3.4.5**, will reduce the demand at those off-ramps enough to create better flow in the a.m. and p.m. peak periods.

When comparing the Boyson Road DDI plus four-lane I-380 option (Build Alternative Two) with the six-lane I-380 plus Boyson DDI option (Build Alternative Four), the main difference can be seen during the a.m. peak. The southbound peak direction in Build Alternative Two has a LOS E at the County Home Road merge and LOS D spanning much of the southbound corridor. Build Alternative Four shows LOS C or better within the core study area.

Table 2.3-G: 2040 Build Alternative 4 Freeway LOS

Description	Type	2040 No-Build				2040 Build Alternative 4			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS
Southbound I-380									
SB County Home Rd Off-Ramp	diverge	22.9	C	14.2	B	18.1	B	11.6	B
SB Between County Home Rd Ramps	basic	50.1	F	12.1	B	20.0	C	12.2	B
SB County Home Rd On-Ramp	merge	104.7	F*	12.7	B	18.0	C	9.9	A
SB County Home Rd On-Ramp to Boyson Rd Off-Ramp	basic	172.6	F	14.9	B	18.2	C	10.1	A
SB Boyson Rd Off-Ramp	diverge	193.0	F*	152.6	F*	18.1	B	10.0	A
SB Between Boyson Rd Ramps	basic	21.2	C	15.2	B	17.6	B	10.3	A
SB Boyson Rd On-Ramp to Blairs Ferry Rd Off-Ramp	weave	37.0	E	23.6	C				
SB Boyson Rd On-Ramp	merge					20.7	C	13.9	B
SB Blairs Ferry Rd Off-Ramp	diverge					18.5	B	12.9	B
SB Between Blairs Ferry Rd Ramps	basic	23.7	C	19.4	C	18.6	C	12.5	B
SB Blairs Ferry Rd On-Ramp	basic	20.9	C	17.0	B	17.3	B	12.8	B
SB Blairs Ferry Rd On-Ramp to Collins Rd On-Ramp	basic	21.7	C	17.7	B	24.4	C	17.5	B
SB Collins Rd On-Ramp	merge	31.6	D	26.1	C	31.2	D	25.9	C
SB Collins Rd On-Ramp to 42nd St On-Ramp	basic	15.2	B	16.2	B	24.2	C	19.8	C
SB 42nd St On-Ramp to Glass Rd Off-Ramp	weave	27.6	C	22.4	C	26.0	C	20.9	C
SB Between Glass Rd Ramps	basic	29.8	D	25.2	C	32.3	D	25.4	C
Northbound I-380									
NB 29th St Off-Ramp to Glass Rd On-Ramp	basic	60.0	F	107.8	F	30.5	D	80.0	F
NB Glass Rd On-Ramp to 42nd St Off-Ramp	weave	79.7	F	132.5	F	27.0	C	74.5	F
NB Collins Rd Off-Ramp	diverge	99.5	F*	147.4	F*	42.9	E	85.9	F*
NB Collins Rd Off-Ramp to Blairs Ferry Rd Off-Ramp	basic	104.9	F	142.7	F	21.0	C	21.0	C
NB Blairs Ferry Rd Off-Ramp	diverge	125.4	F	148.0	F	15.4	B	16.0	B
NB Between Blairs Ferry Rd Ramps	basic	155.8	F	164.8	F	13.9	B	14.0	B
NB Blairs Ferry Rd On-Ramp to Boyson Rd Off-Ramp	merge	173.5	F*	179.4	F*				
NB Blairs Ferry Rd On-Ramp	merge					15.3	B	18.6	B
NB Boyson Rd Off-Ramp	diverge					15.0	B	17.1	B
NB Between Boyson Rd Ramps	basic	11.7	B	20.4	C	10.2	A	14.2	B
NB Boyson Rd On-Ramp	merge	10.1	B	20.3	C	9.1	A	14.3	B
NB Boyson Rd On-Ramp to County Home Rd Off-Ramp	basic	11.3	B	31.1	D	10.4	A	15.2	B
NB County Home Rd Off-Ramp	diverge	11.2	B	104.7	F*	10.4	B	15.4	B
NB Between County Home Rd Ramps	basic	9.7	A	15.4	B	13.0	B	16.3	B
NB County Home Rd On-Ramp	merge	9.5	A	14.0	B	12.3	B	15.0	B

Source: VISSIM

Table 2.3-H: 2040 Build Alternative 4 Intersection LOS

Description	Control Type	2040 No-Build				2040 Build Alternative 4			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
32nd St SB	Signalized	12.8	B	11.2	B	10.7	B	10.7	B
32nd St & Center Point Rd	Signalized	26.5	C	23.8	C	12.7	B	14.1	B
42nd St & Center Point Rd	Signalized	21.5	C	29.5	C	21.5	C	28.9	C
42nd St NB	Signalized	9.8	A	30.0	C	10.3	B	20.0	C
42nd St SB	Signalized	9.0	A	7.7	A	8.9	A	7.9	A
EB Collins Rd SB	Signalized	13.0	B	7.7	A	11.0	B	7.3	A
EB Collins Rd & Center Point Rd	Signalized	16.5	B	16.1	B	19.9	B	103.5	F
EB Collins Rd NB	Signalized	23.1	C	25.3	C	21.8	C	62.6	E
WB Collins Rd SB	Signalized	10.7	B	13.1	B	11.3	B	12.7	B
WB Collins Rd & Center Point Rd	Signalized	15.1	B	15.6	B	14.4	B	29.9	C
WB Collins Rd NB	Signalized	13.6	B	23.1	C	13.0	B	31.8	C
Blairs Ferry Rd SB	Signalized	32.4	C	>120	F	24.6	C	20.5	C
Blairs Ferry Rd NB	Signalized	14.1	B	>120	F	23.1	C	60.2	E
Boyson Rd & Center Point Rd	Signalized	>120	F	>120	F	29.8	C	50.2	D
Boyson Rd SB	Signalized	>120	F	>120	F	11.9	B	12.1	B
Boyson Rd NB	Signalized	>120	F	>120	F	20.5	C	13.7	B
County Home Rd NB	Unsignalized	19.7	C	>120	F				
County Home Rd SB	Unsignalized	>120	F	12.9	B				
County Home Rd NB	Signalized					8.0	A	10.1	B
County Home Rd SB	Signalized					18.2	B	12.4	B
Blairs Ferry Rd & Center Point Rd	Signalized	37.1	D	>120	F	39.7	D	57.2	E
32nd St NB	Signalized	9.5	A	17.1	B	10.7	B	14.9	B
Collins Rd & Council St	Signalized	33.3	C	50.0	D	39.6	D	96.1	F
County Home Rd & N. Center Point Rd	Signalized	12.6	B	11.4	B	11.4	B	12.2	B
County Home Rd & Edgewood Rd	Unsignalized	9.6	A	8.5	A	9.4	A	8.4	A
Tower Terrace & Center Point Rd	Unsignalized	>120	F	>120	F				
Tower Terrace & Center Point Rd	Signalized					51.1	D	61.2	E
Tower Terrace and Edgewood Rd	Unsignalized	>120	F	>120	F				
Tower Terrace and Edgewood Rd	Signalized					29.8	C	35.0	D
Tower Terrace & Miller Rd	Unsignalized	>120	F	35.5	E				
Boyson & Miller	Unsignalized	>120	F	>120	F				
Boyson & Miller	Signalized					97.7	F	33.8	C

Source: VISSIM

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

STOP A or B

STOP C

STOP D

STOP E

STOP F

>120

>120

County Home Rd (CR E-34)

Center Point Rd

Main St

STUDY AREA

Main St

Edgewood Rd

Tower Terrace Rd

Robins Rd

380

Boyson Rd

Miller Rd

Boyson Rd

Boyson Rd

Robins Rd

Center Point Rd

Blairs Ferry Rd

380

Blairs Ferry Rd

Collins Rd

100

100

Council St

42nd St

Glass Rd

42nd St

32nd St

EXHIBIT 2.3-7

Tower Terrace Build Alternative 4 AM 2040 Level of Service

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

A or B

C

D

E

F

>120

>120

STOP

County Home Rd (CR E-34)

Center Point Rd

Main St

STUDY AREA

Main St

Edgewood Rd

Tower Terrace Rd

Robins Rd

380

Boyson Rd

Miller Rd

Boyson Rd

Boyson Rd

Robins Rd

Center Point Rd

Blairs Ferry Rd

Blairs Ferry Rd

Collins Rd

100

Council St

42nd St

Glass Rd

32nd St

42nd St

100

EXHIBIT

2.3-8

Tower Terrace
Build Alternative 4 PM 2040
Level of Service

2.3.2.5 Build Alternatives Five A and Five B

Build Alternatives Five A and B have similar proposed improvements, with one distinct difference. The difference between A and B is the type of interchange design at Tower Terrace Road. Alternative Five A constructs a standard diamond interchange, whereas Alternative Five B constructs a DDI. **Exhibit 2.3-9** displays the peak hour turning movements for the 2040 build alternative. **Tables 2.3-I through 2.3-J and Exhibits 2.3-10 through 2.3-13** display the operational performance of Build Alternatives Five A and B. Roundabout ramp terminals were also considered as part of Alternative Five A, but were found not to operate well with the design year volumes. More details of this analysis can be found in **Appendix A**.

A.M.

Tables 2.3-I and 2.3-J reveal that Alternative Five A and B are similar in terms of performance. Acceptable LOS occurs in both directions of I-380 within the core study area boundaries. Like other six-lane options (one and four), Level of service E does occur at the diverge at Collins Road. All intersections perform at a LOS D or better.

P.M.

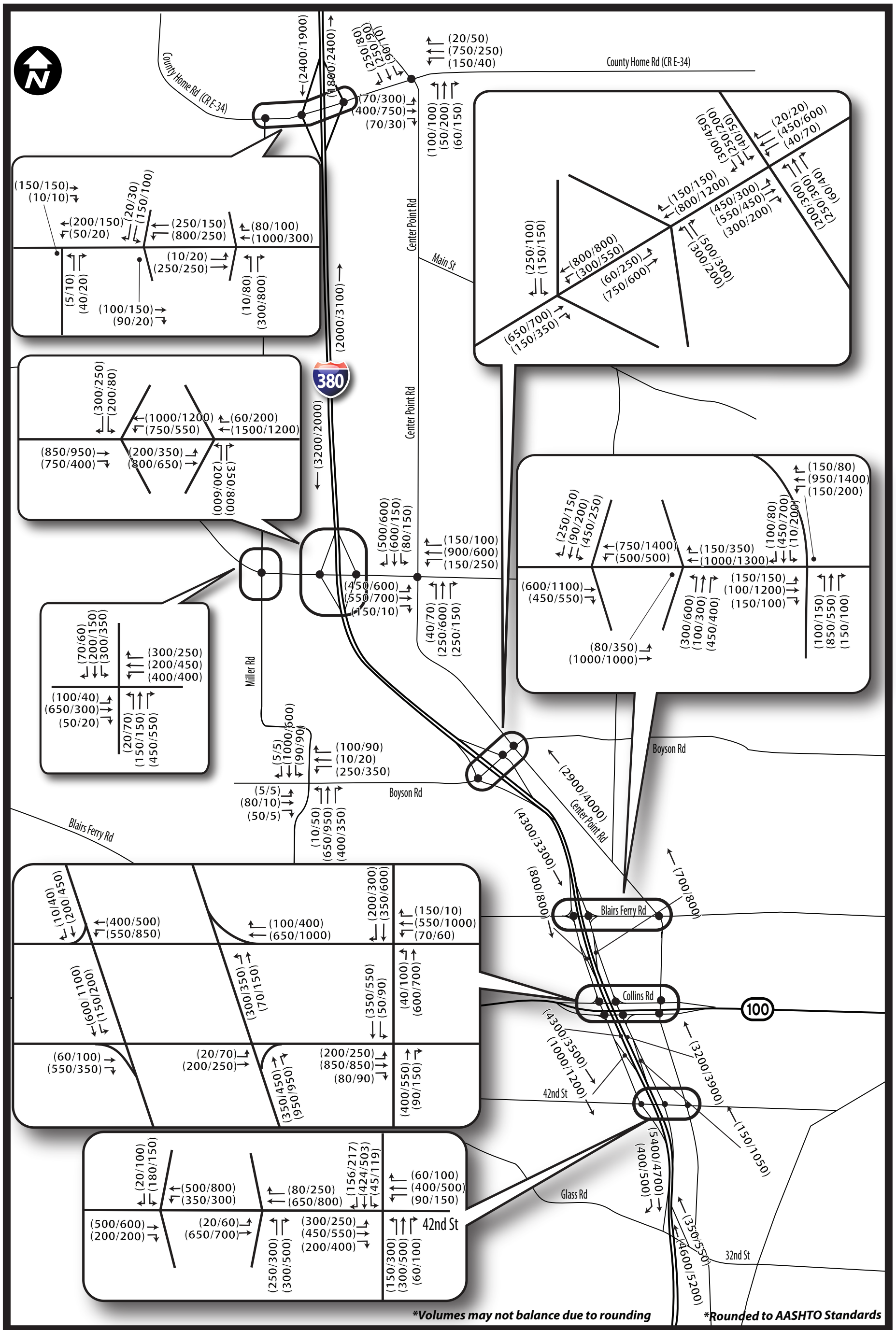
Alternatives One and Four were the only other two options with six-lanes on I-380. Both of those alternatives contributed to a failing LOS on the northbound I-380 lanes from beyond the analysis area up to the Collins Street diverge. In Build Alternatives Five A and B, the LOS in that area is a D or better because the construction of the Tower Terrace Interchange pulls enough northbound vehicles off the Collins Road and Blairs Ferry Road off-ramps (and moves them to Tower Terrace) to achieve a better LOS. Level of service D or better is forecasted throughout the core study and analysis area. At the intersection level, the same two intersections perform at a LOS E for Alternatives A and B:

- Collins Road and Council Street – LOS E
- Tower Terrace Road and Center Point Road – LOS E

By 2040, Highway 100/Collins Road will be extended to connect with Highway 30 to the west. This will increase demand along the Highway 100/Collins Road corridor. This is the contributing factor for the poor LOS at Collins Road and Council Street. In the No-Build Alternative, both directions of I-380 are congested, which limits the rate at which vehicles can access Collins Road from I-380 resulting in a LOS D in the p.m. peak. The Tower Terrace and Center Point intersection performance is driven by the increase in vehicles using the Tower Terrace Road Interchange.

Conclusion

Both Alternatives Five A and B show a better overall operational performance than the other build alternatives. Operations on I-380 within the core study area meet the Iowa DOT recommended performance standards. Boyson Road and Tower Terrace Road interchanges also perform at acceptable levels of service in the morning and afternoon peaks.



*Volumes may not balance due to rounding

*Rounded to AASHTO Standards

EXHIBIT

2.3-9

Tower Terrace
Preferred Build Alternative
Volumes 2040 AM/PM

Table 2.3-I: 2040 Build Alternative 5a and 5b Freeway LOS

Description	Type	2040 No-Build				2040 Build Alternative 5a				2040 Build Alternative 5b			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS	Peak Density (vpmpl)	LOS
Southbound I-380													
SB County Home Rd Off-Ramp	diverge	22.9	C	14.2	B	18.1	B	11.6	B	18.1	B	11.6	B
SB Between County Home Rd Ramps	basic	50.1	F	12.1	B	20.6	C	13.0	B	20.6	C	13.0	B
SB County Home Rd On-Ramp	merge	104.7	F*	12.7	B	18.0	C	10.0	A	18.0	C	10.0	A
SB County Home Rd On-Ramp to Boyson Rd Off-Ramp	basic	172.6	F	14.9	B								
SB County Home Rd On-Ramp to Tower Terrace Rd Off-Ramp	basic					18.1	C	10.1	A	18.1	C	10.1	A
SB Tower Terrace Rd Off-Ramp	diverge					15.8	B	9.2	A	15.8	B	9.2	A
SB Between Tower Terrace Rd Ramps	basic					15.7	B	8.5	A	15.7	B	8.5	A
SB Tower Terrace Rd On-Ramp	merge					26.9	C	13.1	B	26.9	C	13.1	B
SB Tower Terrace On-Ramp to Boyson Off-Ramp	basic					25.9	C	14.6	B	25.9	C	14.6	B
SB Boyson Rd Off-Ramp	diverge	193.0	F*	152.6	F*	24.7	C	15.0	B	24.7	C	15.0	B
SB Between Boyson Rd Ramps	basic	21.2	C	15.2	B	24.1	C	13.6	B	24.1	C	13.6	B
SB Boyson Rd On-Ramp to Blairs Ferry Rd Off-Ramp	weave	37.0	E	23.6	C								
SB Boyson Rd On-Ramp	merge					25.1	C	19.0	B	25.1	C	19.0	B
SB Blairs Ferry Rd Off-Ramp	diverge					20.8	C	15.7	B	20.8	C	15.7	B
SB Between Blairs Ferry Rd Ramps	basic	23.7	C	19.4	C	21.9	C	15.2	B	21.9	C	15.2	B
SB Blairs Ferry Rd On-Ramp	basic	20.9	C	17.0	B	18.9	B	14.1	B	18.9	B	14.1	B
SB Blairs Ferry Rd On-Ramp to Collins Rd On-Ramp	basic	21.7	C	17.7	B	26.8	D	19.6	C	26.8	D	19.6	C
SB Collins Rd On-Ramp	merge	31.6	D	26.1	C	33.1	D	28.5	D	33.1	D	28.5	D
SB Collins Rd On-Ramp to 42nd St On-Ramp	basic	15.2	B	16.2	B	25.7	C	21.6	C	25.7	C	21.6	C
SB 42nd St On-Ramp to Glass Rd Off-Ramp	weave	27.6	C	22.4	C	27.3	C	22.7	C	27.3	C	22.7	C
SB Between Glass Rd Ramps	basic	29.8	D	25.2	C	33.5	D	27.1	D	33.5	D	27.1	D
Northbound I-380													
NB 29th St Off-Ramp to Glass Rd On-Ramp	basic	60.0	F	107.8	F	30.4	D	30.3	D	30.4	D	30.3	D
NB Glass Rd On-Ramp to 42nd St Off-Ramp	weave	79.7	F	132.5	F	26.4	C	25.8	C	26.4	C	25.8	C
NB Collins Rd Off-Ramp	diverge	99.5	F*	147.4	F*	40.8	E	31.8	D	40.8	E	31.8	D
NB Collins Rd Off-Ramp to Blairs Ferry Rd Off-Ramp	basic	104.9	F	142.7	F	21.2	C	21.7	C	21.2	C	21.7	C
NB Blairs Ferry Rd Off-Ramp	diverge	125.4	F	148.0	F	15.6	B	15.8	B	15.6	B	15.8	B
NB Between Blairs Ferry Rd Ramps	basic	155.8	F	164.8	F	14.5	B	15.7	B	14.5	B	15.7	B
NB Blairs Ferry Rd On-Ramp to Boyson Rd Off-Ramp	merge	173.5	F*	179.4	F*								
NB Blairs Ferry Rd On-Ramp	merge					16.4	B	20.7	C	16.4	B	20.7	C
NB Boyson Rd Off-Ramp	diverge					16.2	B	19.4	B	16.2	B	19.4	B
NB Between Boyson Rd Ramps	basic	11.7	B	20.4	C	12.1	B	19.3	C	12.1	B	19.3	C
NB Boyson Rd On-Ramp	merge	10.1	B	20.3	C	12.3	B	24.1	C	12.3	B	24.1	C
NB Boyson Rd On-Ramp to County Home Rd Off-Ramp	basic	11.3	B	31.1	D								
NB Boyson On-Ramp to TT Off-Ramp	basic					13.2	B	21.6	C	13.2	B	21.6	C
NB TT Rd Off-Ramp	diverge					11.9	B	21.2	C	11.9	B	21.2	C
NB Between TT Rd Ramps	basic					9.4	A	13.0	B	9.4	A	13.0	B
NB TT Rd On-Ramp	merge					9.9	A	15.9	B	9.9	A	15.9	B
NB TT On-Ramp to County home Off-Ramp	basic					11.0	A	16.5	B	11.0	A	16.5	B
NB County Home Rd Off-Ramp	diverge	11.2	B	104.7	F*	11.0	B	16.6	B	11.0	B	16.6	B
NB Between County Home Rd Ramps	basic	9.7	A	15.4	B	14.2	B	17.8	B	14.2	B	17.8	B
NB County Home Rd On-Ramp	merge	9.5	A	14.0	B	12.3	B	15.6	B	12.3	B	15.6	B

Source: VISSIM

Table 2.3-J: 2040 Build Alternative 5a and 5b Intersection LOS

Description	Control Type	2040 No-Build				2040 Build Alternative 5a				2040 Build Alternative 5b			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
32nd St SB	Signalized	12.8	B	11.2	B	14.7	B	14.9	B	15.2	B	14.2	B
32nd St & Center Point Rd	Signalized	26.5	C	23.8	C	12.1	B	14.0	B	12.2	B	14.0	B
42nd St & Center Point Rd	Signalized	21.5	C	29.5	C	21.3	C	28.9	C	21.5	C	29.6	C
42nd St NB	Signalized	9.8	A	30.0	C	11.2	B	19.8	B	10.4	B	21.1	C
42nd St SB	Signalized	9.0	A	7.7	A	9.4	A	8.3	A	9.5	A	8.6	A
EB Collins Rd SB	Signalized	13.0	B	7.7	A	13.2	B	7.7	A	13.5	B	7.7	A
EB Collins Rd & Center Point Rd	Signalized	16.5	B	16.1	B	19.9	B	27.8	C	20.0	B	26.0	C
EB Collins Rd NB	Signalized	23.1	C	25.3	C	21.2	C	21.9	C	21.0	C	21.9	C
WB Collins Rd SB	Signalized	10.7	B	13.1	B	11.8	B	15.0	B	11.6	B	15.5	B
WB Collins Rd & Center Point Rd	Signalized	15.1	B	15.6	B	13.2	B	18.8	B	13.2	B	18.8	B
WB Collins Rd NB	Signalized	13.6	B	23.1	C	12.6	B	29.1	C	12.6	B	29.2	C
Blairs Ferry Rd SB	Signalized	32.4	C	>120	F	28.2	C	35.7	D	29.5	C	34.5	C
Blairs Ferry Rd NB	Signalized	14.1	B	>120	F	12.0	B	40.3	D	12.3	B	41.2	D
Boyson Rd & Center Point Rd	Signalized	>120	F	>120	F	24.3	C	29.5	C	24.6	C	29.4	C
Boyson Rd SB	Signalized	>120	F	>120	F	13.0	B	15.1	B	12.9	B	13.9	B
Boyson Rd NB	Signalized	>120	F	>120	F	16.7	B	17.9	B	17.6	B	15.6	B
County Home Rd NB	Unsignalized	19.7	C	>120	F								
County Home Rd SB	Unsignalized	>120	F	12.9	B								
County Home Rd NB	Signalized					7.6	A	9.2	A	7.6	A	9.8	A
County Home Rd SB	Signalized					15.7	B	9.8	A	14.9	B	9.6	A
Blairs Ferry Rd & Center Point Rd	Signalized	37.1	D	>120	F	32.6	C	43.2	D	34.4	C	43.7	D
32nd St NB	Signalized	9.5	A	17.1	B	10.3	B	15.8	B	10.4	B	15.7	B
Collins Rd & Council St	Signalized	33.3	C	50.0	D	40.2	D	73.0	E	40.7	D	74.8	E
County Home Rd & N. Center Point Rd	Signalized	12.6	B	11.4	B	11.3	B	10.8	B	11.1	B	10.9	B
County Home Rd & Edgewood Rd	Unsignalized	9.6	A	8.5	A	9.4	A	8.7	A	10.5	B	8.8	A
Tower Terrace & Center Point Rd	Unsignalized	>120	F	>120	F								
Tower Terrace & Center Point Rd	Signalized					36.0	D	59.3	E	36.8	D	57.9	E
Tower Terrace and Edgewood Rd	Unsignalized	>120	F	>120	F								
Tower Terrace and Edgewood Rd	Signalized					34.0	C	31.9	C	32.7	C	33.6	C
Tower Terrace & Miller Rd	Unsignalized	>120	F	35.5	E								
Boyson & Miller	Unsignalized	>120	F	>120	F								
Boyson & Miller	Signalized					24.8	C	23.4	C	25.1	C	23.0	C
Tower Terrace SB	Signalized					28.8	C	15.3	B	16.2	B	16.7	B
Tower Terrace NB	Signalized					22.2	C	20.0	C	19.8	B	17.0	B

Source: VISSIM

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

STOP A or B

STOP C

STOP D

STOP E

STOP F

>120

>120

County Home Rd (CR E-34)

Center Point Rd

Main St

STUDY AREA

Main St

Tower Terrace Rd

Edgewood Rd

Center Point Rd

Robins Rd

Boyson Rd

Miller Rd

Boyson Rd

Boyson Rd

Robins Rd

Center Point Rd

Blairs Ferry Rd

Blairs Ferry Rd

Collins Rd

100

Council St

42nd St

Glass Rd

32nd St

42nd St

100

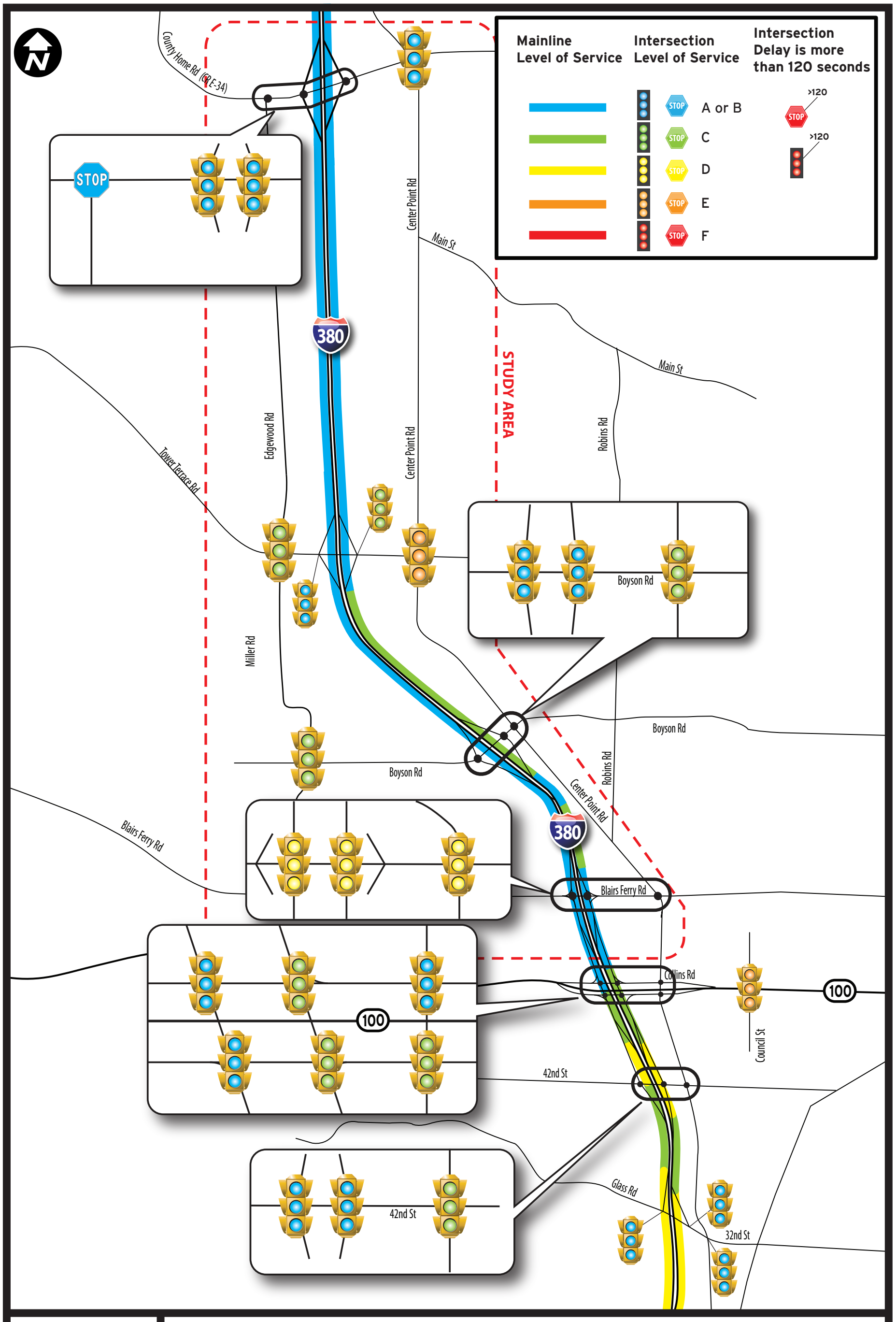
380

380

STOP

EXHIBIT 2.3-10

Tower Terrace
Build Alternative 5A AM 2040
Level of Service



EXHIBIT

2.3-11

Tower Terrace
Build Alternative 5A PM 2040
Level of Service

Mainline Level of Service

Intersection Level of Service

Intersection Delay is more than 120 seconds

A or B

C

D

E

F

>120

>120

STOP

County Home Rd (CR E-34)

Center Point Rd

Main St

STUDY AREA

Main St

Robins Rd

Edgewood Rd

Tower Terrace Rd

Center Point Rd

Boyson Rd

Miller Rd

Boyson Rd

Boyson Rd

Robins Rd

Center Point Rd

Blairs Ferry Rd

Blairs Ferry Rd

380

380

100

Collins Rd

100

Council St

42nd St

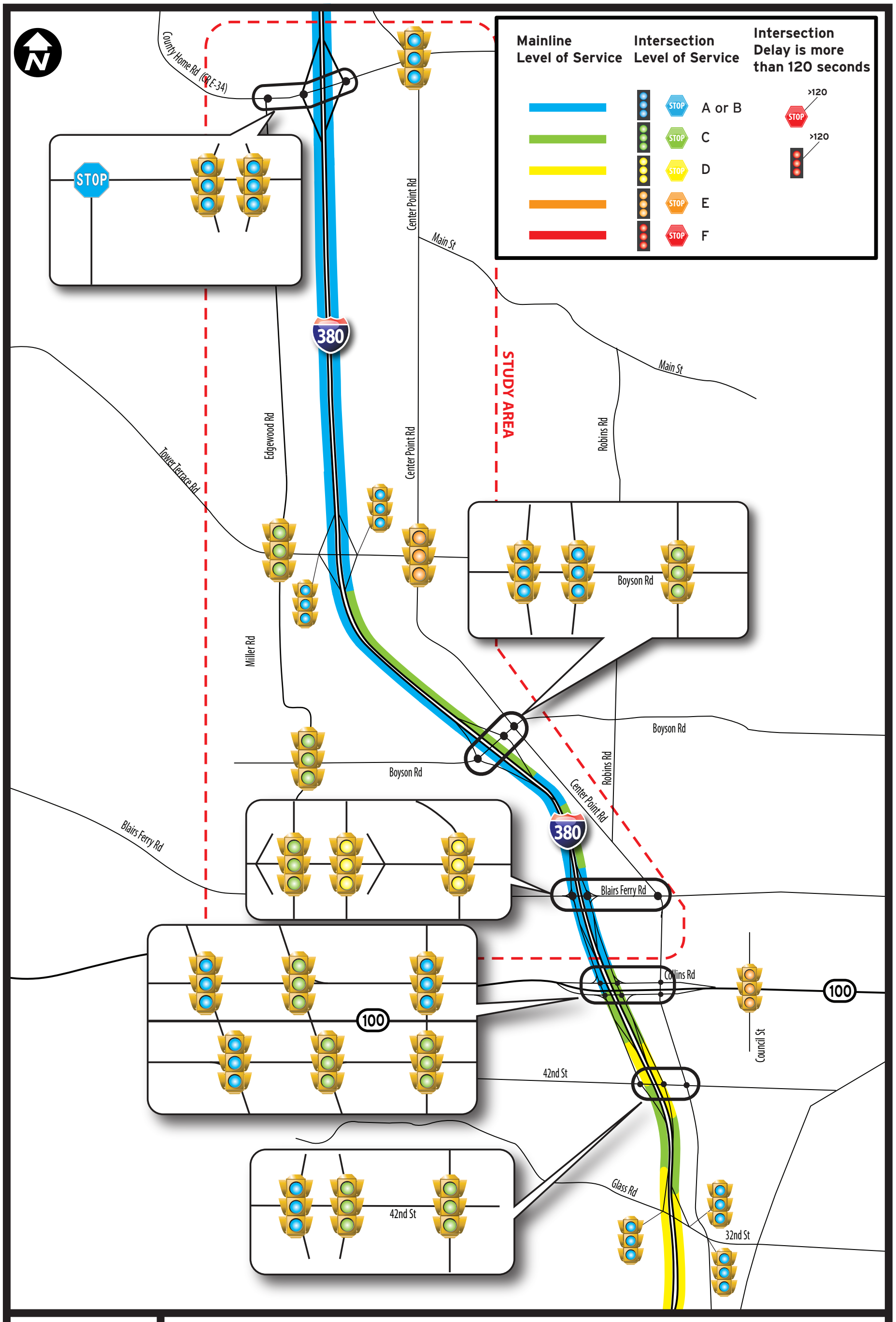
42nd St

Glass Rd

32nd St

EXHIBIT 2.3-12

Tower Terrace
Build Alternative 5B AM 2040
Level of Service



EXHIBIT

2.3-13

Tower Terrace
Build Alternative 5B PM 2040
Level of Service

2.3.3 Sensitivity Analysis

Standard Diamond versus a DDI

The analysis above shows that the traffic operations of Build Alternative A and B are nearly the same in both the a.m. and p.m. peak periods by the year 2040. An interchange at Tower Terrace Road, regardless of the type, contributes to better overall performance within the study area when coupled with a DDI at Boyson Road and six-lanes on I-380.

The study team tested the operational capabilities of both interchange designs by increasing the traffic volumes on each until the point of deterioration. **Table 2.3-K** shows the results of the sensitivity analysis. Traffic volumes were increased 20 percent higher than the 2040 forecasted amount before the standard diamond interchange option performed below the Iowa DOT's desired LOS. The DDI option performed at a LOS B at both intersections with the same volume increase. If the volumes on Tower Terrace are 20 percent higher than the forecasted amount by 2040, the DDI interchange would still be able to operate at an acceptable LOS.

Table 2.3-K: LOS Comparison of Tower Terrace with 20 Percent Volume Increase

Intersection	Standard Diamond	DDI
I-380 NB Ramp Terminal	LOS E	LOS B
I-380 SB Ramp Terminal	LOS D	LOS B

Source: VISSIM

Eastbound Auxiliary Lane on Tower Terrace Road and Boyson Road DDIs

The need for an auxiliary lane on the proposed eastbound Tower Terrace DDI was considered by the project team. The project team chose to clear three lanes through the NEPA process to leave flexibility during the final design process. **Table 2.3-L** reveals that the two-lane option operates at the same LOS as the two-lane with auxiliary option. Because it has lower future traffic volumes, the Boyson Road DDI would operate the same or better than the Tower Terrace DDI without an eastbound auxiliary lane.

Exhibit 2.3-14: Eastbound Two Lane vs. Two Lane Plus Auxiliary

2 Lane Eastbound

2 Lane with Aux

Table 2.3-L: LOS Comparison of Two Lane vs. Two Lane Plus Auxiliary

Intersection	2 Lane Eastbound	2 Lane with Aux
I-380 NB Ramp Terminal	LOS B	LOS B
I-380 SB Ramp Terminal	LOS B	LOS B

Source: VISSIM

2.3.4 Safety Analysis

A future predictive crash analysis was conducted using the Interactive Highway Safety Design Model (IHSDM) software developed by the Federal Highway Administration (FHWA) for future no-build and build scenarios. The IHSDM utilizes methodology from the Highway Safety Manual (HSM) to predict crashes based on roadway geometry, characteristics and traffic volumes.

A total of six scenarios were modeled for comparison for the analysis year 2040. A no-build scenario was considered to establish baselines for comparison of the five build scenarios. Scenarios modeled are:

- 2040 No Build – 4 Lanes on I-380, No changes to any interchanges
- 2040 Build Alternative 1 – 6 Lanes on I-380, No changes to any interchanges
- 2040 Build Alternative 2 – 4 Lanes on I-380, Conversion of Diamond to DDI at Boyson Road, No changes to other interchanges
- 2040 Build Alternative 3 – 4 Lanes on I-380, Construct DDI at Tower Terrace, No changes to other interchanges
- 2040 Build Alternative 4 – 6 Lanes on I-380, Conversion of Diamond to DDI at Boyson Road, No changes to other interchanges
- 2040 Build Alternative 5b – 6 Lanes on I-380, Conversion of Diamond to DDI at Boyson Road, Construct DDI at Tower Terrace, No changes to other interchanges

To evaluate the addition of a DDI at Boyson Road and Tower Terrace, a Crash Modification Factor (CMF) was used as IHSDM doesn't allow for the modeling of a DDI. The CMF is utilized by modeling a traditional diamond interchange and applying a CMF to adjust crashes. The CMF applied is meant to calculate the reduction in crashes when converting a traditional diamond to a DDI.

The CMF used was developed in a study called *Safety Evaluation of Seven of the Earliest Diverging Diamond Interchanges Installed in the US (*Hummer et al. 2016). The CMF is applied to the interchange as a whole described as "800 feet along the surface street and 1,500 feet along the ramps in each direction from the center of the interchange". The recommended CMF is 0.67 which is a 33% reduction in all crash types. The CMFs were applied to the total for all crash severities (fatal and injury, or property-damage only).

Table 2.3-M shows the predicted crashes for all alternatives.

Table 2.3-M: Predicted Crashes Per Year - No-Build and Build Alternatives

Model	Total Crashes
2040 No Build	126
Build Alternative 1	122
Build Alternative 2	125
Build Alternative 3	143
Build Alternative 4	121
Build Alternative 5b	140

Source: IHSDM

Table 2.3-N: Ramp + Intersection Crashes Per Year by Interchange

	No-Build	Build Alt 1	Build Alt 2	Build Alt 3	Build Alt 4	Build Alt 5b - Preferred	Difference Preferred vs. NB	Percent Difference Preferred vs. NB
Boyson Road	19.80	19.99	17.15	16.67	17.50	15.16	-4.64	-23%
Blairs Ferry Road	38.46	38.06	38.47	38.21	38.06	38.05	-0.41	-1%
County Home Road	14.48	16.93	15.11	10.44	16.92	12.44	-2.04	-14%
Tower Terrace Road	N/A	N/A	N/A	19.32	N/A	18.67	+18.67	N/A
Tot. Ramp +Int Crashes	72.74	74.98	70.73	84.64	72.78	84.32	+11.58	+16%

Source: IHSDM

Alternative Five A was not modeled, but is anticipated to have a similar crash rate as Build Alternative Five B except at Tower Terrace Road, where it would be similar to Alternative Three because a Diamond Interchange at Tower Terrace Road will have a higher predicted crash total compared to the statistically safer DDI option.

Build Alternatives Three and Five B, with an interchange added at Tower Terrace Road, had a higher number of predicted crashes compared to the no-build. This total is a sum of mainline, ramp and intersection crashes. The result is expected because an increase in the number of merge, diverge and ramp terminals in the study area will always increase the likelihood of a crash occurring. While new crashes are predicted at the proposed Tower Terrace Interchange, crashes are expected to be reduced at all other interchange ramps and intersections in the study area. **Table 2.3-N** shows that with the addition of the Tower Terrace DDI, the number of crashes goes down at every existing interchange within the study area compared to the no-build.

2.3.5 Preferred Alternative

Build Alternative Five B was chosen as the Preferred Alternative. This alternative satisfies the need requirements for the project. A conceptual signing plan of the Preferred Alternative can be found in **Appendix B**. Below is a summary of why the Preferred Alternative is the best option based on the evaluation factors described in **Section 2.2**.

Traffic operations on the I-380 corridor, measured by LOS - Level of service A, B and/or C span both directions of I-380 in the core study area. The only undesired LOS is south of the study area at the Collins Road diverge. All other alternatives had poorer overall LOS results.

Total congestion relieved on Boyson Road and other surrounding interchanges at the I-380 ramp terminals and at Center Point Road, measured by peak hour volumes and LOS - The intersection operations for Boyson Road at the I-380 north and southbound ramp terminals is a LOS B during both peak periods. The Boyson Road and Center Point Road intersection performs at a LOS C during both peak periods. Any build alternative with a Boyson Road DDI (Build Alternatives Two, Four, Five A and Five B) had acceptable levels of service during the peak periods; however, when comparing each alternative, the Preferred had the better overall LOS results. Out of all the alternatives, the Preferred was the only one without an intersection operating at a LOS F.

Traffic operations along Tower Terrace Road, measured by LOS - The intersections at the proposed Tower Terrace Road interchange operate at a LOS B in both peak periods. Level of service C is forecasted for the reconfigured intersection at Edgewood Road. Level of service E in the p.m. peak can be expected at the intersection of Tower Terrace Road and Center Point Road. It is not expected to queue back to the interchange ramp terminals. Some improvements, such as upgrading from a two-way stop to a signalized intersection, were assumed in the analysis. Additional improvements will be a part of the City of Hiawatha's construction project.

Predicted crash rates for the I-380 study area, measured with IHSDM crash software - The addition of the Tower Terrace Road interchange will add new crashes at I-380 and Tower Terrace because of the new merges, diverges and ramp terminals. However, the total number of crashes at every other interchange goes down compared to the no-build.

2.3.6 Pedestrian Mobility

Pedestrian and bicycle accommodations will be accounted for at the new Tower Terrace Interchange. There will be five feet reserved for on-street bike lanes. A 10-foot shared use path will span the center of the DDI. Outside the ramp terminals, a five-foot pedestrian sidewalk will be provided on the north side of the roadway and a 10-foot shared use path will be provided on the south. The same pedestrian accommodations will be available at the new Boyson Road DDI as well. There will not be any on-street bicycle lanes added, however.

2.3.7 Policy Statement Three Summary

Build Alternative Five B was selected as the Preferred Alternative. This alternative best satisfies the Purpose and Need and has the best overall operational performance out of any of the other alternatives. A conceptual signing plan of the Preferred Alternative can be found in **Appendix B**. The requirements for Policy Statement Three have been satisfied.

2.4 FHWA Policy Statement Four

The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.

2.4.1 Basic Traffic Movements

Tower Terrace Road is an existing, public roadway with several public owners adjacent to its right-of-way. The roadway is owned and maintained by the City of Hiawatha and the City of Cedar Rapids in the immediate vicinity of I-380. As it stretches east and west, it falls under the jurisdiction of the City of Marion, the City of Robins, and Linn County. The interchange alternatives considered for connecting Tower Terrace Road to I-380 provide for each of the eight basic traffic movements, allowing for a full-access interchange. Boyson Road will also be maintained as a full access interchange connecting to a public roadway.

2.4.2 Design Standards

The proposed geometric concepts of the interchanges at Tower Terrace Road and Boyson Road conform to current Iowa DOT and AASHTO design standards and policies. On I-380, a design exception will be likely at the Emmons Street overpass and a design variance will be likely at the Blairs Ferry Road overpass, both for narrow shoulder widths. It is assumed the existing overpasses at both Tower Terrace Road and Boyson Road will be replaced as part of each respective interchange's DDI construction prior to widening I-380, to accommodate full shoulder widths at those locations.

2.4.3 Policy Statement Four Summary

The proposed design accommodates all turning movements at both the Tower Terrace and Boyson interchanges. On I-380, a design exception will be likely at the Emmons Street overpass and a design variance will be likely at the Blairs Ferry Road overpass.

2.5 FHWA Policy Statement Five

The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93.

2.5.1 Planning Consistency

Corridor MPO's Long-Range Transportation Plan (LRTP), "Connections 2040" identifies Tower Terrace Road as a regionally significant corridor and a corridor that is expected to see significant economic and traffic growth through 2040. **Table 2.5-A** shows in which planning documents Tower Terrace and the other associated projects are identified.

Table 2.5-A – Project Planning

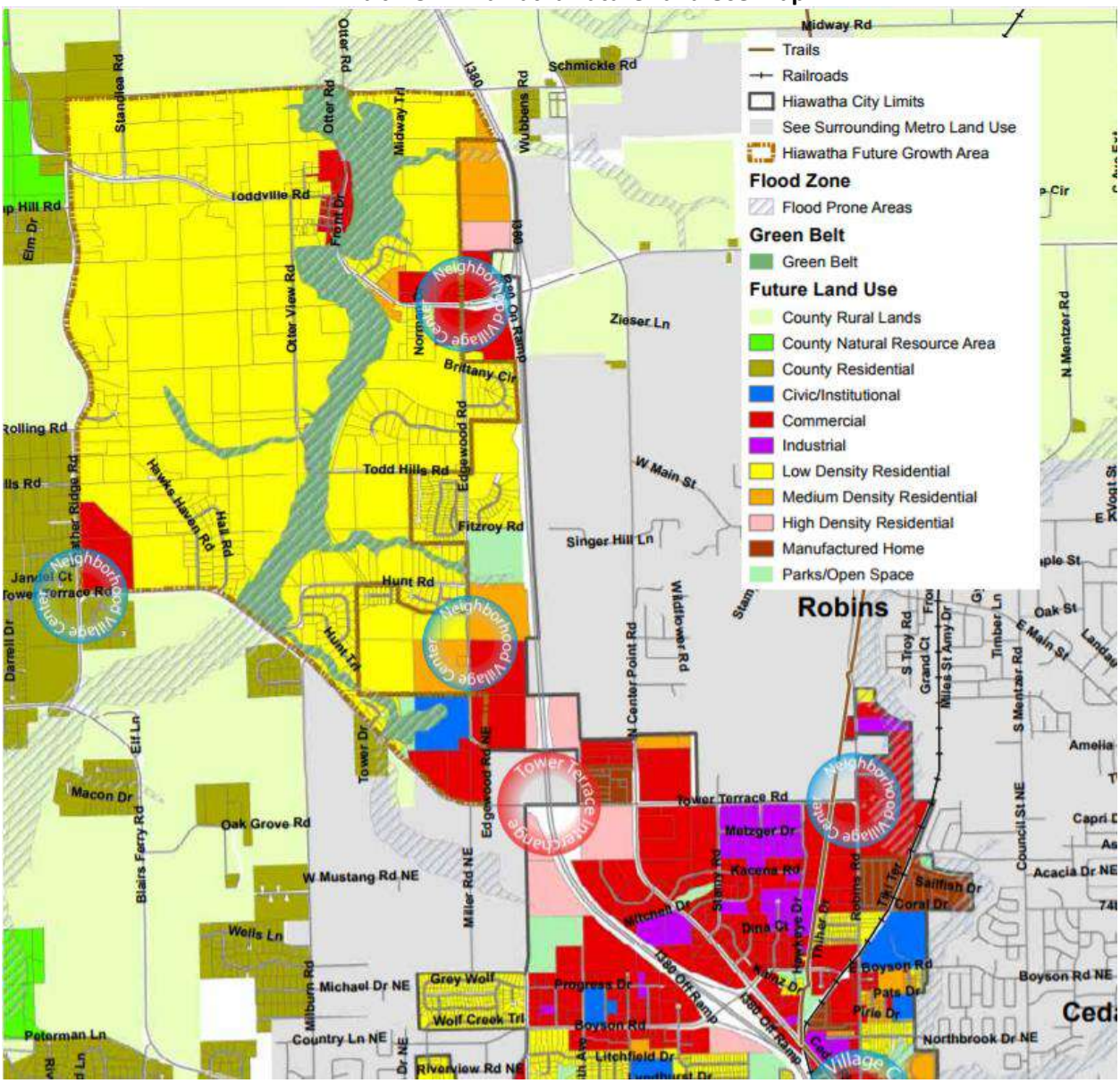
Project	LRTP	TIP	STIP
Tower Terrace Interchange	X	X	X
Boyson Road Interchange		X	X
I-380 Widening	X		

Sources: MPOJC, Corridor MPO, Iowa DOT

An interchange at Tower Terrace and widening on I-380 are part of the fiscally constrained list of projects for FY 2020 – 2024 in the Long-Range Transportation Plan (projects 41 and 42). The Boyson Road interchange project is being included in the July 2018 update of the LRTP. The Tower Terrace interchange and Boyson Road interchange are both listed in Corridor MPO's FY 2018 – 2021 TIP and in the Iowa 2018 – 2021 Statewide Transportation Improvement Plan (STIP) (projects 36940 and 34204).

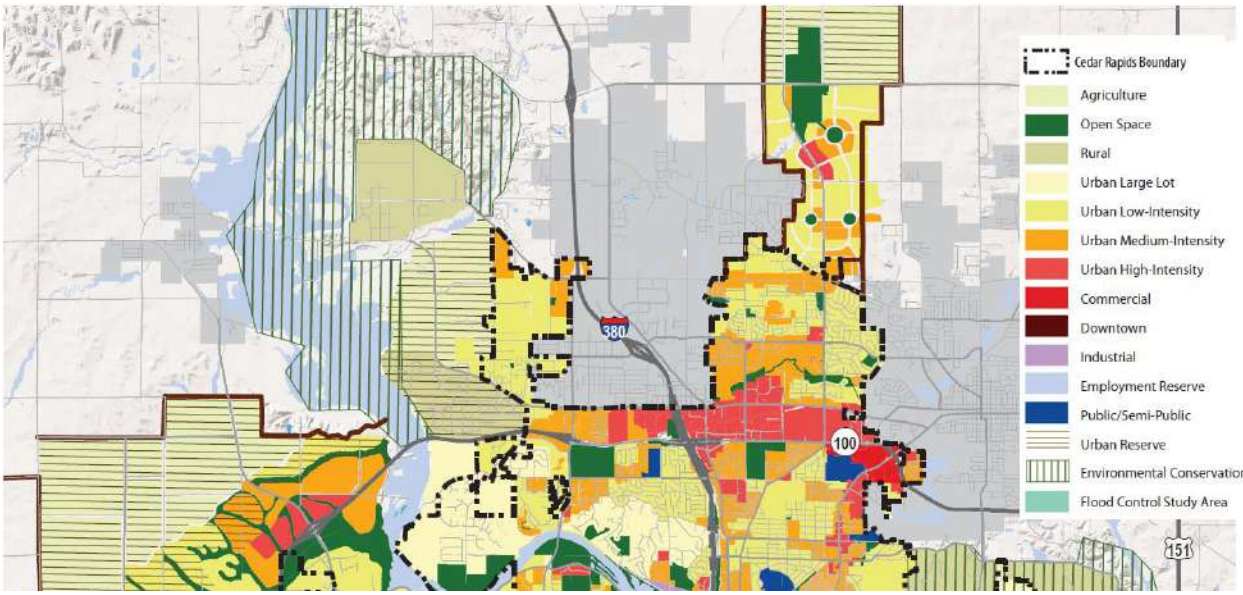
Exhibits 2.5-1 and 2.5-2 show the future land use for Hiawatha and Cedar Rapids. The maps show a mix of high and medium density residential surrounding the interchange and pockets of commercial surrounding the rest of Tower Terrace Road. At Boyson Road, the land surrounding the interchange is mostly commercial development with some residential to the southwest.

Exhibit 2.5-1: Hiawatha Future Land Use Map



Source: City of Hiawatha Comprehensive Plan 2036

Exhibit 2.5-2: Cedar Rapids Future Land Use Map



Source: Envision CR

2.5.2 Policy Statement Five Summary

Improvements at Tower Terrace Road and along I-380 are included in the Corridor MPO LRTP. The Boyson Road interchange project is being included in the July update of the LRTP. Improvements at Tower Terrace Road and Boyson Road are included in the fiscally constrained TIP and STIP. There are no issues with the future land use designations within the study area corridor. Requirements for Policy Statement Five have been met.

2.6 FHWA Policy Statement Six

In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan (23 U.S.C. 109(d), 23 CFR 625.2(a), 655.603(d), and 771.111).

2.6.1 Policy Statement Six Summary

There are no planned interchange additions within the corridor besides the proposed interchange at Tower Terrace Road. The AASHTO standard for interchange spacing is one mile in urban areas and two miles in rural areas. The proposed interchange at Tower Terrace Road will comply with the AASHTO standard for urban interchanges. Any proposed new interchanges south of Tower Terrace Road would be in non-compliance with the urban interchange standards. There are no plans or discussions of adding another interchange within or immediately outside the project study area. Requirements for Policy Statement Six have been met.

2.7 FHWA Policy Statement Seven

When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements (23 CFR 625.2(a) and 655.603(d)). The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point (23 CFR 625.2(a) and 655.603(d)).

2.7.1 Required Local System Improvements

There are no developments occurring around the proposed interchange at Tower Terrace Road that would require coordination between the Iowa DOT and a private developer. Coordination has taken place between the Iowa DOT and the surrounding municipalities. This coordination is reflected in the Environmental Assessment (EA) that has been developed in concurrence with this IJR.

2.7.2 Local Agency Commitment

The City of Hiawatha is supportive of the proposed interchange at Tower Terrace Road. The city has plans to make improvements to Tower Terrace Road from the eastern terminus of the proposed interchange to Center Point Road. These improvements will be completed in coordination with the interchange project. Also, there are plans to develop Tower Terrace Road east of Center Point Road that are identified in the Corridor MPO's Long-Range Transportation Plan (LRTP). The City of Hiawatha has applied to the Corridor MPO for funding for its respective segments of Tower Terrace Road.

2.7.3 Policy Statement Seven Summary

No coordination is needed between the Iowa DOT and any local developers. The Iowa DOT has an agreement with the City of Hiawatha for the City to reconstruct Tower Terrace Road from east of the proposed interchange to Center Point Road. Requirements for Policy Statement Seven have been met.

2.8 FHWA Policy Statement Eight

The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing (23 CFR 771.111).

2.8.1 Environmental Process

An EA is being developed concurrent with the IJR for the proposed improvements at Tower Terrace Road and Boyson Road and along I-380. The proposed improvements in the EA are within the same boundaries. A public hearing is anticipated in Q3 of 2018 and a decision on the EA and IJR are expected by Q4 of 2018.

The surrounding communities of Cedar Rapids, Hiawatha and Robins are supportive of the proposed interchange at Tower Terrace Road and reconfiguration of the Boyson Road interchange. More information on the public coordination can be found in the EA.

2.8.2 Policy Statement Eight Summary

A decision on the EA and IJR are expected by Q4 of 2018. Stakeholder opinion regarding the improvements within the study area are in favor of the upgrades. The requirements for Policy Statement Eight have been met.

3.0 Conclusions and Recommendations

The proposed interchange at Tower Terrace Road, plus the associated improvements at the Boyson Road interchange and widening of I-380 to six lanes, satisfy the requirements of the FHWA policy concerning access to the interstate. The improvements are justified because they fulfill the project's purpose and need. The Preferred Alternative will:

- Improve traffic operations at existing interchanges on I-380;
- Accommodate future traffic growth in the study area;
- Address geometric deficiencies; and
- Support regional travel needs for planned economic development and land use.

Below is a summary of all the IJR policy statements.

Policy Statement One

Interstate 380 at Boyson Road, as it exists today, is operating at a suboptimal level. Crash data collected for the study area revealed that most of the study area is below the statewide crash average in terms of number of crashes. There were areas, however, that exceed the fatal crash rate. Unless improvements are made to the system, operations within the I-380 study area will decay prior to 2040. Improvements must be made within the I-380 study area to ensure adequate operations and maintain safe roadways.

Policy Statement Two

Five build alternatives were selected for consideration as the Preferred Alternative. The Preferred Alternative will be selected based on a defined set of evaluation factors which will be measured using LOS, peak hour volume and predicted crash rates. Alternative transportation solutions such as TSM, TDM and multimodal will not satisfy the project's purpose and need alone; however, these solutions will not be precluded with any proposed action.

Policy Statement Three

Build Alternative Five B was selected as the Preferred Alternative. This alternative has the best overall operational performance out of any of the other alternatives. The addition of the Tower Terrace Road interchange will increase the total number of crashes in the study area compared to the no-build alternative. However, the total number of crashes at every other interchange in the study area besides Tower Terrace Road goes down compared to the no-build. A conceptual signing plan of the Preferred Alternative can be found in **Appendix B**.

Policy Statement Four

The proposed design accommodates all turning movements at both the Tower Terrace and Boyson interchanges. On I-380, a design exception will be likely at the Emmons Street overpass and a design variance will be likely at the Blairs Ferry Road overpass.

Policy Statement Five

Improvements at Tower Terrace Road and along I-380 are included in the Corridor MPO LRTP. The Boyson Road interchange project is being included in the July update of the LRTP. Improvements at Tower Terrace Road and Boyson Road are included in the fiscally constrained TIP and STIP. There are no issues with the future land use designations within the study area corridor.

Policy Statement Six

There are no planned interchange additions within the corridor besides the proposed interchange at Tower Terrace Road. The AASHTO standard for interchange spacing is one mile in urban areas and two miles in rural areas. The proposed interchange at Tower Terrace Road will comply with the AASHTO standard for urban interchanges. Any proposed new interchanges south of Tower Terrace Road would be in non-compliance with the urban interchange standards. There are no plans or discussions of adding another interchange within or immediately outside the project study area.

Policy Statement Seven

No coordination is needed between the Iowa DOT and any local developers. The Iowa DOT has an agreement with the City of Hiawatha for the City to reconstruct Tower Terrace Road from east of the proposed interchange to Center Point Road.

Policy Statement Eight

A decision on the EA and IJR are expected by Q4 of 2018. Stakeholder opinion regarding the improvements within the study area are in favor of the upgrades.

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Date
8/15/2017

To
Dan Zeimen, Iowa DOT

From
Joe Blasi, PE, HNTB Corporation

PROJECT CORRESPONDENCE

Subject
Tower Terrace – VISSIM Model Development & Calibration

Traffic models were built using VISSIM software (version 8) to simulate existing AM and PM peak hour travel conditions. When properly calibrated, traffic models can ultimately test traffic operations for future roadway configurations. The AM and PM peak hour models that have been evaluated are for use with the Tower Terrace Road Interchange Justification Report (IJR). The study area boundaries consist ofthe following limits:

- South: the entirety of the Blairs Ferry Road interchange with I-380;
- North: the entirety of the County Home Road interchange with I-380;
- West: the Loggerhead Road, Miller Road/Edgewood Road corridor from County Home Road to Boyson Road, and;
- East: Center Point Road corridor from County Home Road to Boyson Road.

The limits for the microsimulation analysis are more expansive in the southern limits compared to the analysis area defined above. For the microsimulation analysis, the southern limit is the entirety of Glass Road/32nd Street interchange with I-380. The reason for this is to accurately capture the traffic conditions at the southern limits of the study area. The Iowa DOT is meeting its obligation to study a minimum of one interchange upstream and downstream from a proposed interchange. However, the closely-spaced interchanges beyond the southern limits have the potential of affecting traffic flows in and out of the study area. Therefore, the decision was made to expand the southern limits of the microsimulation modeling and forecasting.

The model duration was determined by analyzing volumes provided by the Iowa DOT. It was determined that most of the peak morning and afternoon traffic occurs over the course of one hour. Therefore, the peak period that was simulated in VISSIM was 7:00 a.m. to 8:00 a.m. and 5:00 p.m. to 6:00 p.m. A 15 minute seeding period was added to each a.m. and p.m. model, making the model duration 1 hour and 15 minutes.

Calibration measures and targets are listed below. Results from the VISSIM calibration are also listed in individual sections below. Measures and targets follow guidance from the FHWA's July 2004 Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software (particularly Chapter 5, Table 4 (p.64) Calibration Targets). The measures include:

- Travel Times within 15% or one minute in at least 85% of cases
- Vehicle spot speeds within 10% in 85% of cases
- Volumes within 15% for volumes between 700 and 2700 vehicles per hour, within 100 vehicles per hour for volumes under 700 and within 400 vehicles per hour for volumes above 2700 in 85% of cases
- GEH of volumes less than 5 in 85% of cases
- Summation of entering and exiting volumes within 5%u
- Lane utilization within 15%
- Headways/Saturation Flow Rates within 15% in 85% of cases
- Queues lengths representative of those observed in the field

The following data was collected to build the existing VISSIM models:

- Existing traffic counts
- Signal timing plans
- Spot speeds and lane utilization on mainline I-380
- Travel times on mainline I-380 using INRIX software
- Field observation notes such as saturation flow rates, queues, signal operations and travel times

Once built, both AM and PM models were calibrated to reflect existing traffic conditions. The calibration that was conducted was verified using three sets of data: travel times from the field and from INRIX, speeds, existing volumes, lane utilization, and saturation flow rate. This was completed following guidance from the FHWA's July 2004 *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software* (particularly Chapter 5, Table 4 (p.64) Calibration Targets). The sections below detail the steps taken to achieve acceptable calibration thresholds.

Travel Time

Travel time data collected from field observations and INRIX software was compared to the VISSIM model output data at similar split locations on the network. Travel time runs were conducted in the field on three separate days during the peak periods. Each travel time segment was run at least three times in each direction in both the AM and PM peak periods. Because the freeways operate at near free-flow conditions with little variability, the runs were sufficient to meet a 95% confidence interval of +/- 10% of the mean travel time. The floating car method was the technique used while collecting data. The floating car method is a way of ensuring that prevailing speed is matched in the vehicle being used to collect data. This is

accomplished by making sure that the amount of passing done by the vehicle collecting data is equivalent to the amount of times it is being passed by other vehicles. The initial model run showed that the VISSIM travel times were longer than the observed travel times collected in the field, meaning that vehicle speeds needed to be increased in VISSIM. When the VISSIM model was first built the desired speed parameters were set to match the posted speeds which are 70 MPH from approximately Tower Terrace Road north and 60 MPH from Tower Terrace Road south on the mainline I-380.

Upon further review and clarification from the data collectors in the field, there were noticeable differences in the posted speeds and the speeds driven during the travel time runs and seen at the spot speed checkpoints. Therefore, the speeds of both the 70 MPH and the 60 MPH desired speed parameters were adjusted to better reflect the speeds seen in the field. This raised the average speed to where 50% of vehicles were traveling the posted speed instead of the assumed 85%.

Tables A and B compare the difference between the travel time field data and what the AM and PM models are showing after being calibrated. The calibrated models satisfy the calibration criteria with travel times within 15% or one minute of the field-measured travel times and INRIX travel times, meeting the Traffic Analysis Toolbox model calibration criteria. Like the field travel time runs and the VISSIM model results, the INRIX data shows near free-flow speeds during the peak hours.

Table A – AM Calibrated Travel Times

Location	Field Data		VISSIM Output		Difference			Calibration Check
	Travel Time (sec)	Speed (MPH)	Travel Time (sec)	Speed (MPH)	% Travel Time	Travel Time (sec)	Speed (MPH)	
I-380 NB Glass to County Home	312.30	66.1	312.10	66.2	-0.07%	-0.20	0.04	OK
I-380 SB County Home to Glass	307.13	65.9	321.28	63.0	4.61%	14.15	-2.90	OK

Table B – PM Calibrated Travel Times

Location	Field Data		VISSIM Output		Difference			Calibration Check
	Travel Time (sec)	Speed (MPH)	Travel Time (sec)	Speed (MPH)	% Travel Time	Travel Time (sec)	Speed (MPH)	
I-380 NB Glass to County Home	312.44	66.1	333.24	62.0	6.66%	20.80	-4.12	OK
I-380 SB County Home to Glass	290.04	69.8	316.76	63.9	9.21%	26.72	-5.89	OK

Speed

Spot speed data collected from Wavetronics data collection recorders was compared to the VISSIM model output data at similar locations on the network (*Tables C and D*). The difference between model speeds and field collection speeds were within a 0-5% range in both the AM and PM peak periods, satisfying the calibration criteria. The target for calibration is all spot speeds within 10% which was met.

Table C – AM Travel Speed

Corridor	Location	Direction	Data Collection ID	Field Speed	Average VISSIM Speed	Percent Difference	Calibration Check
I-380	Glass Road	NB	10	65	63	-2.51%	OK
		SB	20	58	60	3.98%	OK
	Boyson Road	NB	30	70	69	-2.12%	OK
		SB	40	70	68	-2.87%	OK

Table D– PM Travel Speed

Corridor	Location	Direction	Data Collection ID	Field Speed	Average VISSIM Speed	Percent Difference	Calibration Check
I-380	Glass Road	NB	10	65	62	-5.24%	OK
		SB	20	63	61	-3.15%	OK
	Boyson Road	NB	30	70	67	-4.86%	OK
		SB	40	71	69	-2.99%	OK

Volumes

VISSIM model volumes were compared to balanced peak hour traffic counts collected by the Iowa DOT and the cities of Hiawatha and Cedar Rapids. The traffic volumes are consistent between the simulation and data collected in the field, with 99% of the AM and 98% of the PM (goal was >85%) volumes meeting the calibration criteria.

The GEH statistic considers the absolute difference and percent difference between modeled and observed traffic flows. In the AM, 96% of intersection movements meet GEH standards, with a global GEH of 0.41. In the PM, 96% of intersection movements meet GEH standards with a global GEH of 1.76. The target for calibration is a global GEH statistic less than 5.0 which is considered a good match.

Lane Utilization

Lane utilization percentages were used to achieve the correct lane changing behavior within the Vissim model. Observed field volumes and simulated model volumes were used to determine the percentage of vehicles using each lane at two locations – Glass Road and Boyson Road – in the AM and PM peaks (*Tables E and F*). The difference between field and model volume percentages of each lane in the northbound and southbound directions were within a range of 0-14%, meeting calibration criteria of less than 15%. Connector lane change distances were adjusted to achieve calibration.

Table E – AM Lane Utilization

Lane Utilization					
Segment	Lane	Field Volume	Model Volume	Percent Difference	Calibration Check
Glass Rd NB	1	41.7%	51.0%	9.2%	OK
Glass Rd NB	2	33.8%	30.0%	-3.8%	OK
Glass Rd NB	3	24.5%	19.0%	-5.5%	OK
Glass Rd SB	1	34.2%	33.9%	-0.4%	OK
Glass Rd SB	2	35.2%	34.4%	-0.8%	OK
Glass Rd SB	3	30.6%	31.8%	1.2%	OK
Boyson Rd NB	1	68.3%	54.5%	-13.9%	OK
Boyson Rd NB	2	31.7%	45.5%	13.9%	OK
Boyson Rd SB	1	56.5%	51.9%	-4.6%	OK
Boyson Rd SB	2	43.5%	48.1%	4.6%	OK

Table F– PM Lane Utilization

Lane Utilization					
Segment	Lane	Field Volume	Model Volume	Percent Difference	Calibration Check
Glass Rd NB	1	40.5%	45.0%	4.5%	OK
Glass Rd NB	2	32.1%	32.5%	0.4%	OK
Glass Rd NB	3	27.4%	22.5%	-4.9%	OK
Glass Rd SB	1	33.7%	33.2%	-0.5%	OK
Glass Rd SB	2	38.2%	34.6%	-3.5%	OK
Glass Rd SB	3	28.1%	32.2%	4.0%	OK
Boyson Rd NB	1	52.2%	57.0%	4.9%	OK
Boyson Rd NB	2	47.8%	43.0%	-4.9%	OK
Boyson Rd SB	1	66.0%	53.0%	-13.1%	OK
Boyson Rd SB	2	34.0%	47.0%	13.1%	OK

Saturation Flow Rates

Saturation flow rates look at the average number of seconds it takes a vehicle to clear an intersection per lane and approximates the vehicles per hour (VPH) that could theoretically clear an intersection in an all-green, saturated condition. Calibration for the AM and PM models was conducted by comparing the saturation flow rates at intersections in the field to the same intersections in VISSIM.

Field data collected in the AM and PM peak hours show similar saturation flow rates of 1550 - 1650 vehicles per hour. The additive and multiplicative part of safety distances are values used to compute the desired safety distance between vehicles. An increase in these values over the default values simulates more conservative drivers that leave greater distance between vehicles. *Table's G and H* show how the adjustment of both factors affected the saturation flow rate in VISSIM. After appropriate saturation flow levels were achieved in the AM the same factors were applied in the PM model and then validated. For the calibrated model the additive part of safety distance was chosen at 1.50 and the multiplicative part was 2.50; this yielded reasonable results in both the AM & PM Peak Hour models.

Table G– AM Saturation Flow Rates

Vissim Output weighted Average	Additive Part of Safety Distance	Multiplicative Part of Safety Distance	Boyson & Center Point		Blair's Ferry & Center Point		Target		
			Sec/Veh	VPH	Sec/Veh	VPH	VPH	Difference	% Diff
AM Run 1 Summary	2.00	3.00	2.33	1543.38	2.11	1702.66	1668.14	-45.12	-2.7%
AM Run 2 Summary	1.50	2.50	2.32	1549.49	2.07	1737.32	1668.14	-24.74	-1.5%
AM Run 3 Summary	1.00	2.00	2.32	1551.59	2.02	1780.55	1668.14	-2.07	-0.1%
AM Run 4 Summary	0.50	1.50	2.14	1681.27	1.89	1901.00	1668.14	123.00	7.4%
AM Run 5 Summary	0.90	1.90	2.24	1604.29	2.01	1793.95	1668.14	30.98	1.9%
AM Run 6 Summary	0.99	1.99	2.25	1598.22	1.96	1836.88	1668.14	49.41	3.0%
AM Run 7 Summary	1.10	2.10	2.28	1580.75	2.12	1701.02	1668.14	-27.26	-1.6%
AM Run 8 Summary	1.00	2.00	2.32	1551.59	2.02	1780.55	1668.14	-2.07	-0.1%

Table H – PM Saturation Flow Rates

Vissim Output weighted Average	Additive Part of Safety Distance	Boyson & Center Point			Blair's Ferry & Center Point		Target		
		Multiplicative Part of Safety Distance	Sec/Veh	VPH	Sec/Veh	VPH	VPH	Difference	% Diff
PM Run 1 Summary	1.00	2.00	2.21	1625.48	1.67	2161.53	1667.21	226.30	13.6%
PM Run 2 Summary	1.50	2.50	2.39	1509.37	1.73	2075.35	1667.21	125.16	7.5%
PM Run 3 Summary	2.00	3.00	2.19	1644.79	1.84	1960.13	1667.21	135.25	8.1%
PM Run 4 Summary	2.00	3.00	2.19	1644.79	1.84	1960.13	1667.21	135.25	8.1%

Conclusion

Travel times, traffic volumes, speeds, lane utilization and saturation flow rates meet the defined calibration targets; the model is appropriately calibrated. *Table I* provides a summary of parameters that were changed from the default values. For a detailed explanation of each of the values below, refer to the above sections.

Table I – Calibration Values

Parameter	Default Value	New Value
Additive Part of Safety Distance	2.0	1.5
Multiplicative Part of Safety Distance	3.0	2.5
Speed Distribution	100	2, 90*
Lane Change Distance	656.2	5,280**

*Values are based on varying percent's of vehicles driving within the same speed range

**Maximum distance for select Freeway segments

Midway Road

EXIT 28
E34
Toddville
Robins
1 MILE

INTERSTATE
380
27

Wiklup Hill
Outdoor
Learning Area
EXIT 28

FEET
0 500 1000

EXIT 28
E34
Toddville
Robins

County Home Road

EXIT
28

County Home Rd

EXIT
28

EXIT 28
E34
Toddville
Robins
EXIT ONLY
OVERHEAD

Cedar Rapids 4

Wiklup Hill
Outdoor
Learning Area
EXIT 28

EXIT 26
Tower Terrace
Road
1 MILE

EXIT 28
E34
Toddville
Robins
1 MILE
EXIT ONLY
OVERHEAD

Hiawatha
NEXT 3 EXITS

INTERSTATE
380
27

EXIT 26
Tower Terrace
Road

EXIT
26

EXISTING DMS

Hiawatha

Tower Terrace Rd

Tower Terrace Road

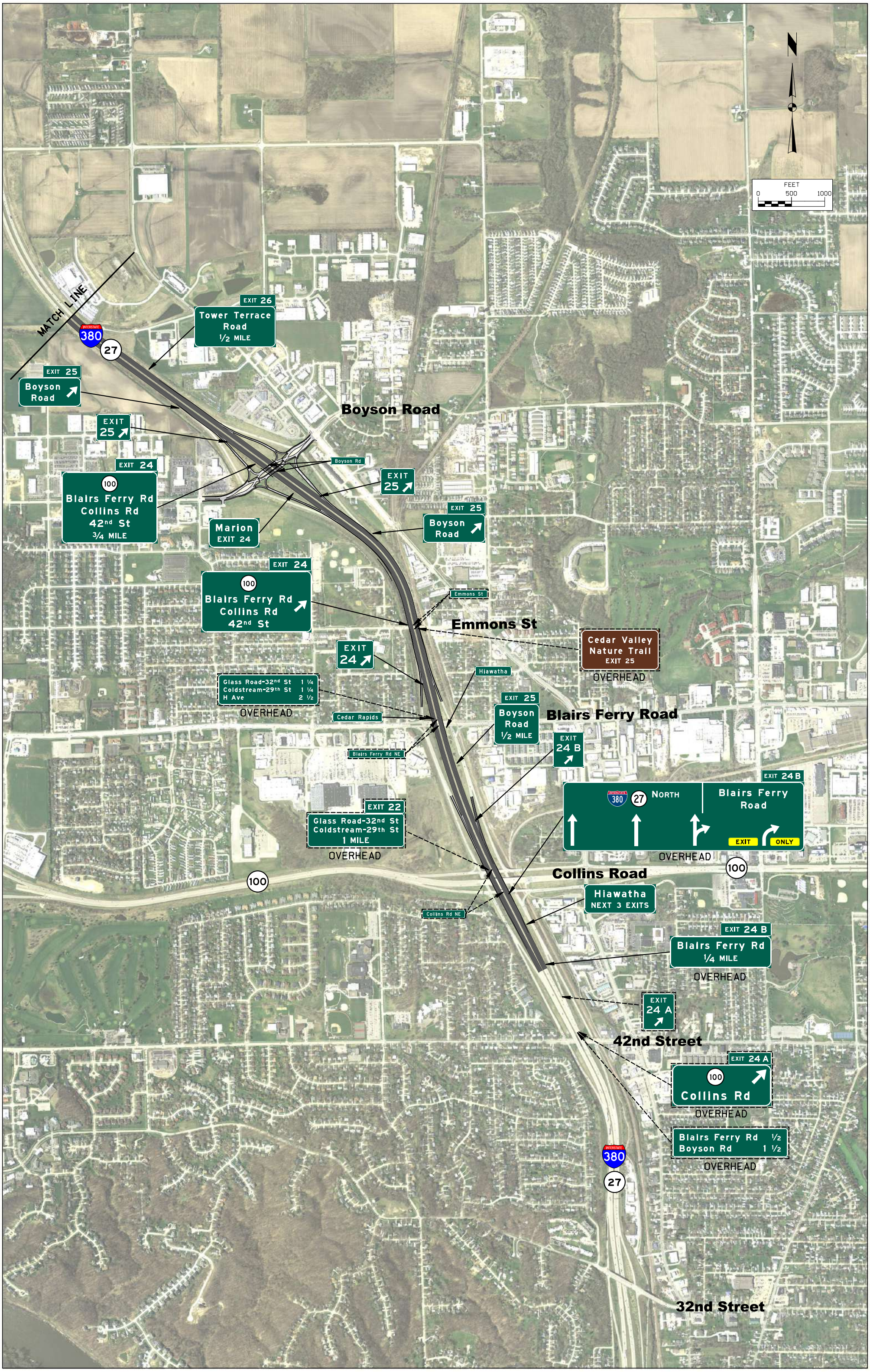
EXIT
26

Cedar Valley
Nature Trail
EXIT 25

EXIT 26
Tower Terrace
Road

EXIT 25
Boyson
Road
½ MILE

MATCH LINE

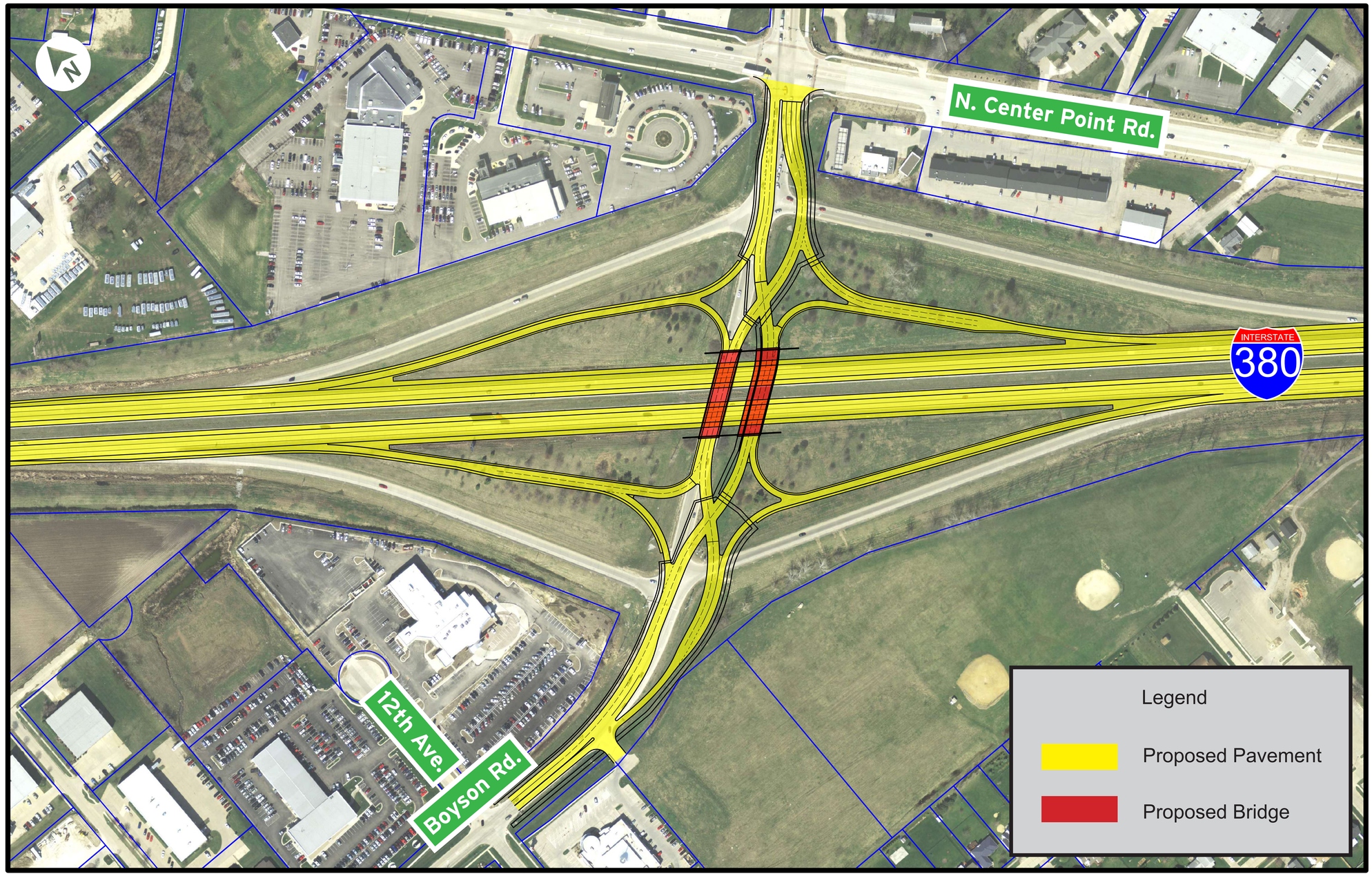

N
FEET
0
500
1000
MATCH LINE
INTERSTATE 380
27
EXIT 26
Tower Terrace Road
1/2 MILE
EXIT 25
Boyson Road
Boyson Road
EXIT 25
Boyson Rd
EXIT 24
100
Blairs Ferry Rd
Collins Rd
42nd St
3/4 MILE
Marion
EXIT 24
EXIT 25
Boyson Road
EXIT 24
100
Blairs Ferry Rd
Collins Rd
42nd St
Emmons St
Emmons St
Cedar Valley Nature Trail
EXIT 25
OVERHEAD
EXIT 24
Glass Road-32nd St 1 1/4
Coldstream-29th St 1 1/4
H Ave 2 1/2
OVERHEAD
Hiawatha
EXIT 25
Boyson Road
1/2 MILE
Blairs Ferry Road
Cedar Rapids
Blairs Ferry Rd NE
EXIT 24 B
EXIT 24 B
INTERSTATE 380
27
NORTH
Blairs Ferry Road
EXIT
ONLY
OVERHEAD
EXIT 22
Glass Road-32nd St
Coldstream-29th St
1 MILE
OVERHEAD
100
Collins Road
Hiawatha
NEXT 3 EXITS
Collins Rd NE
EXIT 24 B
Blairs Ferry Rd
1/4 MILE
OVERHEAD
EXIT 24 A
42nd Street
EXIT 24 A
100
Collins Rd
OVERHEAD
Blairs Ferry Rd 1/2
Boyson Rd 1 1/2
OVERHEAD
INTERSTATE 380
27
32nd Street

I-380 Improvements

in Linn County

Concept Displays - Boyson Road

Diverging Diamond Interchange Alternative 1



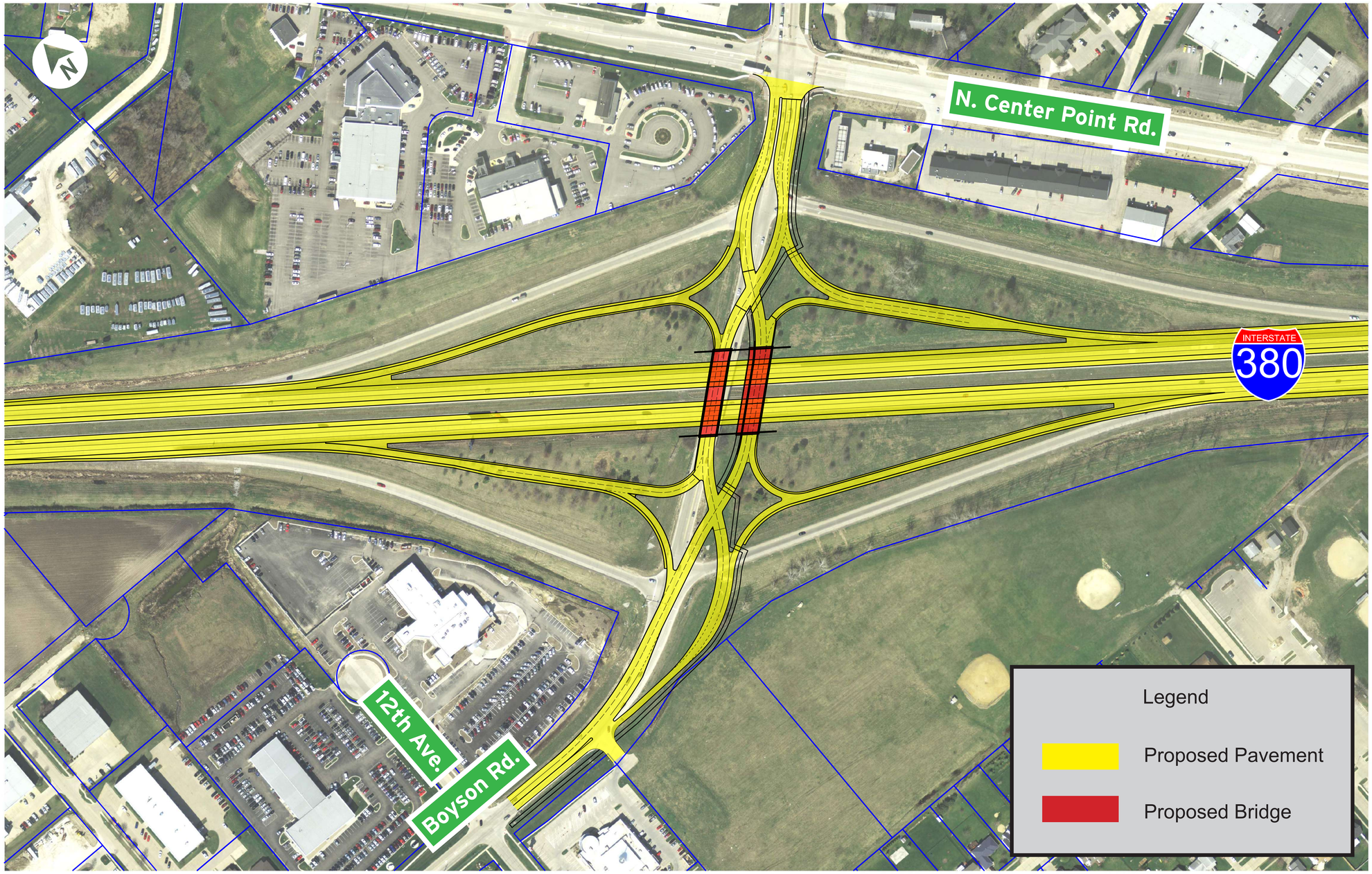
Aerial: 2008

PIM Date: 11/16/2017
Project Number: IM-380-6(224)25-13-57

IOWA DOT

Concept Displays - Boyson Road

Diverging Diamond Interchange Alternative 2



Aerial: 2008

PIM Date: 11/16/2017
Project Number: IM-380-6(224)25-13-57

IOWA DOT

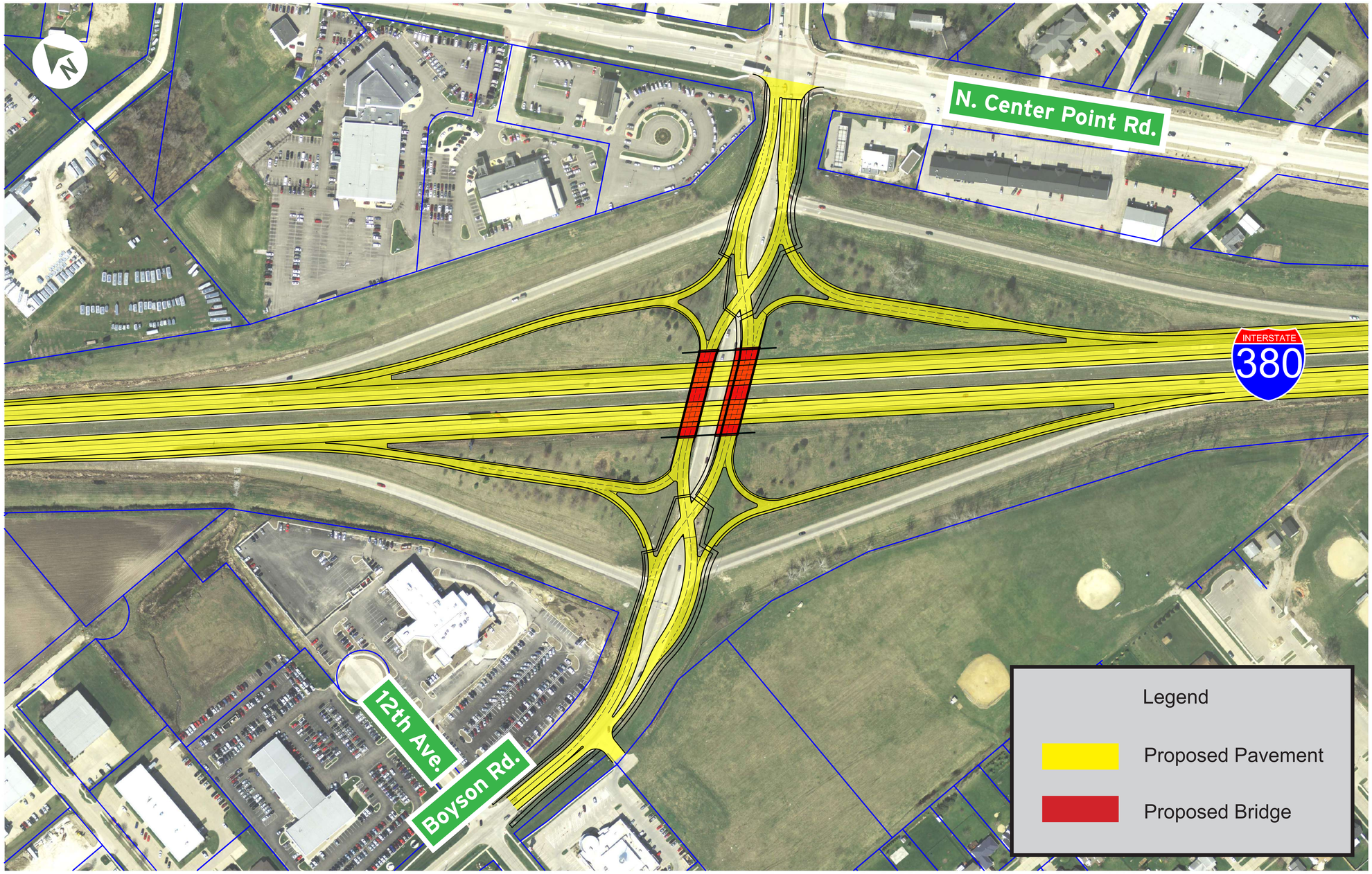
I-380 Improvements in Linn County

I-380 Improvements

in Linn County

Concept Displays - Boyson Road

Diverging Diamond Interchange Alternative 3



Aerial: 2008

PIM Date: 11/16/2017

Project Number: IM-380-6(224)25-13-57

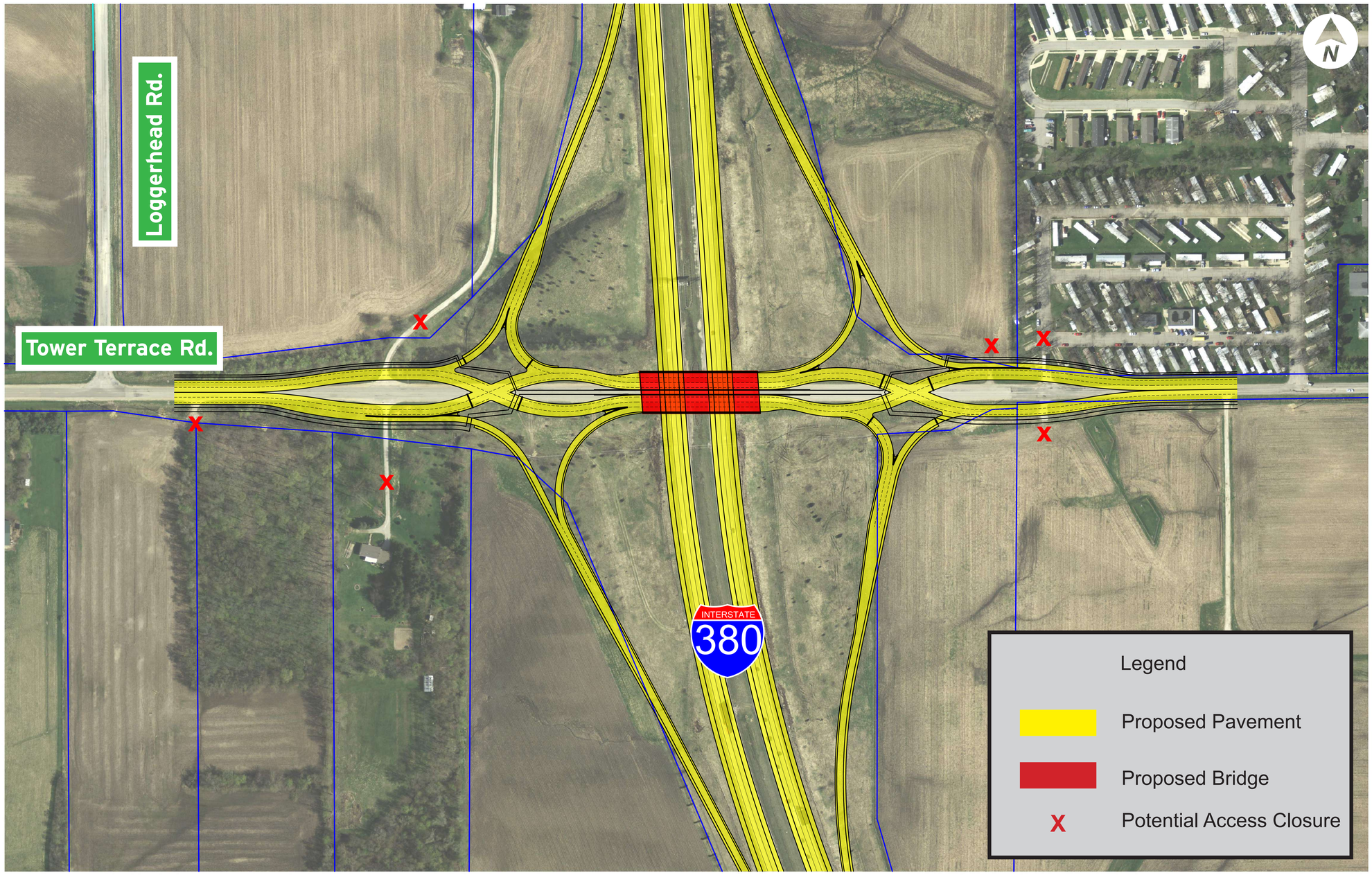
IOWA DOT

I-380 Improvements

in Linn County

Concept Displays - Tower Terrace Road

Diverging Diamond Interchange



Aerial: 2008

PIM Date: 11/16/2017

Project Number: IM-380-6(224)25-13-57

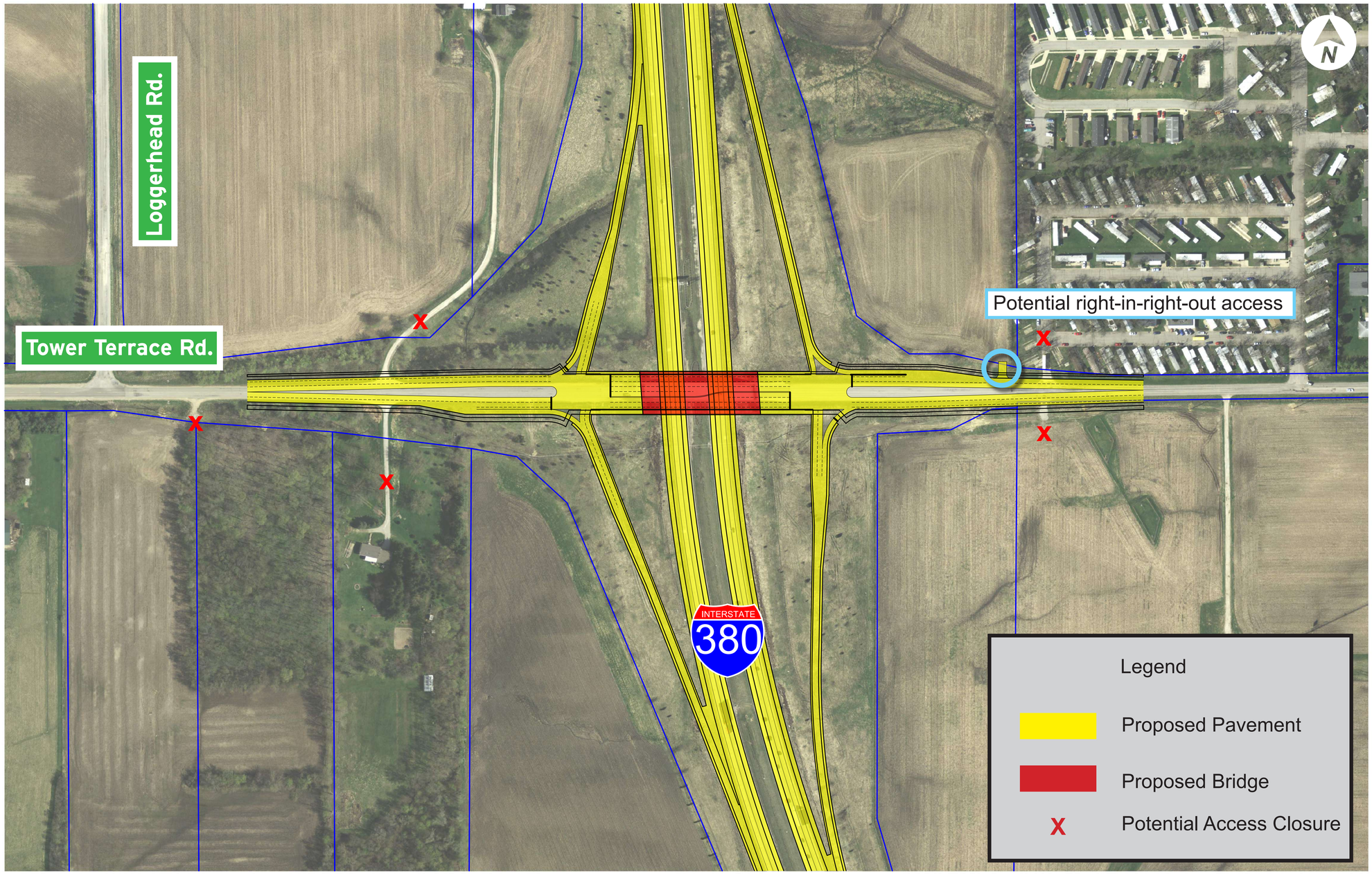
IOWA DOT

I-380 Improvements

in Linn County

Concept Displays - Tower Terrace Road

Diamond Interchange



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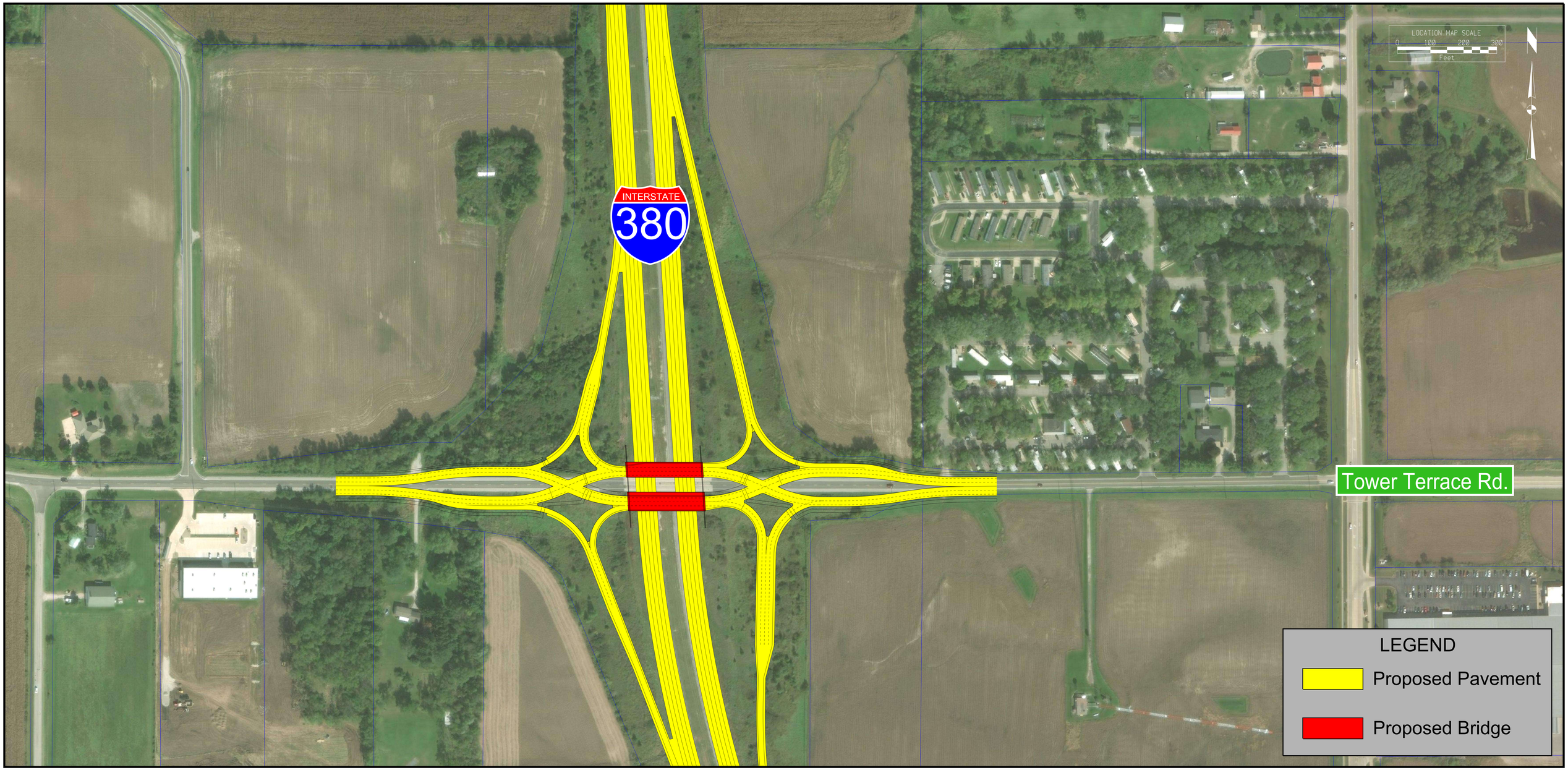
IOWA DOT


INTERSTATE
380
Tower Terrace Rd.
LOCATION MAP SCALE
0 100 200 300
Feet
LEGEND
Proposed Pavement
Proposed Bridge