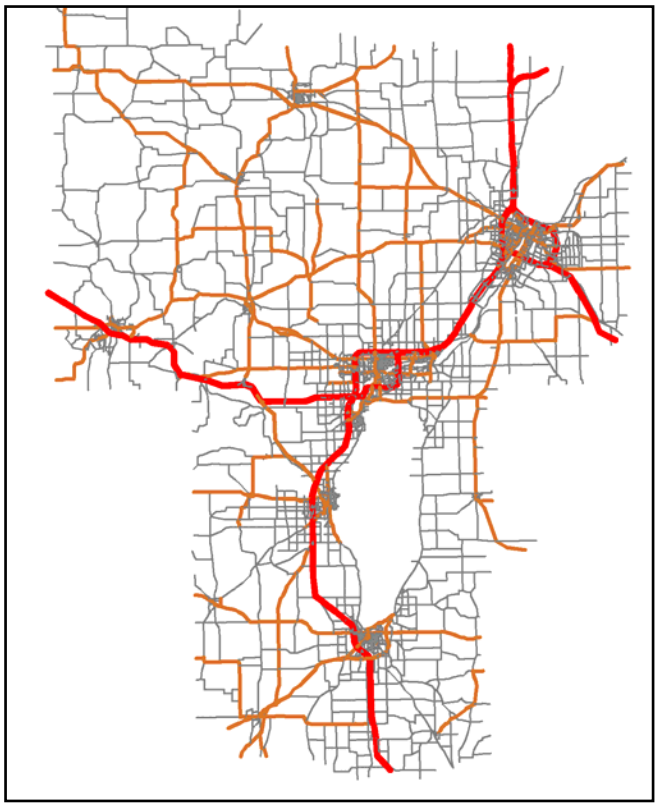
APPENDIX D: TRAVEL DEMAND MODELING OVERVIEW AND SUMMARY

The report team used the WisDOT Northeast Region Travel Demand Model (NE Region TDM) to analyze the WIS 441 corridor. Figure 1 shows the entire WIS 441 corridor in the Appleton area of the WisDOT Northeast Region. The four steps of the travel demand modeling process, trip generation, trip distribution, mode choice, and trip assignment are described in detail below.

Figure 1: NE Region TDM Area



The report team obtained the year 2005 and year 2035 socioeconomic (SE) data for each transportation analysis zone (TAZ) in the NE Region TDM using the existing metropolitan planning organization's (MPO) models for the urban areas of Green Bay, Appleton, Oshkosh, and Fond du Lac. The team used the SE data from the Wisconsin Statewide Travel Demand Model for the rural zones. By holding meetings with the municipalities, the team was able to revise and refine the collected data for a more accurate overall view. The meetings also gave the report team a more refined look at the employment information for the region that they had first estimated using statewide model information subdivided into each zone of the NE Region TDM.

The team developed SE data for year 2020 by interpolating data for years 2005 and 2035. By combining networks form the existing and urban area models, the team established the vehicle travel roadway network, and further supplemented the remaining model areas from the Wisconsin information System for Local Roads (WISLR) network.

The team used the National Household Transportation Survey (NHTS) data to establish: trip generation rates, trip distribution parameters, auto occupancy factors, and time of day factors. There are five distinct trip purposes modeled in the NE Region TDM: home to work, home to school, home to shop, home to other and non-home based trips. Two truck purposes are also modeled: single unit and combination trucks. WisDOT used the Wisconsin Statewide Travel Demand model to estimate the external-external and external-internal trips for the NE Region TDM. The team divided the external-internal trips into the internal trip purposes based on the percentage of each purpose within the internal zones in the region. The report team then used existing counts at 76 external model network stations to generate external-external trips and external-internal/internal-external trips by purpose.

The team used Trip generation rates and the socioeconomic data by TAZ to estimate the trip productions and attractions for each zone in the model. The trip distribution process matches the trip productions in each zone to the trip attractions in the other zones. Trips are distributed across the network based on travel times and travel distances between each zone pair. A zone-to-zone

pair separated by a low travel time and short travel distance will have much higher trip interaction than a zone-to-zone pair separated by high travel time and a long distance. The NHTS data provided targets for validating the trip length distributions and district-to-district movements generated during the trip distribution step.

The daily trip tables created through the distribution process are divided into four periods based on the time of day factors developed using the NHTS data and peak hour counts taken at several locations. Peak period counts collected in 2007-08 provided a validation target for the peak hour modeling.

The trips were assigned by time of day using the Bureau of Public Roads (BPR) equation and then combined to form daily trip assignments. The BPR equation calculates congested speed as a function of the road facility's volume compared to its capacity. The alpha and beta coefficients in the equation vary for each functional class, meaning the speed-flow relationship for an interstate is different from that of an arterial. The daily and period assignments were validated against the existing counts.

The transit component in Green Bay was incorporated into the NE Region TDM from the previously developed Green Bay demand model. New transit components were developed for Fox Cities and Fond du Lac. On-board surveys of transit users were used to calibrate the transit model.

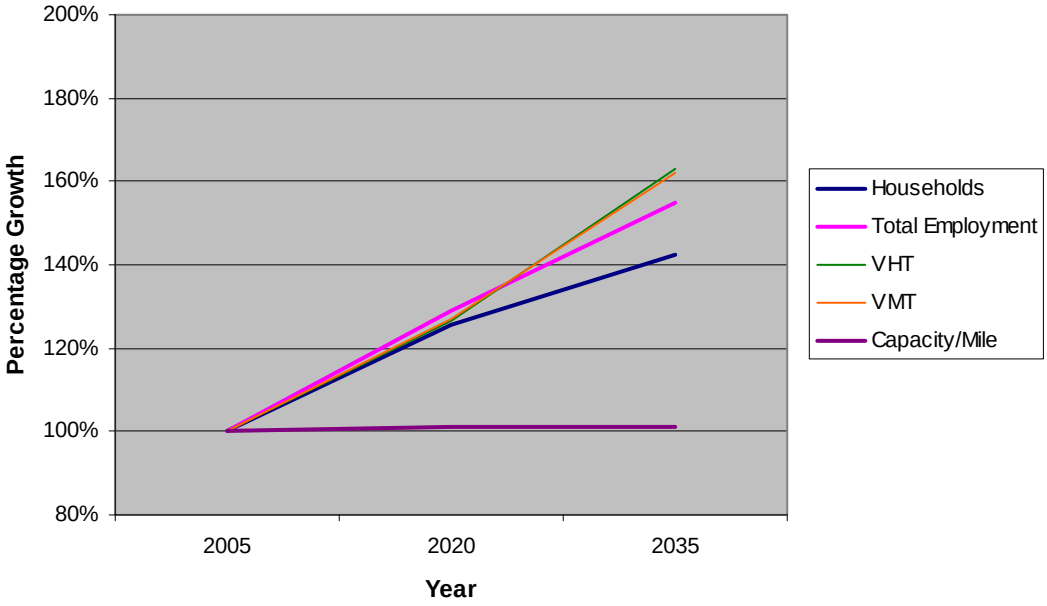
The final base year NE Region TDM was validated against the WisDOT standards for model validation. The performance of the NE Region TDM is within acceptable standards as shown in Table 1.

Table 1: Validation of NE Region Travel Demand Model

Statistical Measures	WisDOT Standard	NE Region Model
Volume to Count Ratio	+-5%	-4.2%
R-Squared	>88%	93%
Root Mean Squared Error	32 - 39%	33.6%
GEH >40	5% links or less	5% links

Figure 2 shows the growth in network and land use input parameters from 2005 to 2035 and the change in model outputs over the same time period. The graph shows the network capacity remaining relatively unchanged over time in relation to the other input parameters – housing and total employment. The housing and employment growth show similar growth trends. The model's outputs measured in Vehicle Hours Traveled (VHT) and Vehicle Miles Traveled (VMT) increase with the growth in land use and the associated traffic volumes.

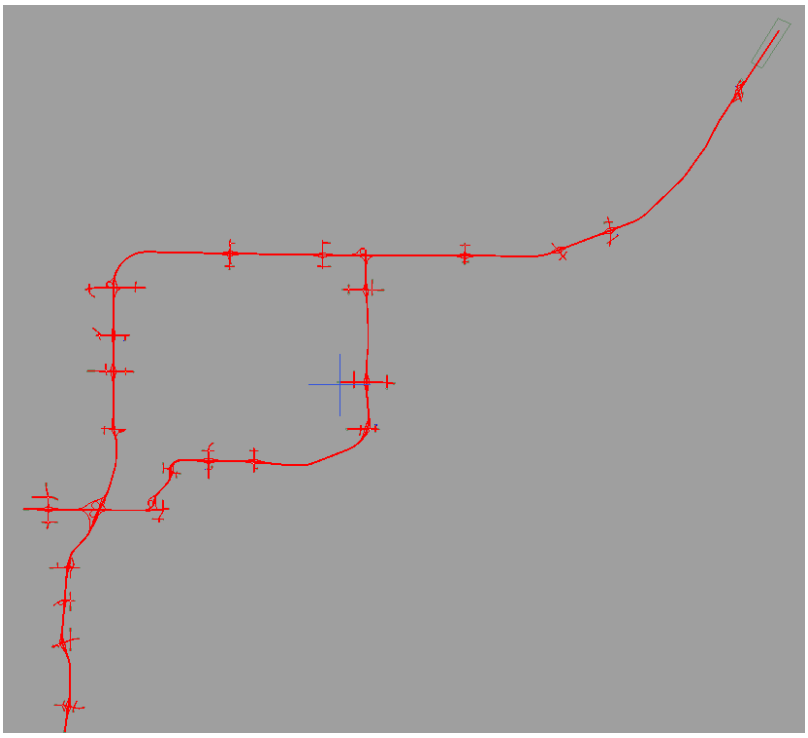
Figure 2: Growth in Input/Output Parameters from 2005-2035



The report team conducted a sub-area extraction process from the NE Region TDM to develop zone-to-zone trip tables for each peak hour and for each scenario. The sub-area trip tables are then reformatted, allowing the demand model generated subarea trip tables to be used in the estimation of travel demands for analysis using Paramics.

Paramics is a microsimulation model that simulates behavior of individual vehicles on the network with respect to road geometry, intersection control, congestion, and interaction with other vehicles. The Paramics modeling uses base and future year travel demands from the NE Region demand model to estimate the future travel demands on the transportation system. Figure 3 shows the geographic area extracted for sub-area analysis with Paramics.

Figure 3: WIS 441 Sub-area Extraction Network



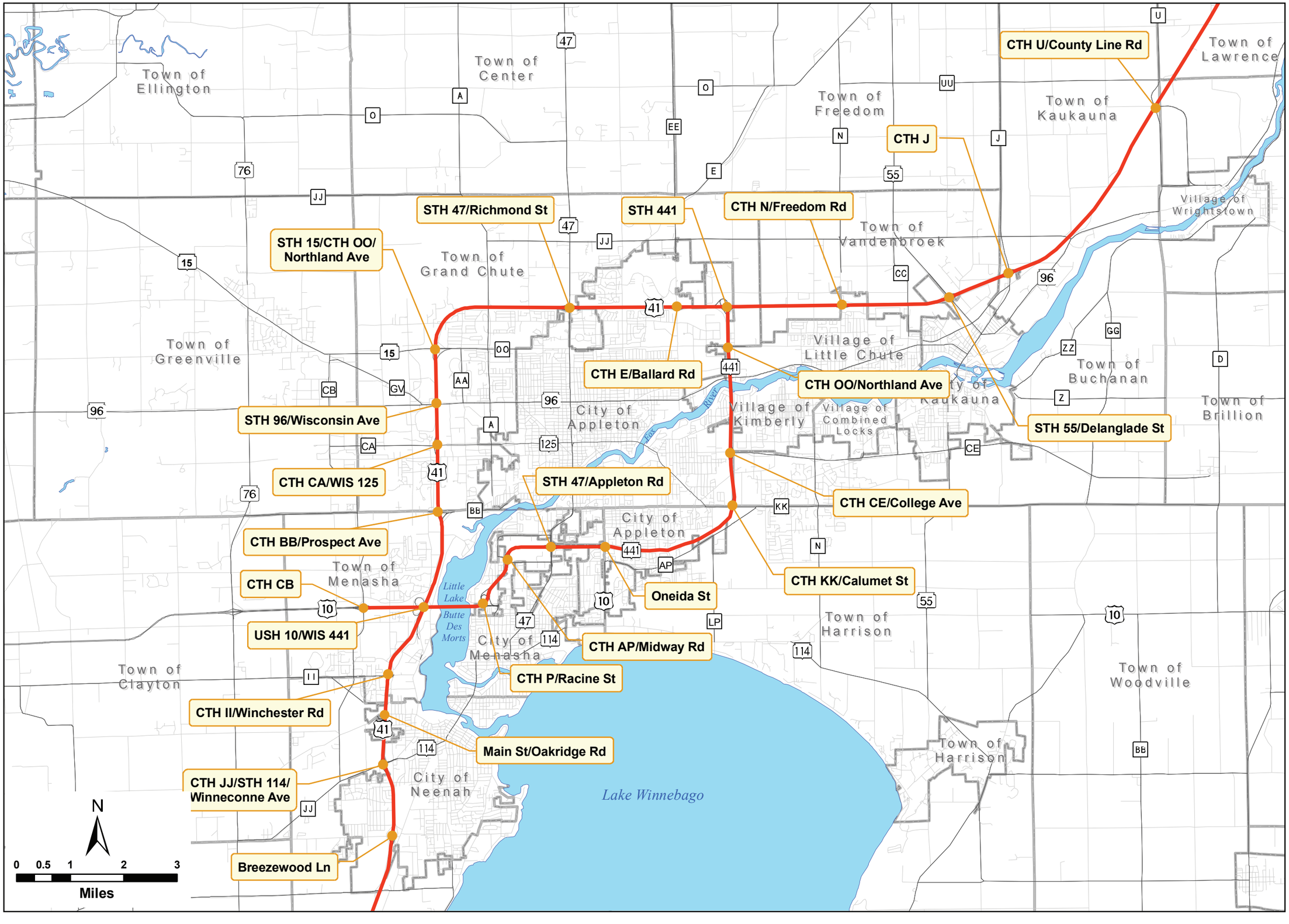
Select Link Analysis

A Select link analysis provides insight into the origins and destinations (O-Ds) of the vehicles on a specific roadway segment or node. The analysis also gives the analyst an indication of all other roadways used by the drivers on the selected roadway segment, therein providing insight into travel patterns and traffic characteristics including trip O-Ds by zones or counties, percentage of local or regional trips, trips by time of day, and trips by purpose.

The team conducted Select Link analyses at 12 locations across the US 41/WIS 441 corridor. **Exhibit D-1** identifies the chosen Select Link analysis locations. **Exhibits D-2 through D-13** show the year 2005 results of each analysis. Additional select link data is available as part of the NE Region TDM documentation, including data for years 2020 and 2035.

The NE Region TDM document further details of the overall demand modeling process for the entire region encompassing the three urban areas of Green Bay, Fond du Lac and the Fox Cities. Rural portions of ten counties, has been documented in the NE Region TDM document.

Exhibits D-14 and D-15 show the balanced link flow counts as well as balanced turning movement counts for the years 2020 and 2035. Similar data for existing roadway segments is located in **Exhibit 6** of the report.



US 41 / WIS 441
SELECTLINK ANALYSIS LOCATIONS

HNTB

Exhibit D1

Operational Needs Assessment
US 41 and WIS 441
PRELIMINARY REPORT

Sheet 1 of 1

Exhibit D-2: US 41 North of US 41/WIS 441 Interchange

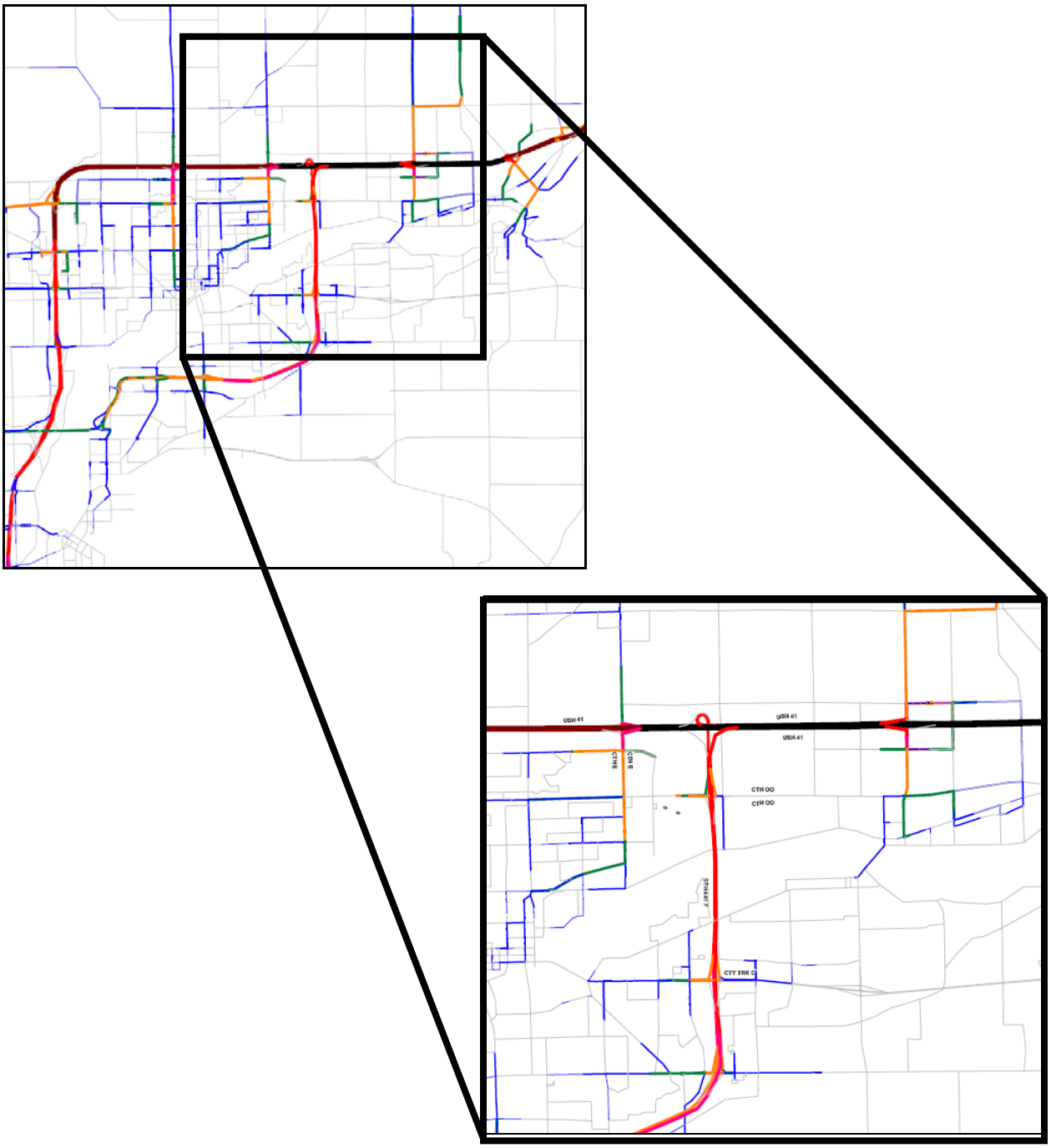
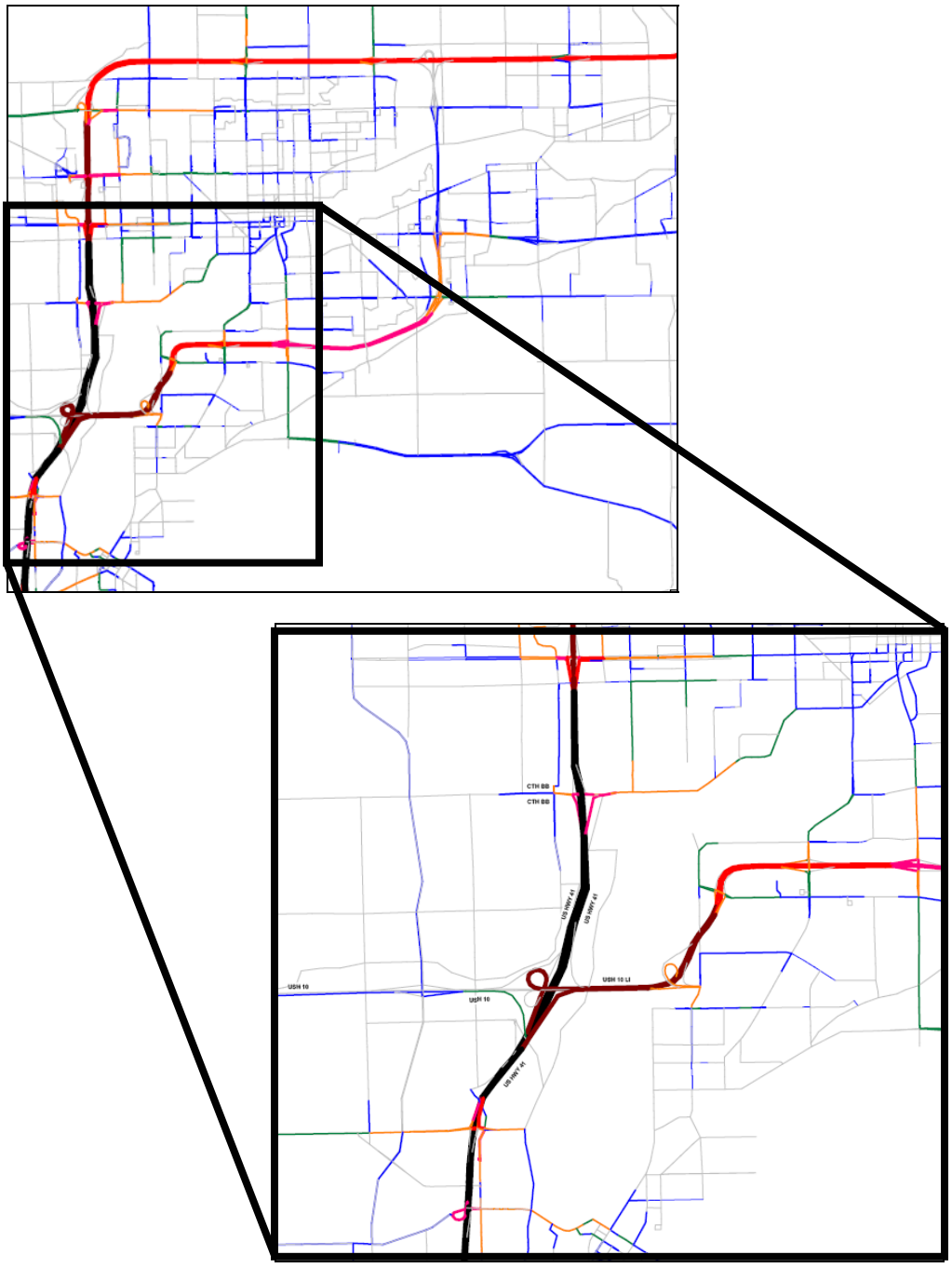
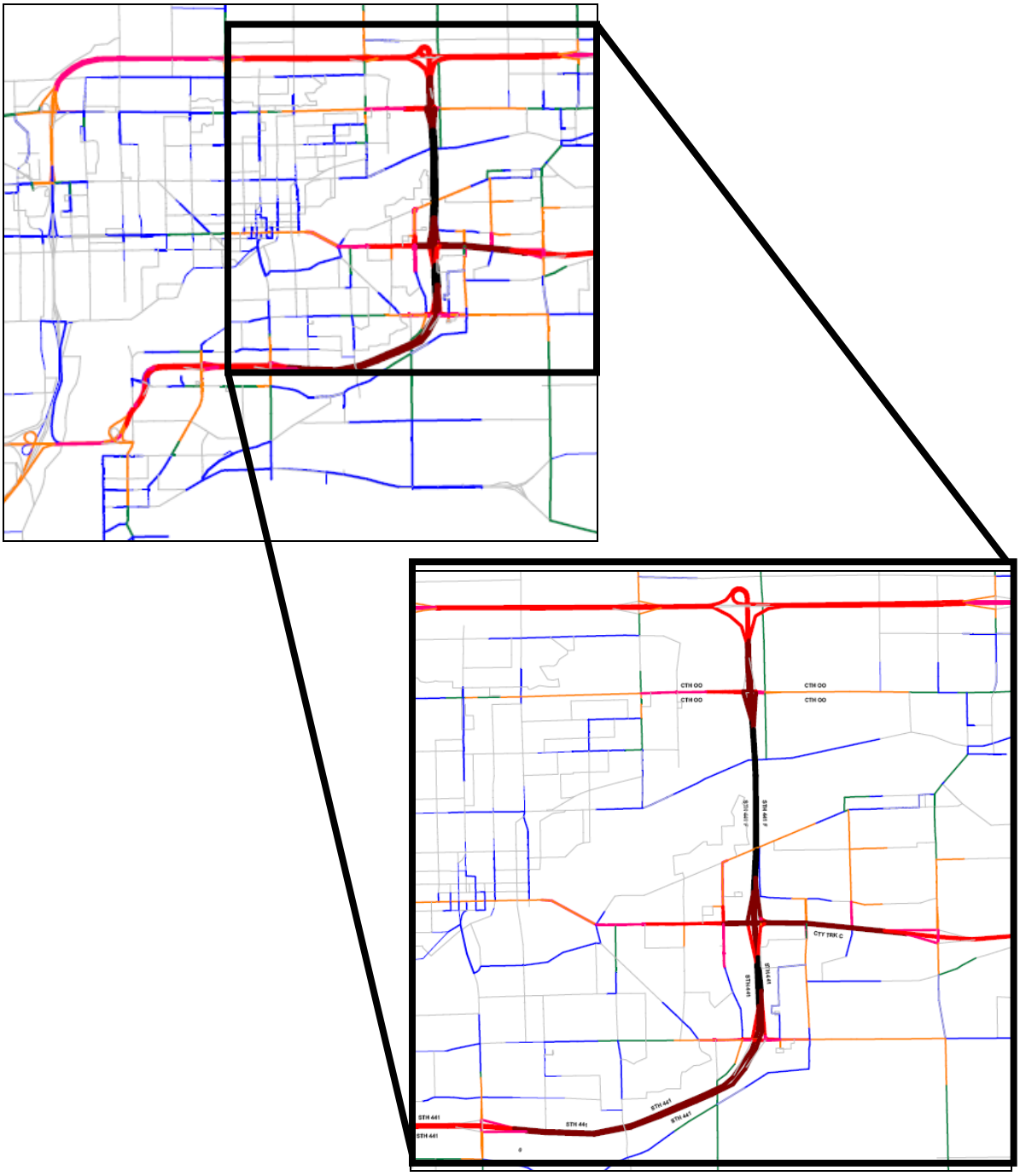


Exhibit D-3: US 41 South of US 41/WIS 441 Interchange



LEGEND
- Volume >50
- Volume>100
- Volume>500
- Volume>1000
- Volume>3000
- Volume>5000
- Volume>10000
- Volume>20000

Exhibit D-4: CTH CE (College Avenue) and WIS 441 Interchange



LEGEND
- Volume >50
- Volume>100
- Volume>500
- Volume>1000
- Volume>3000
- Volume>5000
- Volume>10000
- Volume>20000

Exhibit D-5: WIS 125/CTH CA (College Avenue) and US 41 Interchange

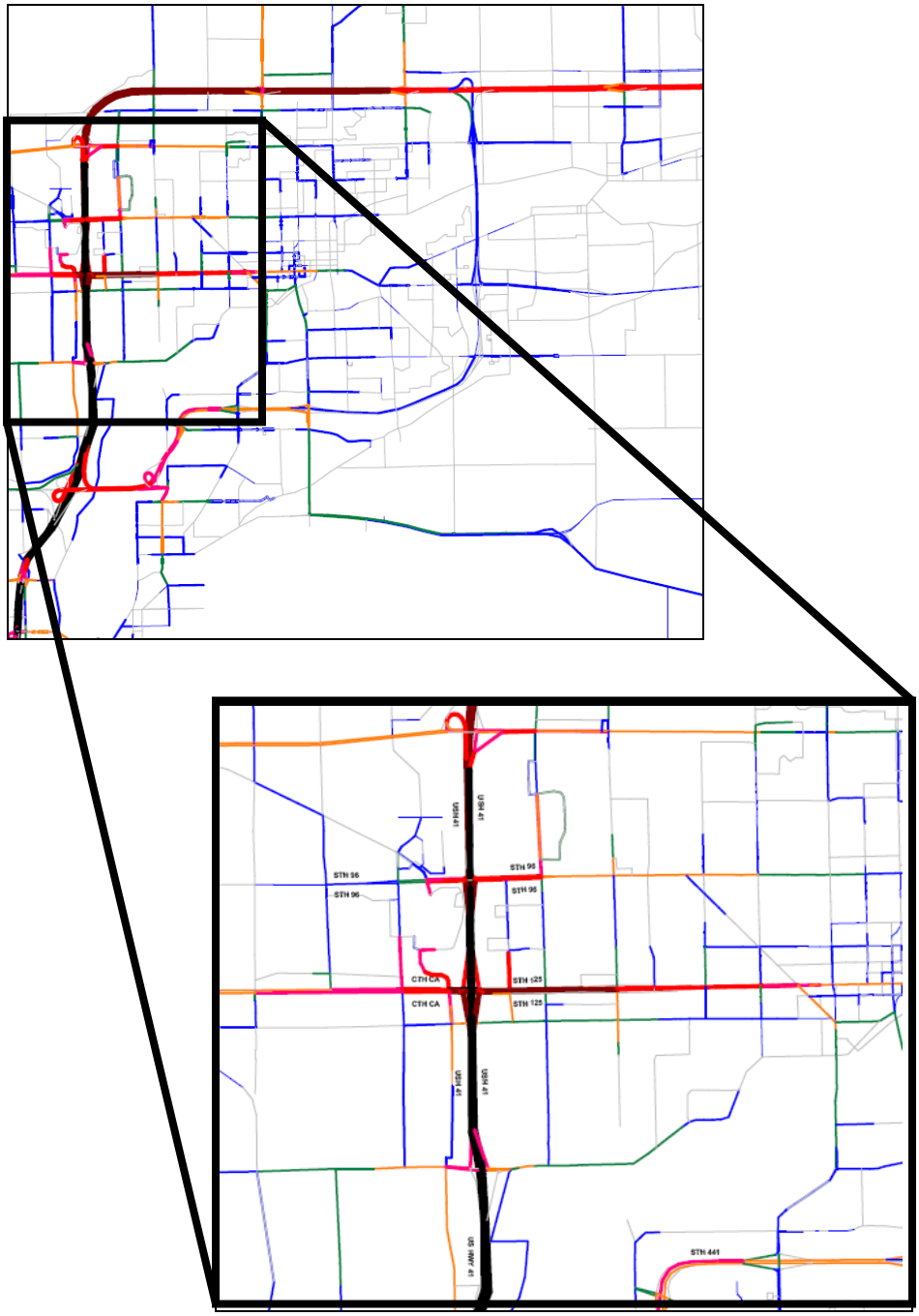


Exhibit D-6: CTH KK (Calumet Street) and WIS 441 Interchange

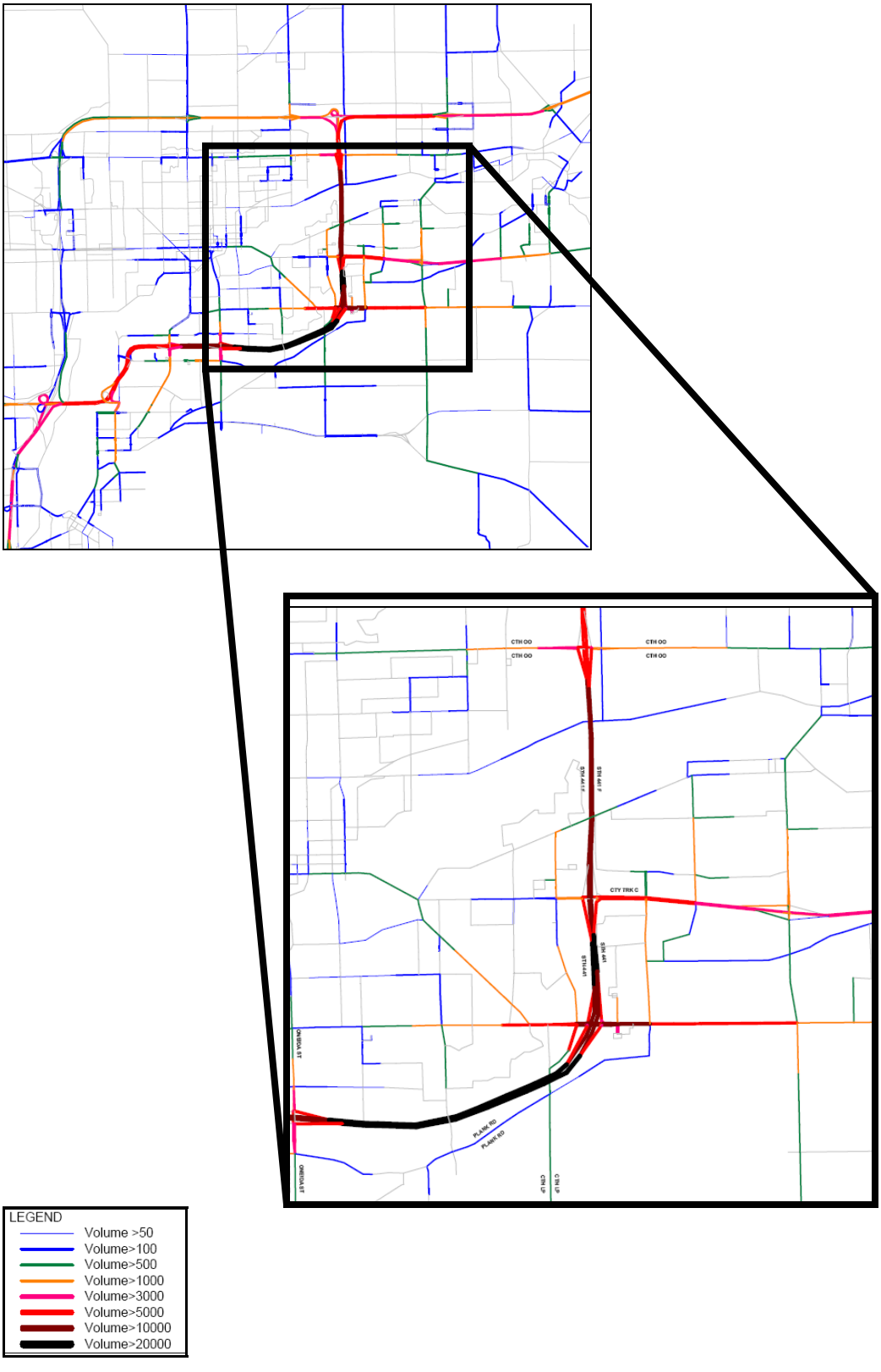
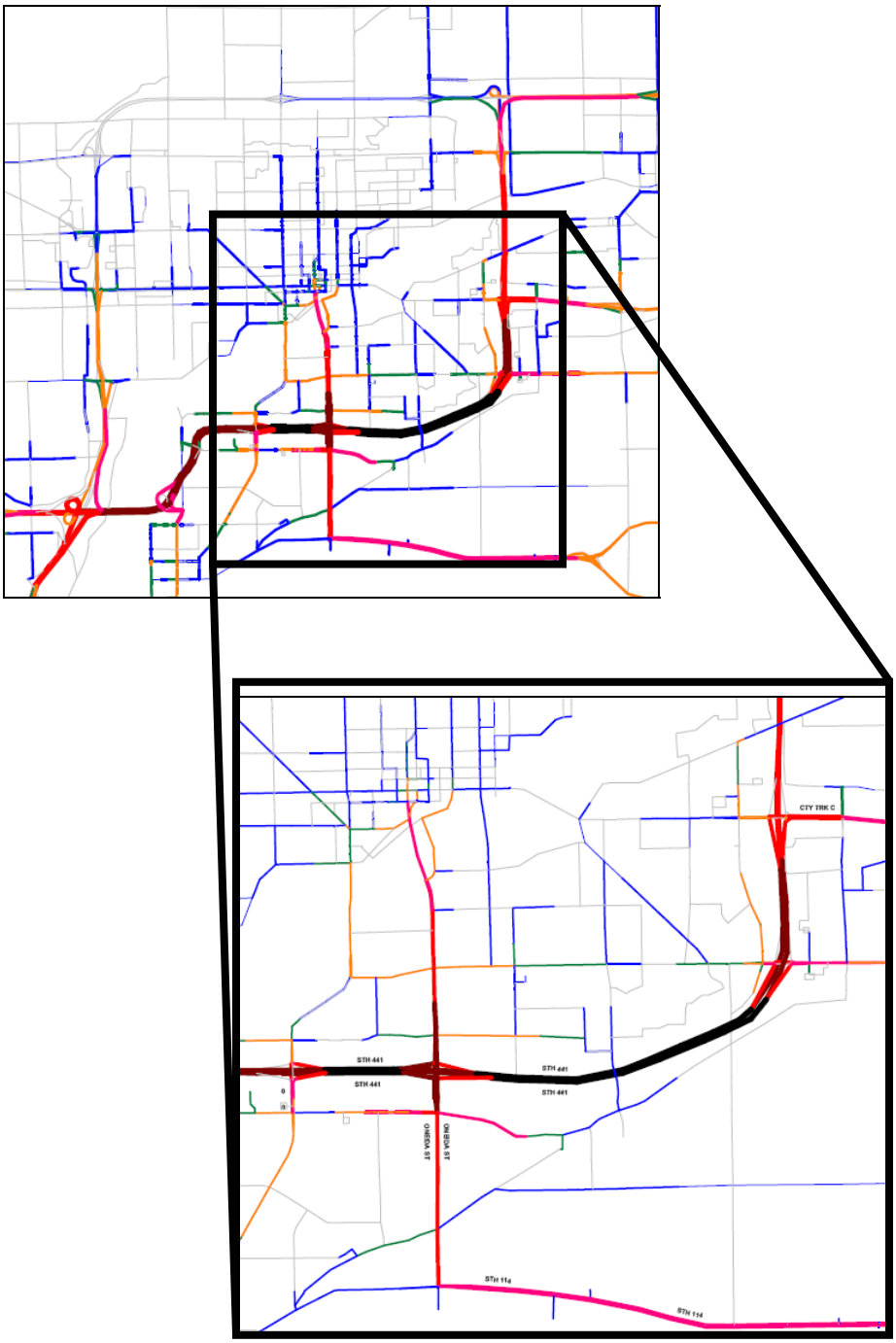
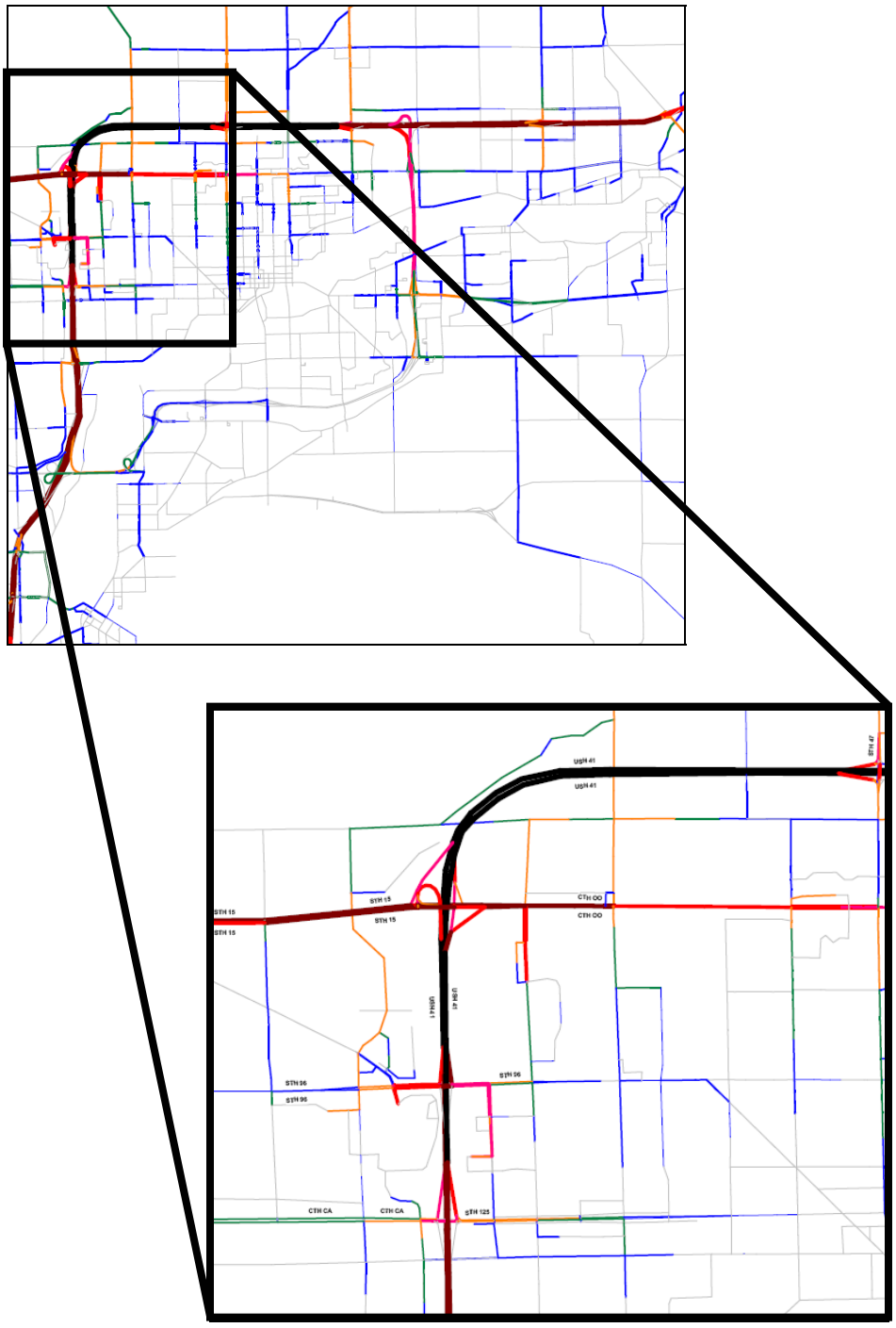


Exhibit D-7: Oneida Street and WIS 441 Interchange



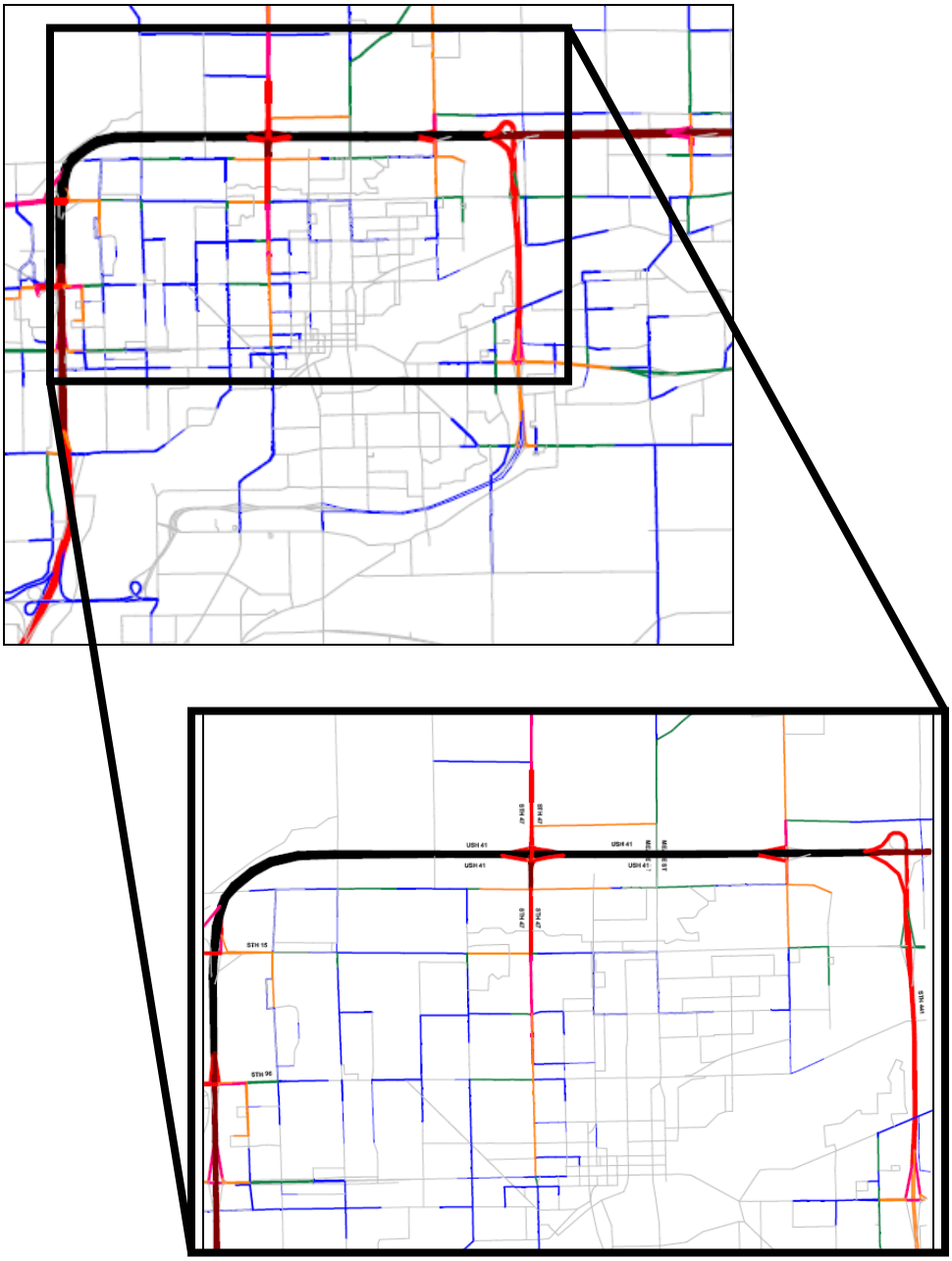
LEGEND
- Volume >50
- Volume>100
- Volume>500
- Volume>1000
- Volume>3000
- Volume>5000
- Volume>10000
- Volume>20000

Exhibit D-8: WIS 15/CTH OO (Northland Avenue) and US 41 Interchange



LEGEND
- Volume >50
- Volume>100
- Volume>500
- Volume>1000
- Volume>3000
- Volume>5000
- Volume>10000
- Volume>20000

Exhibit D-9: WIS 47 (Richmond Street) and US 41 Interchange



LEGEND
- Volume >50
- Volume>100
- Volume>500
- Volume>1000
- Volume>3000
- Volume>5000
- Volume>10000
- Volume>20000

Exhibit D-10: WIS 96 (Wisconsin Avenue) and US 41 Interchange

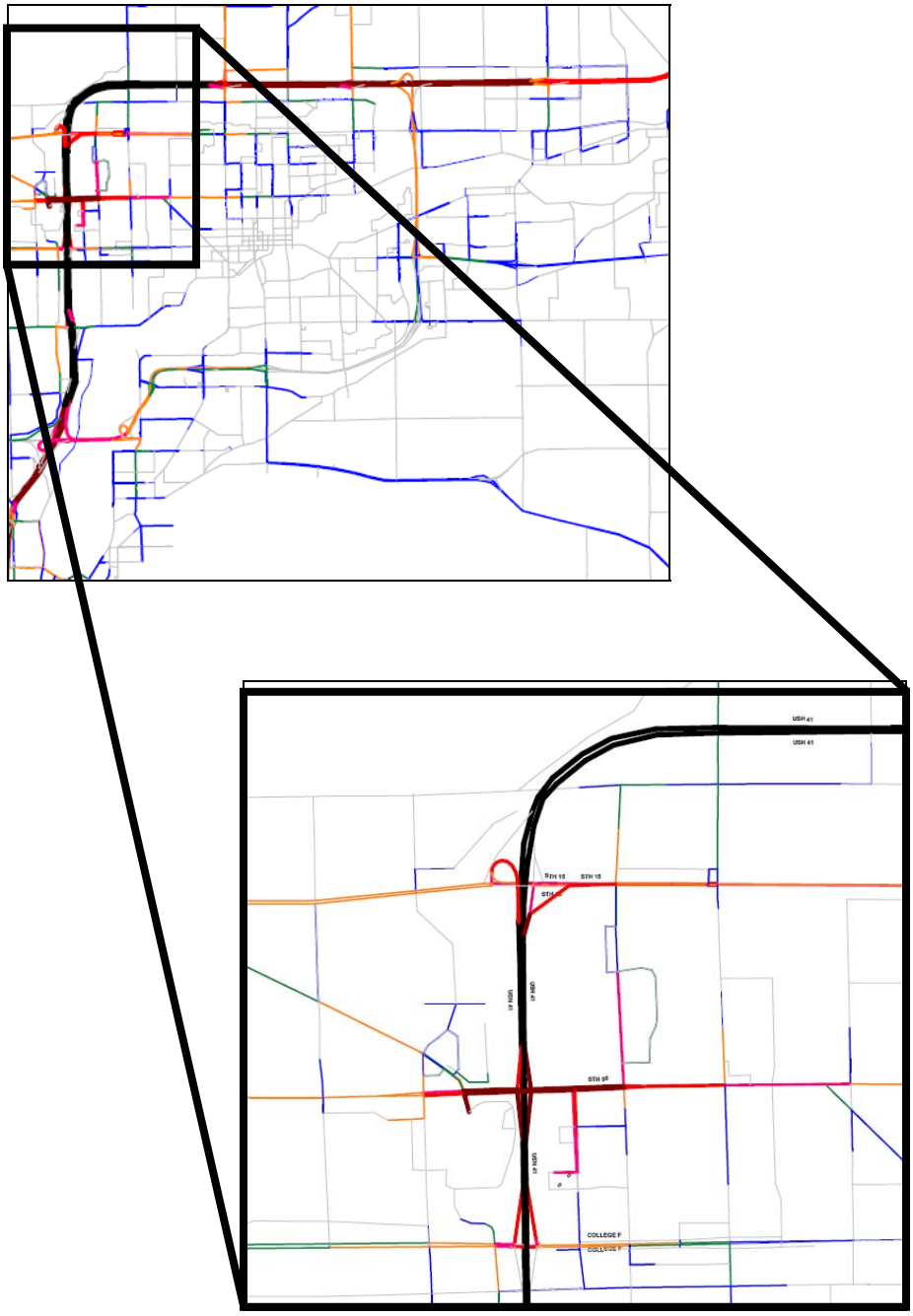
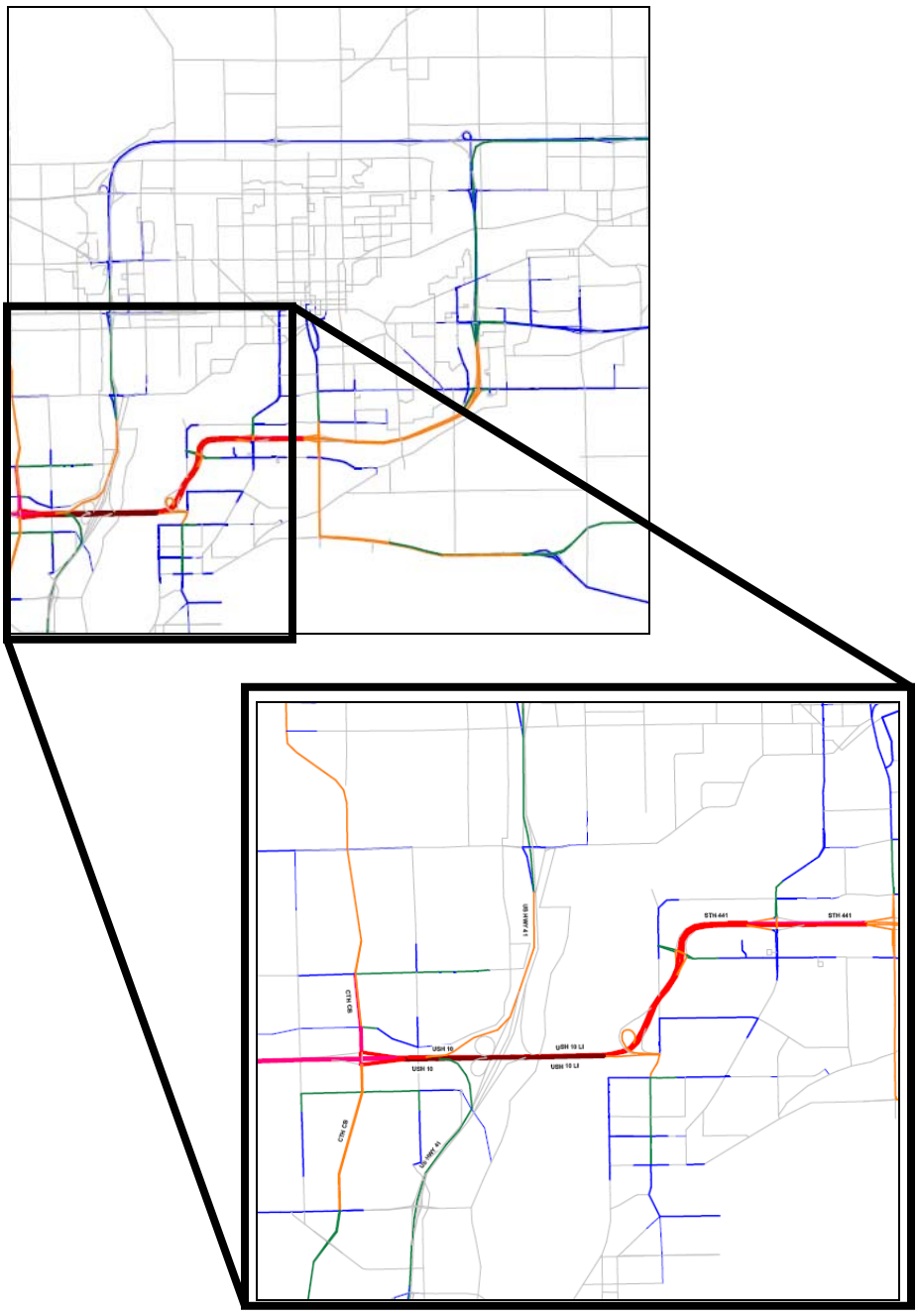


Exhibit D-11: US 10 West of US 41



LEGEND
- Volume >50
- Volume>100
- Volume>500
- Volume>1000
- Volume>3000
- Volume>5000
- Volume>10000
- Volume>20000

Exhibit D-12: US 41 Between US 41/WIS 125/CTH CA (College Avenue) and US 41/WIS 96 (Wisconsin Avenue) Interchanges

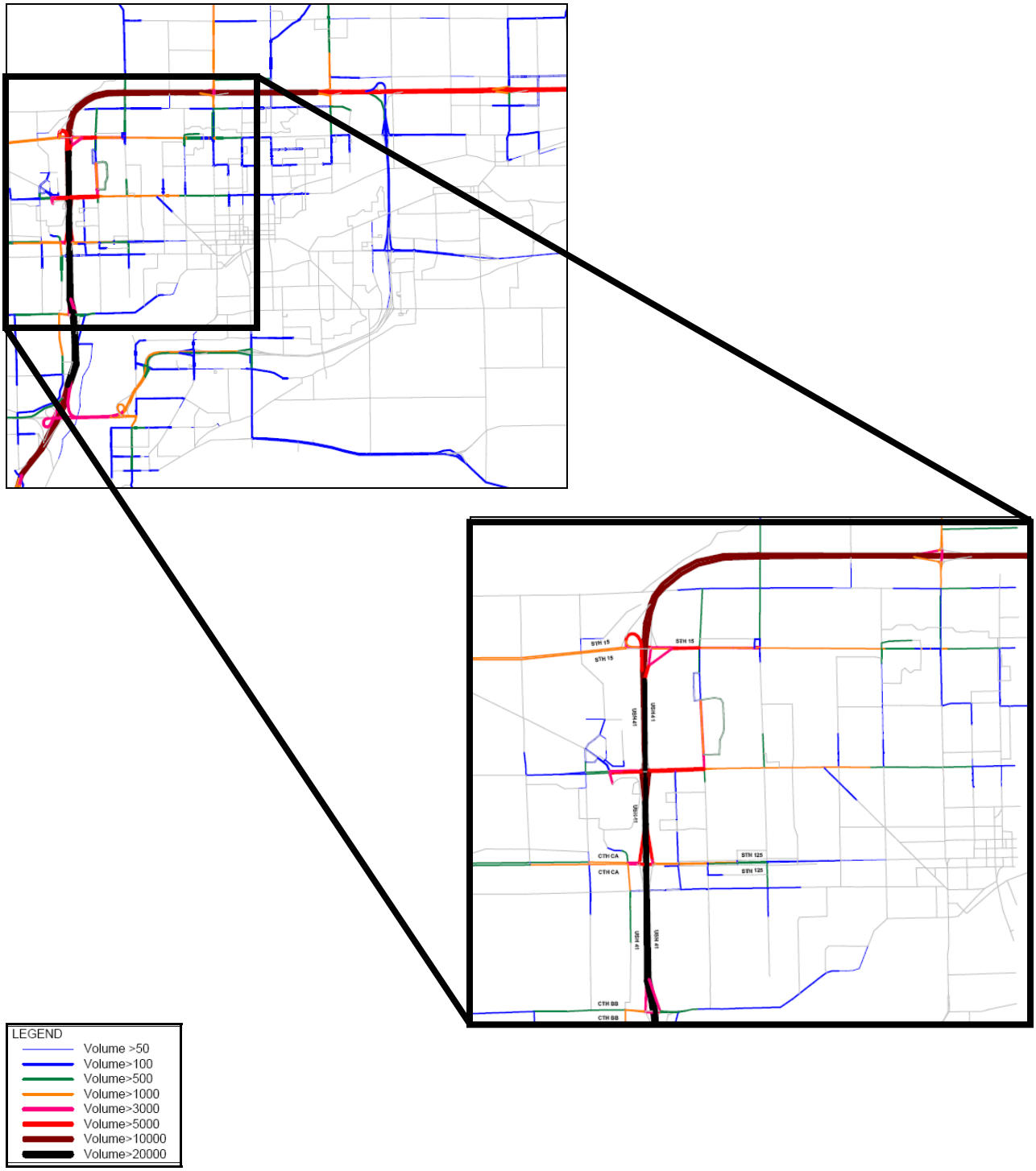
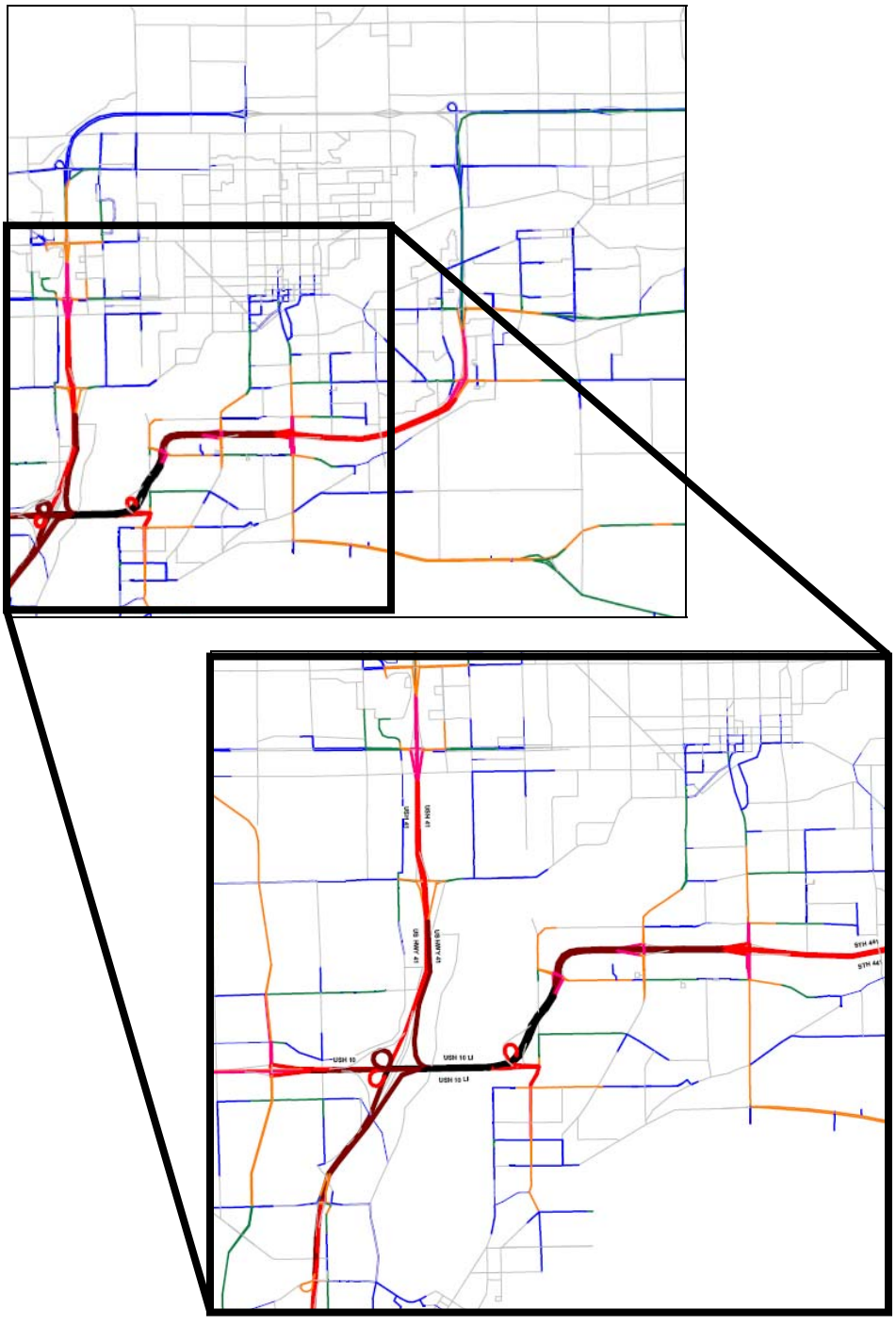


Exhibit D-13: US 10 East of US 41



US 41 / WIS 441

2020 BALANCED LINKFLOWS

Matchline 2

Matchline 1

CB

W American Dr

643 (680)

540 (593)

9534 *1313* (634)

1477 *339* (250)

10

1335 *601* (220)

850 (422)

370 (689)

10370 *833* (1191)

Jacobsen Rd

CB

W American Dr

14758 *1636* (1119)

Cold Spring Rd

Irish Rd

6702 *467* (732)

6467 *1173* (1027)

15502 *1164* (1968)

Jacobsen Rd

10

36900 *4205* (4289)

37500 *3525* (4540)

41

37751 *3803* (2679)

36803 *2235* (4263)

441

N Lake St

51128 *5227* (4062)

50011 *3416* (5138)

N Green Bay Rd

Zeh Ave

Winchester Rd

11

51431 *4719* (4070)

46582 *3354* (4529)

N Green Bay Rd

N Lake St

0

North St

Main St

Oakridge Rd

Tuller Rd

46227 *4442* (3746)

48321 *3523* (4639)

S Green Bay Rd

S Lake St

41

1486 *112* (168)

11857 *814* (615)

12621 *1459* (1131)

10

441

859 *162* (45)

9082 *463* (1383)

13078 *953* (1163)

9801 *514* (1050)

5367 *803* (307)

Zeh Ave

476 (389)

207 (371)

N Green Bay Rd

34 (16)

3 (32)

405 (886)

380 (290)

Winchester Rd

11

405 (535)

581 (375)

275 (307)

385 (619)

Spring Road Dr

5671 *303* (393)

6573 *434* (495)

41

5204 *345* (340)

41

N Green Bay Rd

257 (194)

373 (352)

199 (175)

Main St

252 (228)

652 (569)

Oakridge Rd

268 (216)

223 (301)

211 (182)

1738 *178* (128)

S Green Bay Rd

12315 *782* (1101)

S Green Bay Rd

11033 *776* (986)

352 (514)

300 (584)

951 (1504)

Winneconne Ave

445 (529)

587 (1044)

906 (1076)

456 (476)

118 (230)

138 (209)

JJ

114

687 (802)

5659 *292* (480)

89 (180)

73 (68)

Tuller Rd

Meadow Ln

6306 *457* (538)

41

JJ

114

Meadow Ln

Winneconne Ave

41685 *3064* (4100)

Harrison St

W Cecil St

41500 *4207* (3515)

Gillingham Rd

Jewelers Park Dr

Harrison St

Tuller Rd

Breezewood Ln

W Bell St

Bergstrom Rd

36899 *3481* (3333)

37735 *3002* (3598)

41

13141 *1135* (694)

41

12771 *805* (1157)

88 (165)

Gillingham Rd

Harrison St

770 (686)

137 (234)

300 (446)

273 (164)

Breezewood Ln

967 (1220)

565 (699)

75 (247)

W Bell St

210 (174)

0 (1)

1125 (948)

0 (0)

Bergstrom Rd

8539 *455* (426)

8841 *595* (588)

N

NOT TO SCALE

LEGEND

XXXX = AADT

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

HNTB

Exhibit D-14

US 41

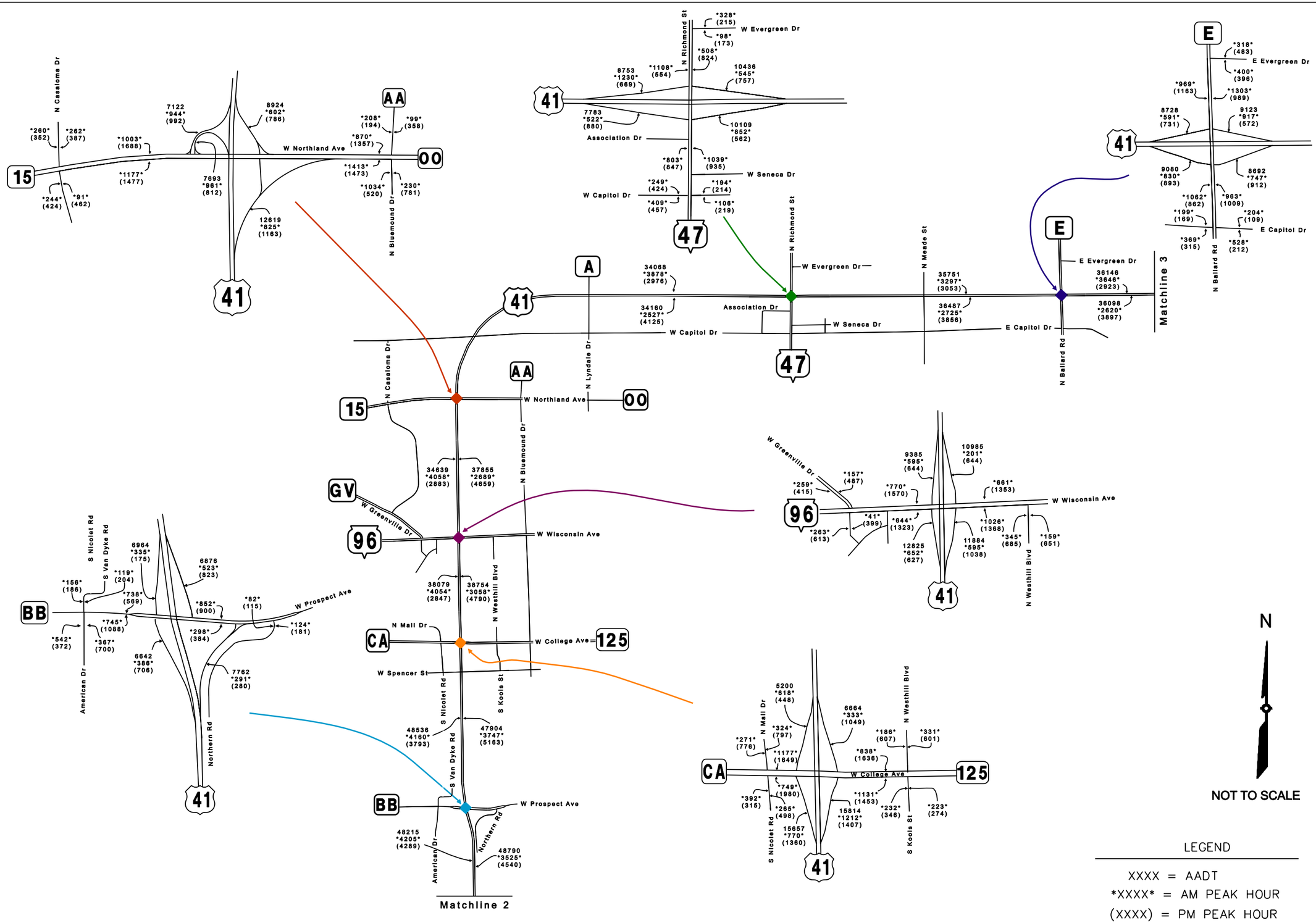
Breezewood Ln to WIS 441 / US 10

Sheet 1 of 9

US 41 / WIS 441

2020 BALANCED LINKFLOWS

WISCONSIN DEPARTMENT OF TRANSPORTATION



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NOT TO SCALE

LEGEND

XXXX = AADT

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

HNTB

Exhibit D-14

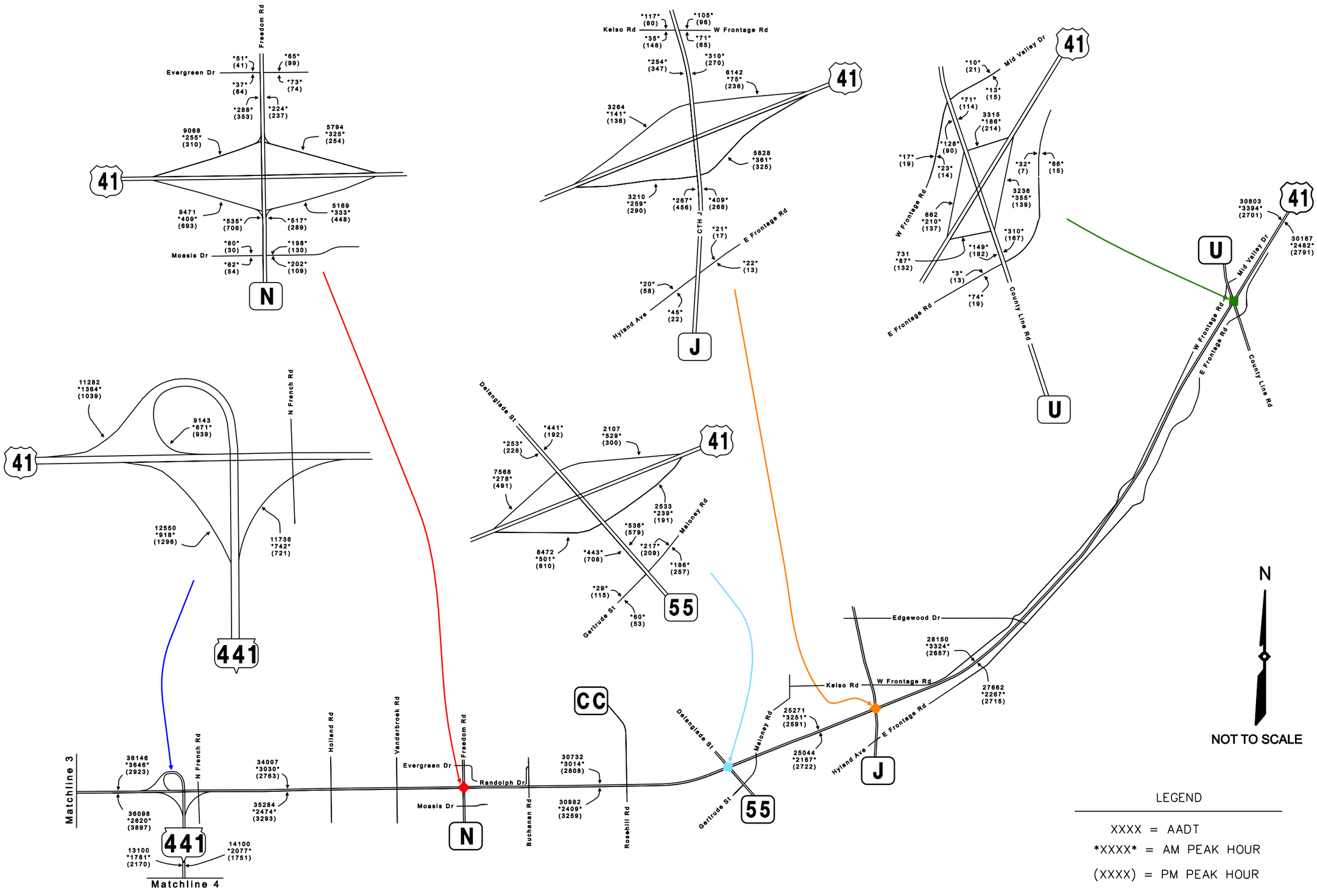
US 41
CTH BB to
WIS 441
(North Interchange)

Sheet 2 of 9

US 41 / WIS 441

2020 BALANCED LINKFLOWS

WISCONSIN DEPARTMENT OF TRANSPORTATION



LEGEND

XXXX = AADT

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

HNTB

Exhibit D-14

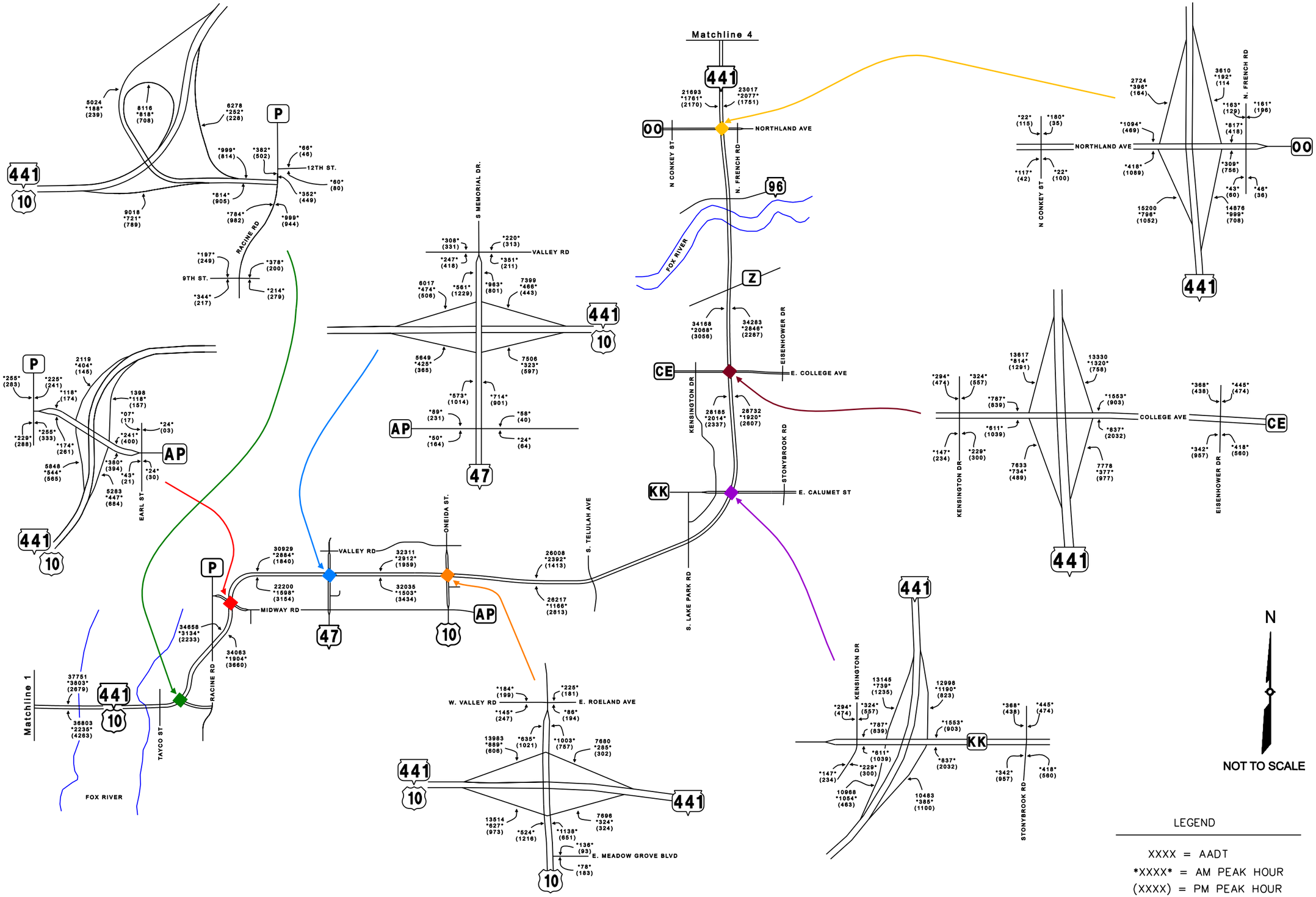
US 41
Wis 441 to County Line Rd. (CTH U)

Sheet 3 of 9

WIS 441

2020 BALANCED LINKFLOWS

WISCONSIN DEPARTMENT OF TRANSPORTATION



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NOT TO SCALE

LEGEND

XXXX = AADT

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

HNTB

Exhibit D-14

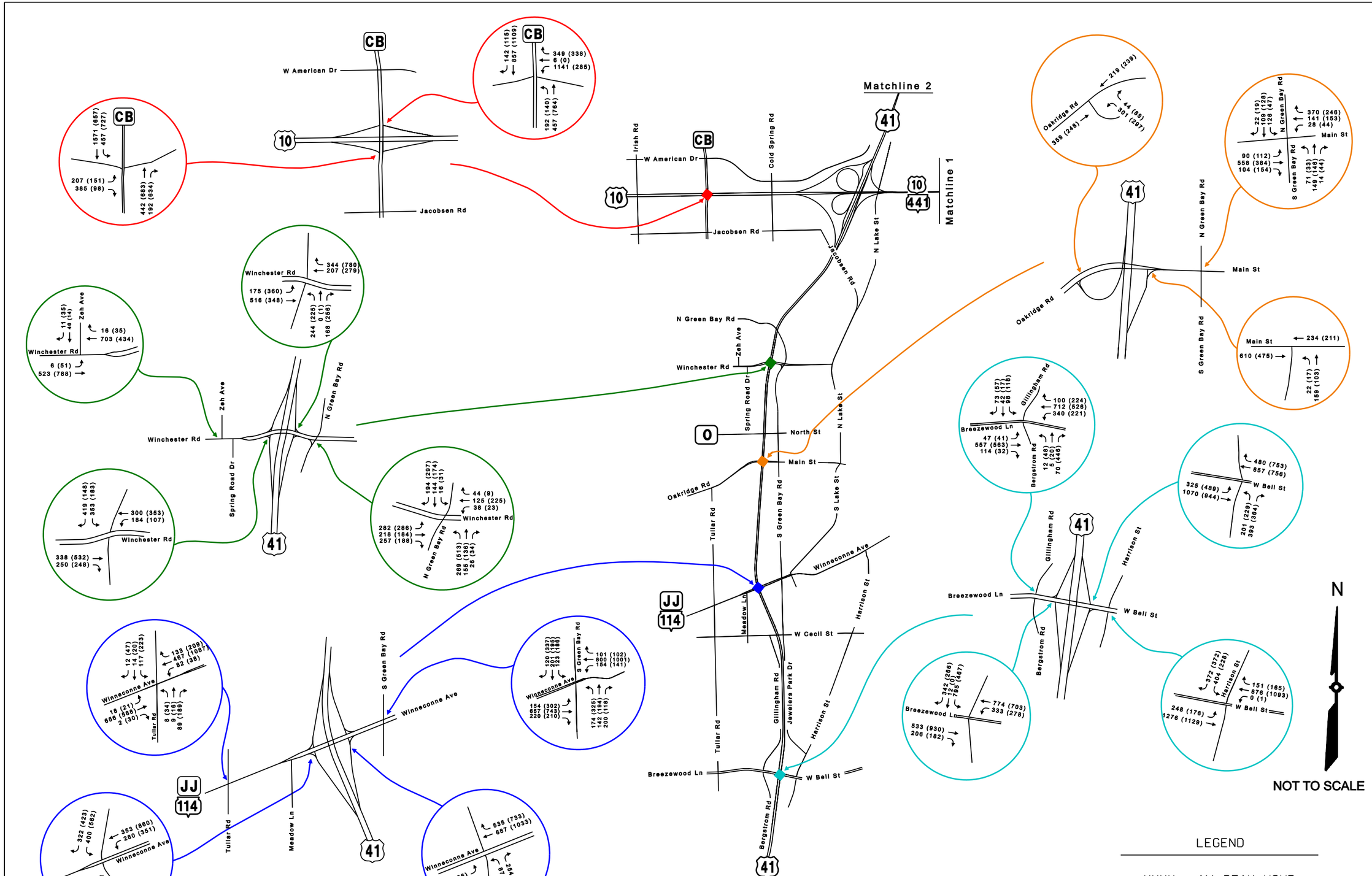
WIS 441/US 10

Fox River to CTH OO (Northland Ave.)

Sheet 4 of 9

US 41 / WIS 441

2020 BALANCED TURNING MOVEMENT COUNTS



N

NOT TO SCALE

LEGEND

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

HNTB

Exhibit D-14

US 41

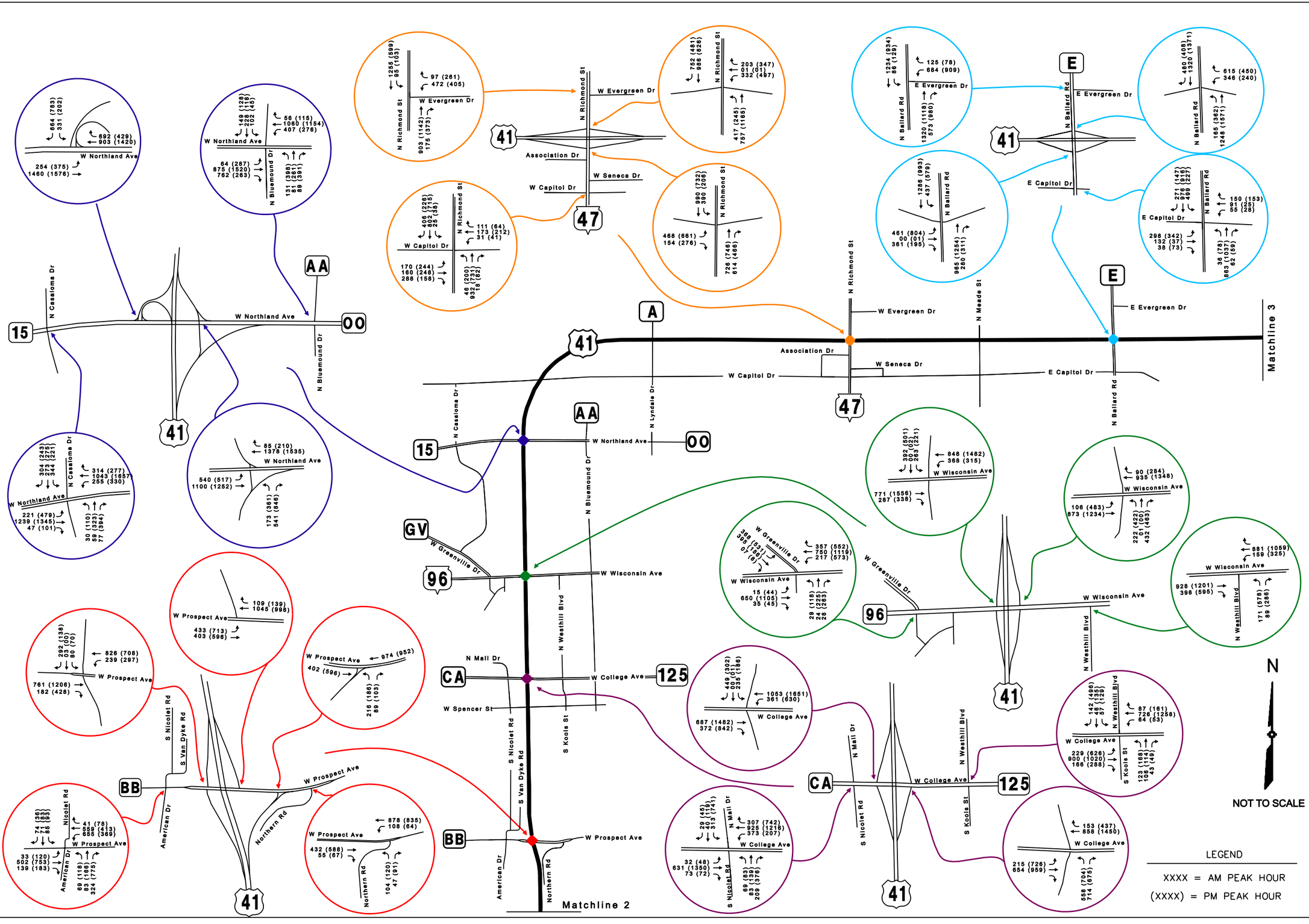
Breezewood Ln to WIS 441 / US 10

Sheet 5 of 9

US 41 / WIS 441

2020 BALANCED TURNING MOVEMENT COUNTS

WISCONSIN DEPARTMENT OF TRANSPORTATION



HNTB

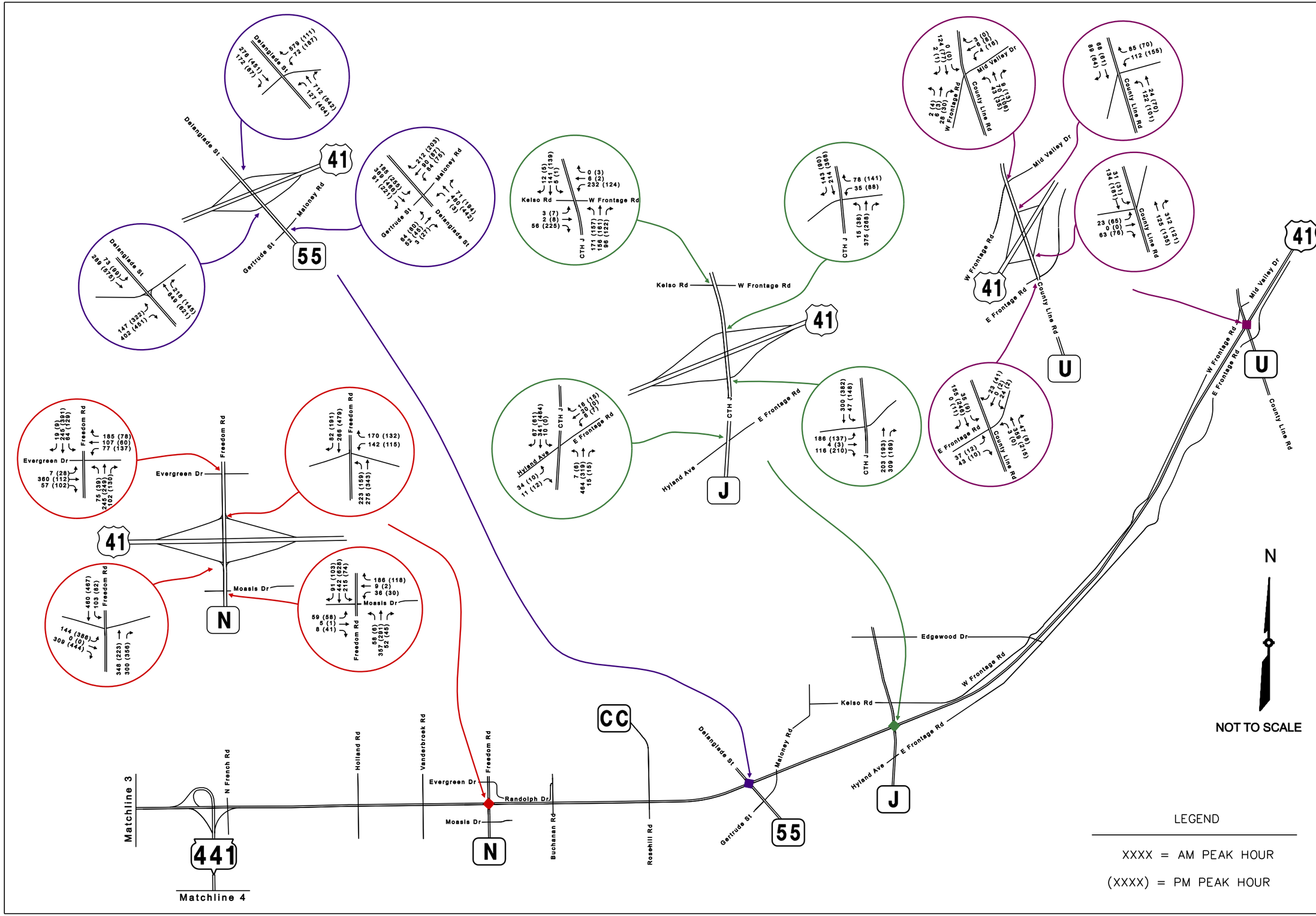
Exhibit D-14

US 41
CTH BB to
WIS 441
(North Interchange)

Sheet 6 of 9

US 41 / WIS 441

2020 BALANCED TURNING MOVEMENT COUNTS

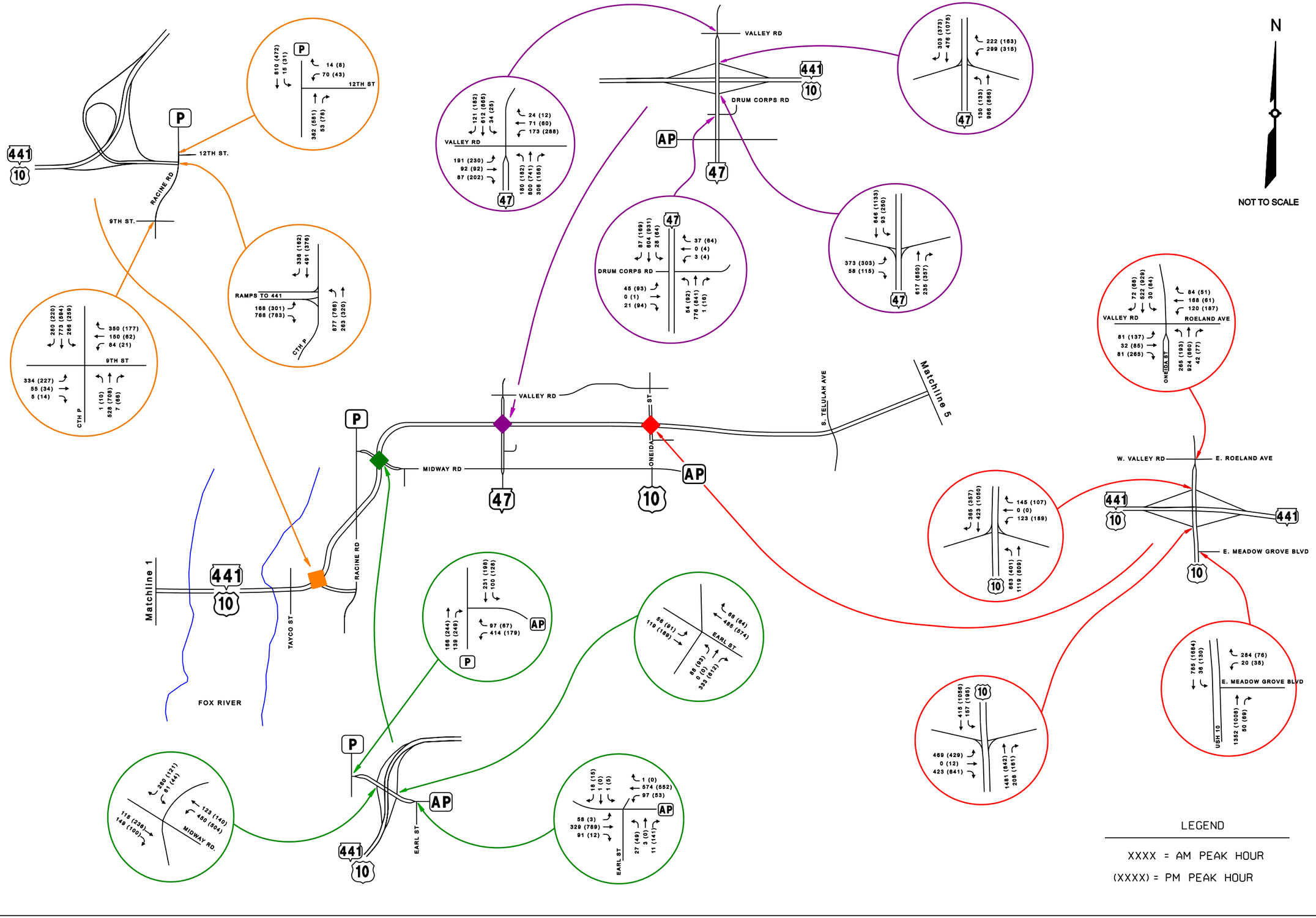


HNTB

Exhibit D-14

US 41
Wis 441 to
County Line Rd.
(CTH U)

Sheet 7 of 9



WIS 441

2020 BALANCED TURNING MOVEMENT COUNTS

HNTB

Exhibit D-14

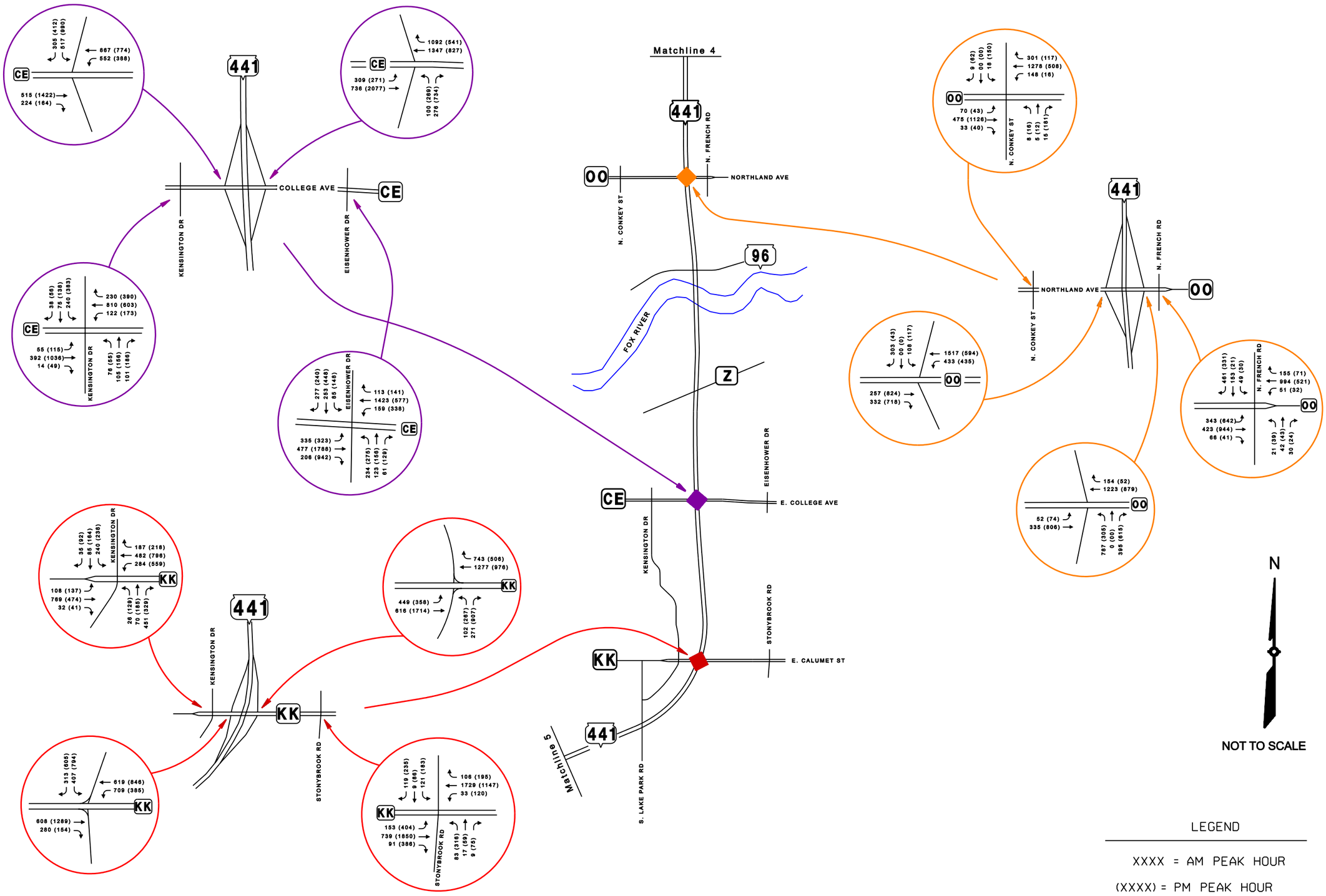
WIS 441 / US 10

Butte de Morts to S. Telulah Ave.

Sheet 8 of 9

WIS 441

2020 BALANCED TURNING MOVEMENT COUNTS



N

NOT TO SCALE

LEGEND

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

HNTB

Exhibit D-14

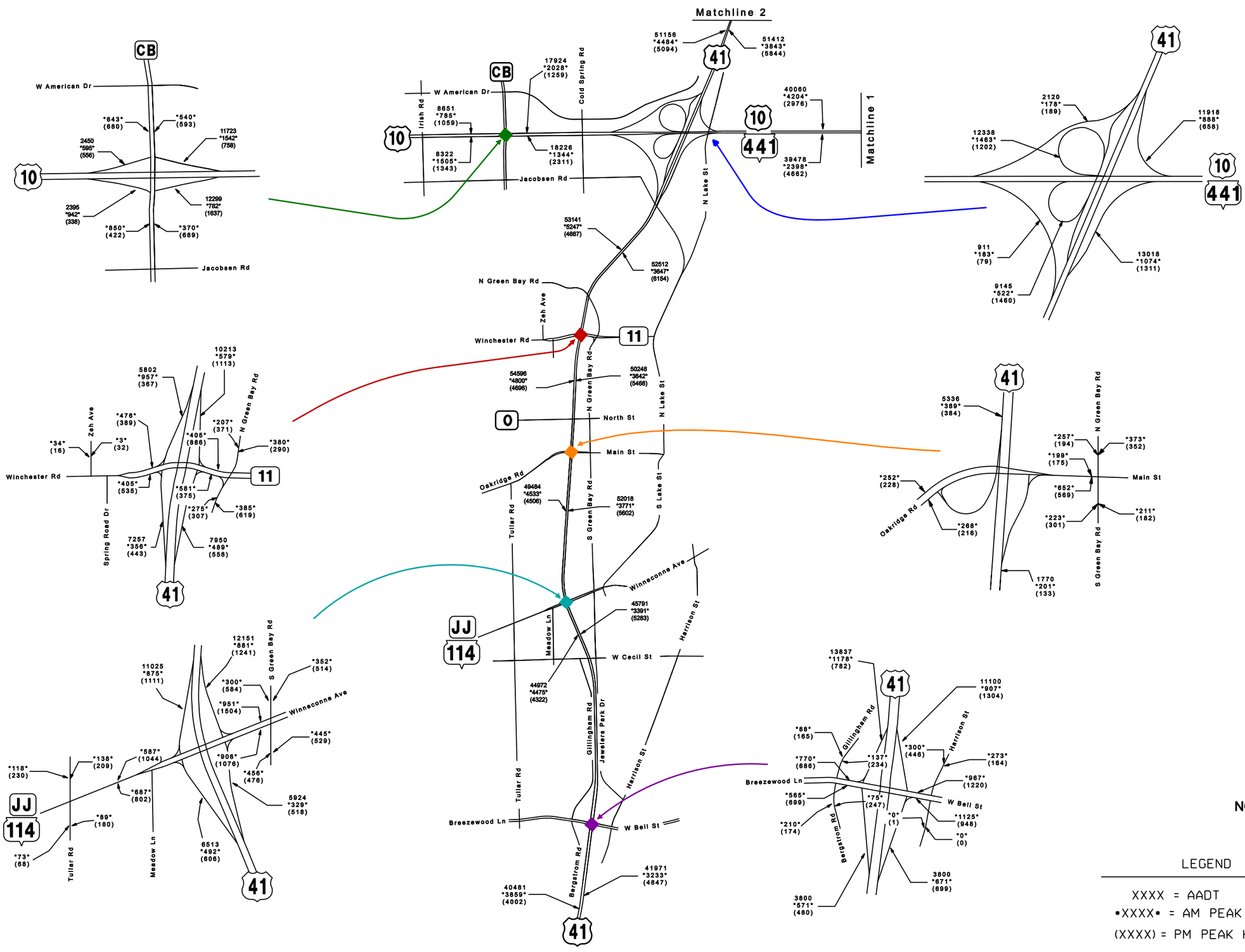
WIS 441/US10

CTH KK to CTH OO

Sheet 9 of 9

US 41 / WIS 441

2035 BALANCED LINKFLOWS



N

NOT TO SCALE

LEGEND

XXXX = AADT

XXXX = AM PEAK HOUR

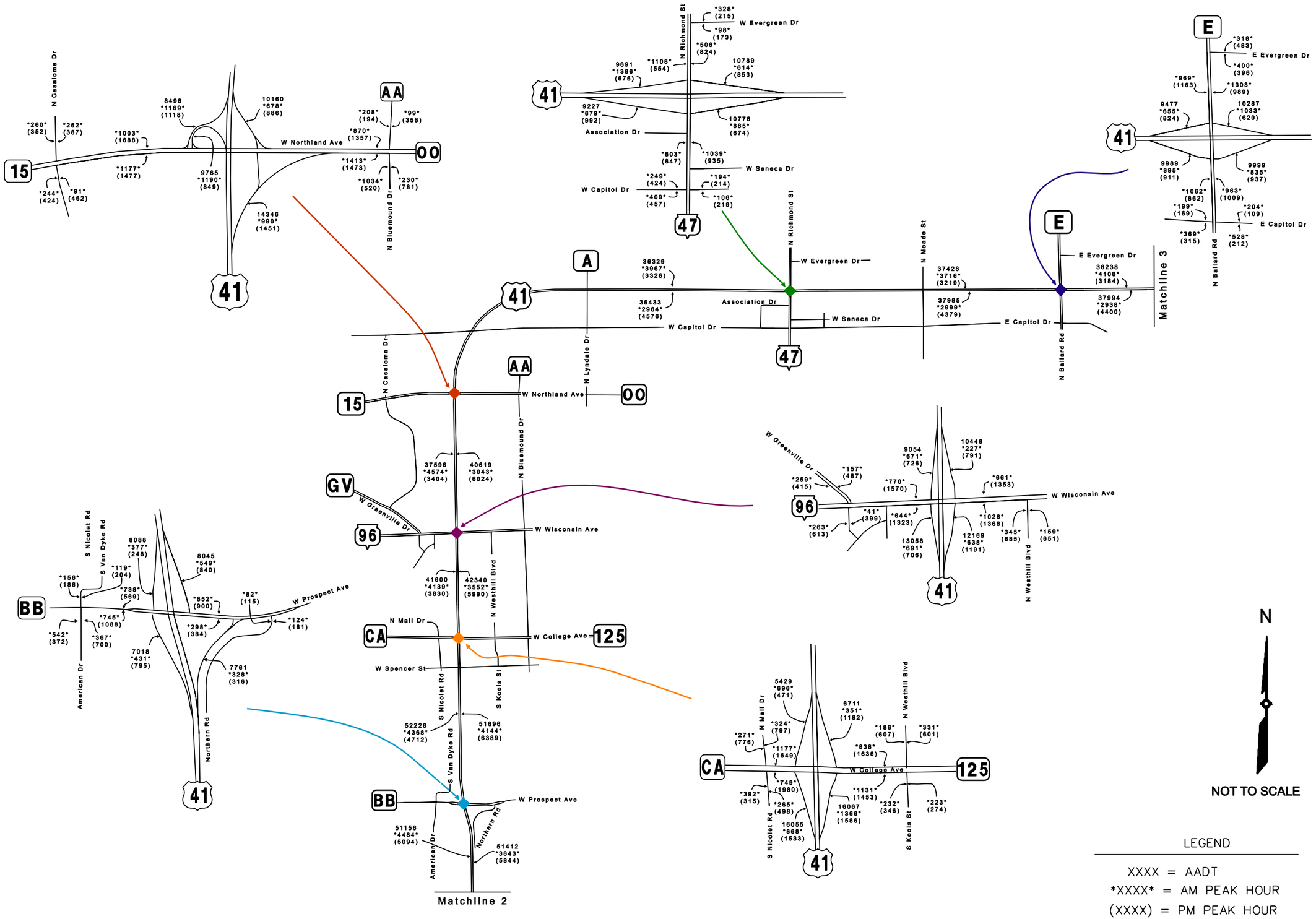
(XXXX) = PM PEAK HOUR

HNTB

Exhibit D-15

US 41

Breezewood Ln to WIS 441 / US 10



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NOT TO SCALE

LEGEND

XXXX = AADT

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

US 41 / WIS 441

2035 BALANCED LINKFLOWS

HNTB

Exhibit D-15

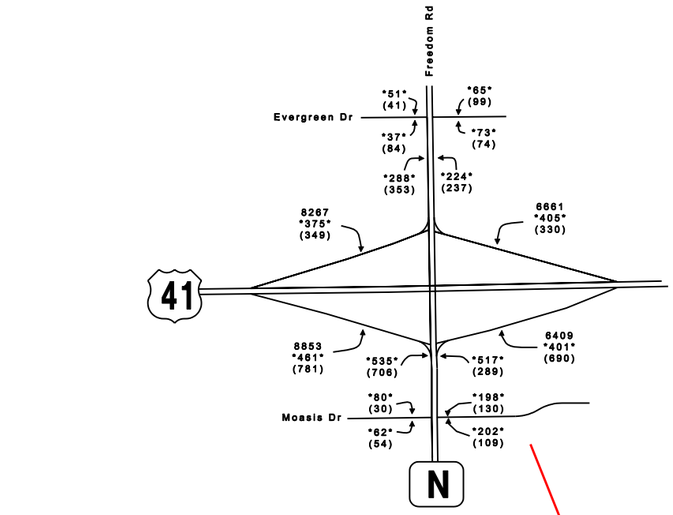
US 41
CTH BB to
WIS 441
(North Interchange)

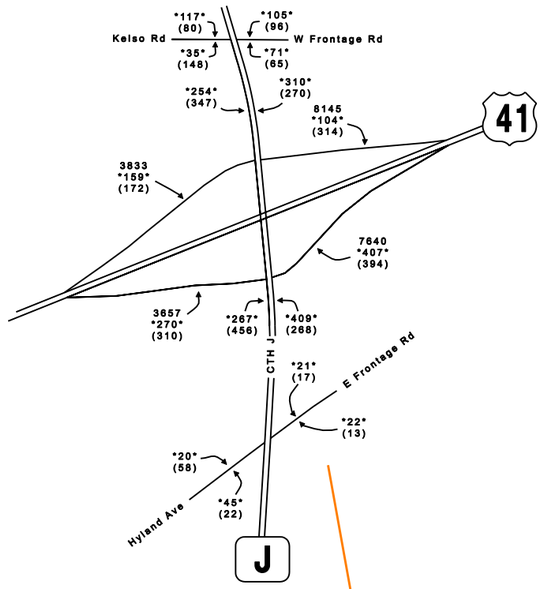
Sheet 2 of 9

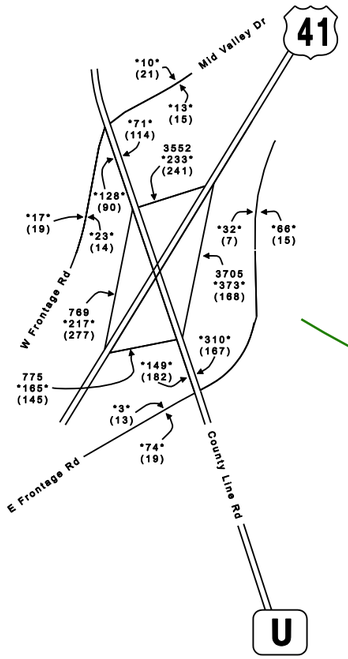
US 41 / WIS 441

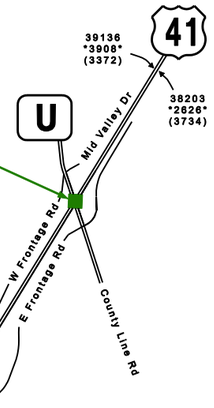
2035 BALANCED LINKFLOWS

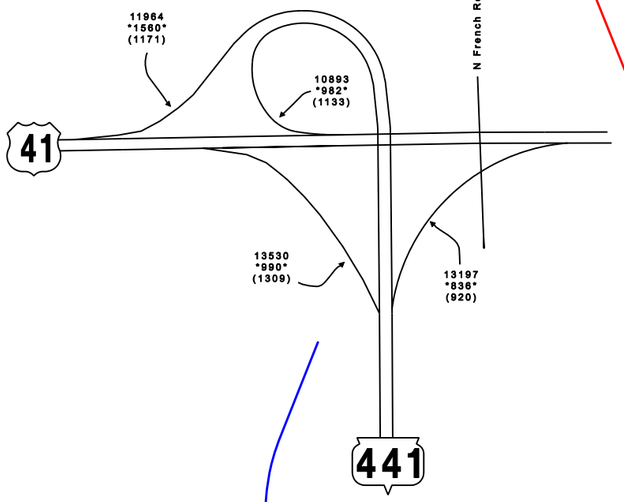
WISCONSIN DEPARTMENT OF TRANSPORTATION

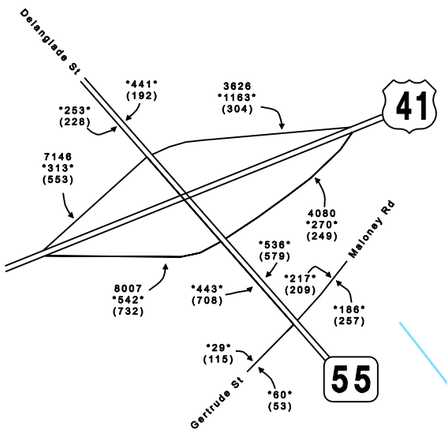


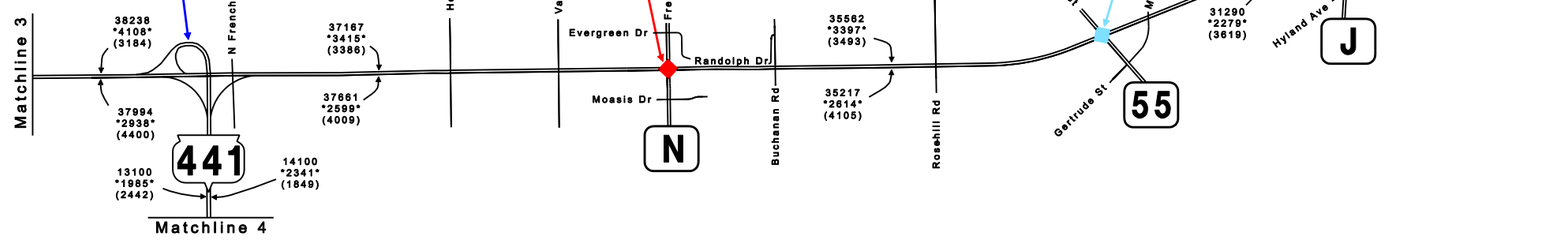












N

NOT TO SCALE

LEGEND

XXXX = AADT

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

HNTB

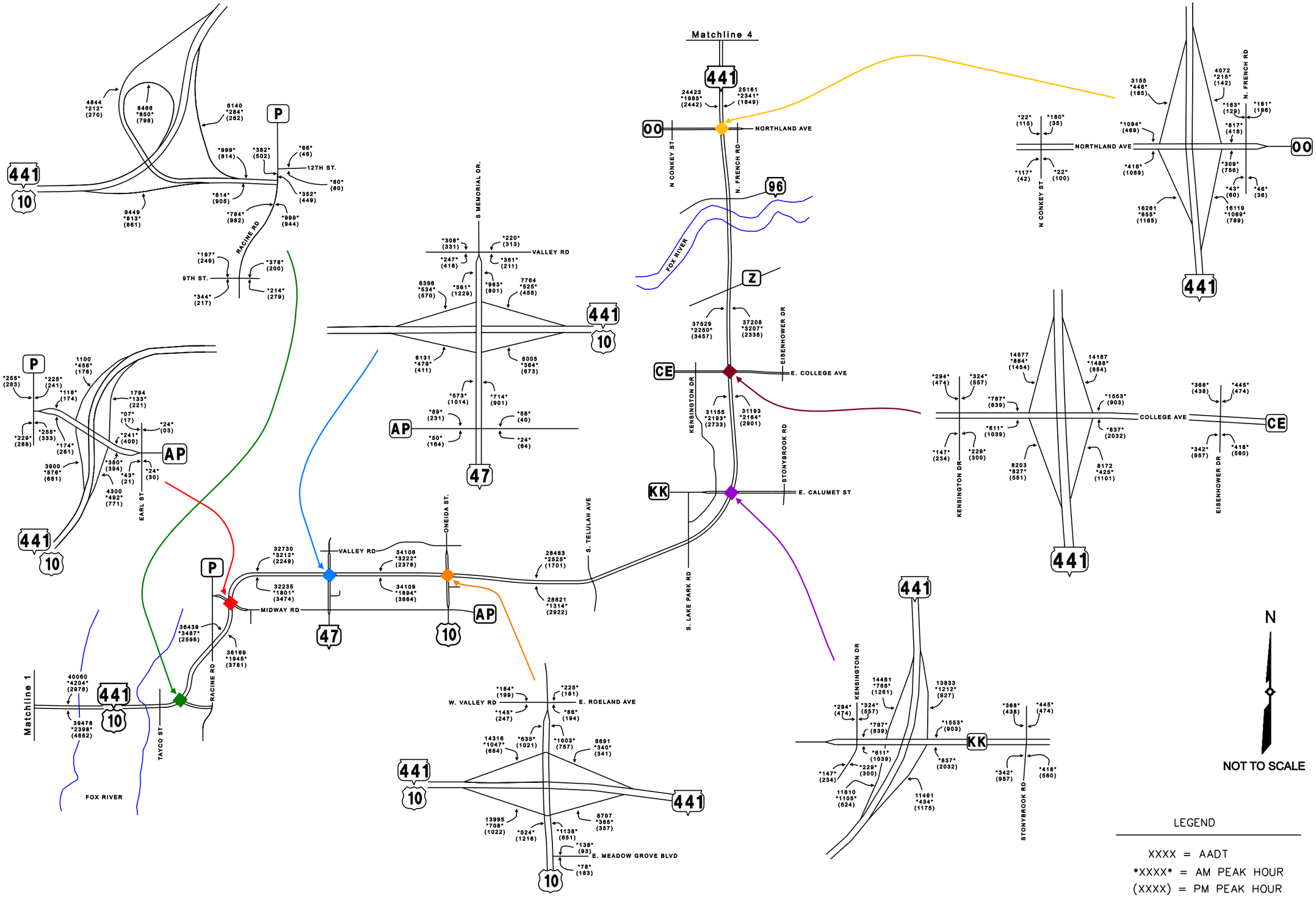
Exhibit D-15

US 41
Wis 441 to County Line Rd. (CTH U)

Sheet 3 of 9

WIS 441

2035 BALANCED LINKFLOWS



N

NOT TO SCALE

LEGEND

XXXX = AADT

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

HNTB

Exhibit D-15

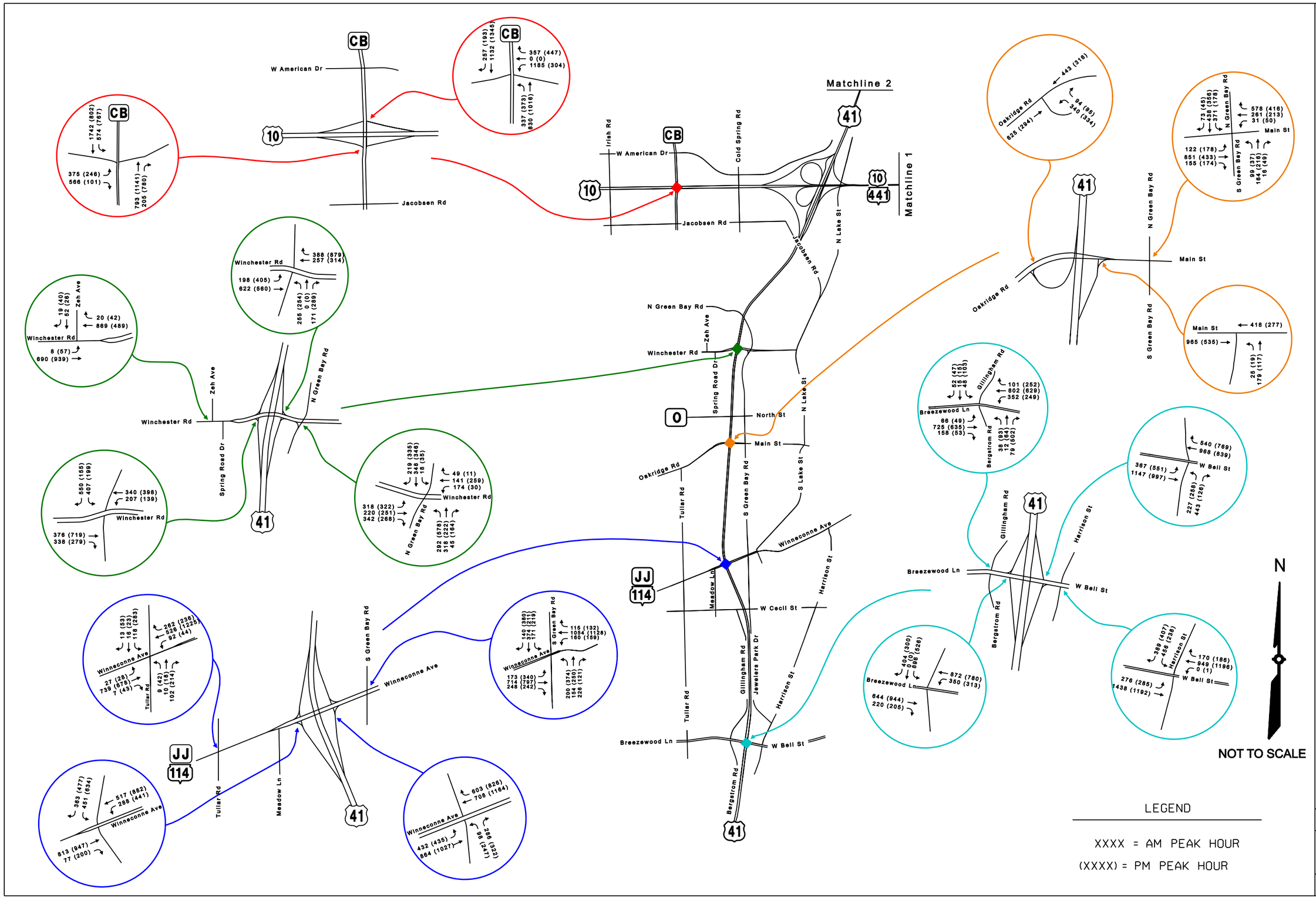
WIS 441/US 10

Fox River to CTH OO (Northland Ave.)

Sheet 4 of 9

US 41 / WIS 441

2035 BALANCED TURNING MOVEMENT COUNTS



LEGEND

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

HNTB

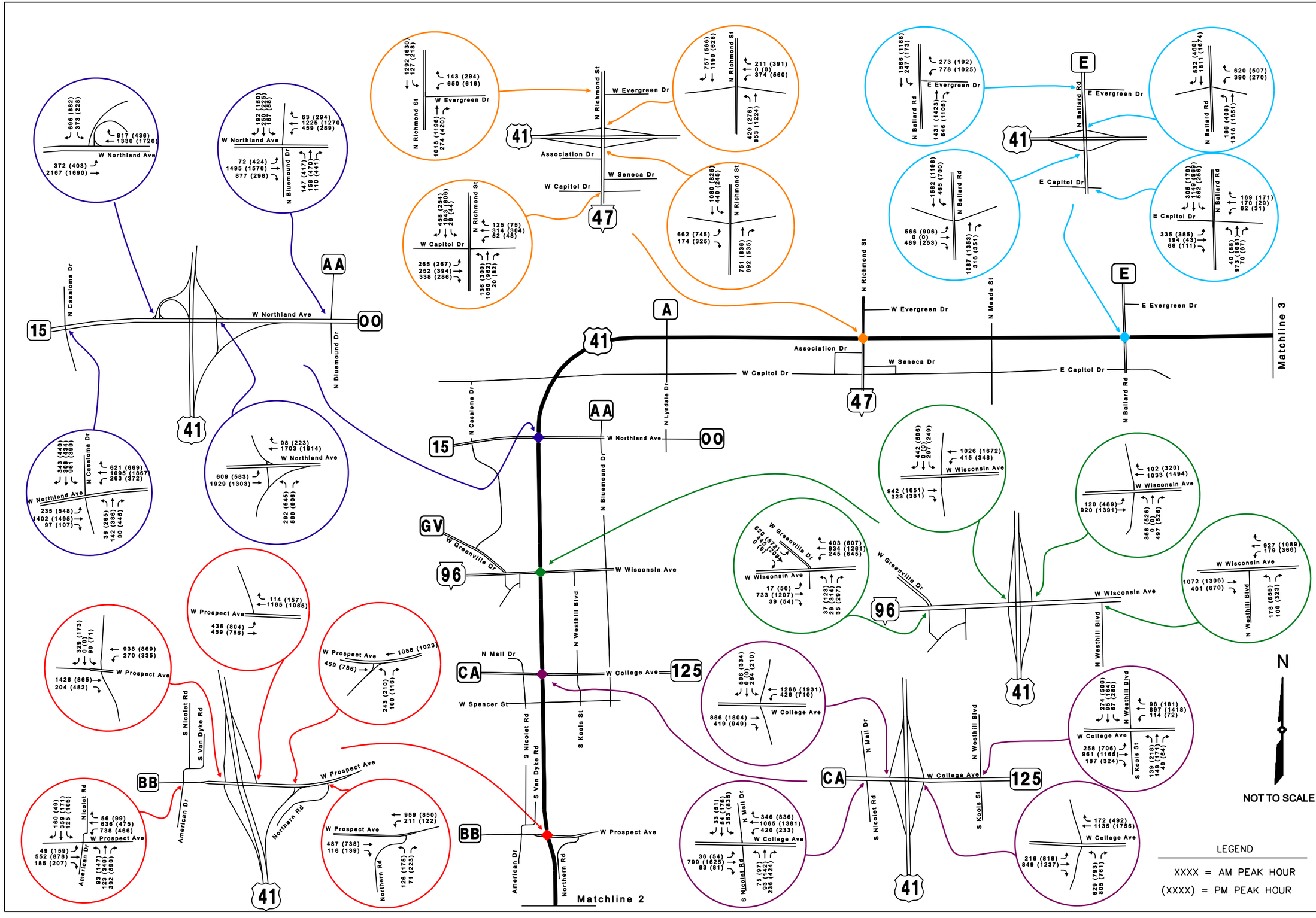
Exhibit D-15

US 41

Breezewood Ln to WIS 441 / US 10

US 41 / WIS 441

2035 BALANCED TURNING MOVEMENT COUNTS



HNTB

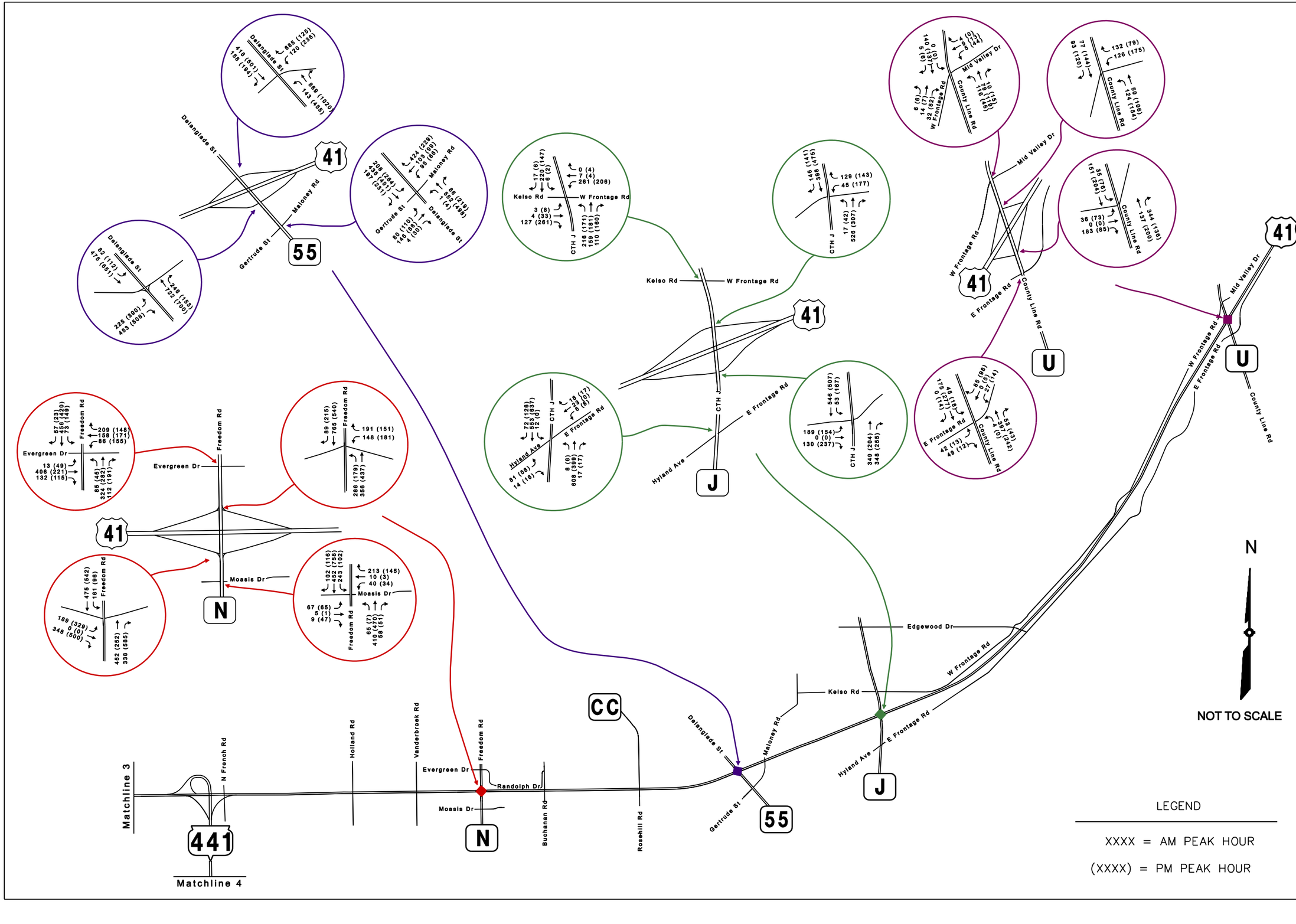
Exhibit D-15

US 41
CTH BB to
WIS 441
(North Interchange)

Sheet 6 of 9

US 41 / WIS 441

2035 BALANCED TURNING MOVEMENT COUNTS



HNTB

Exhibit D-15

US 41
Wis 441 to
County Line Rd.
(CTH U)

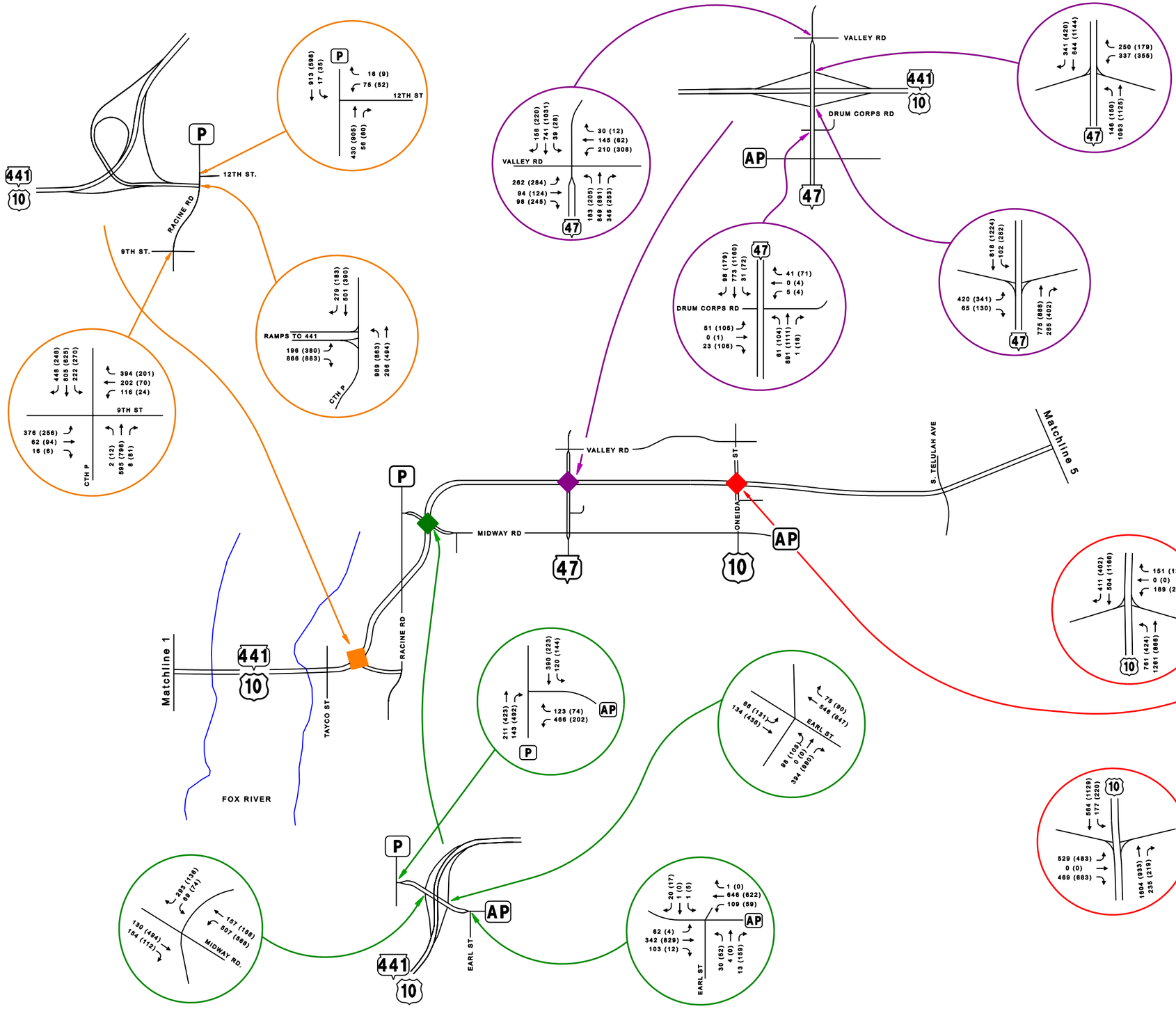
Sheet 7 of 9

WIS 441

2035 BALANCED TURNING MOVEMENT COUNTS

N

NOT TO SCALE



LEGEND

XXXX = AM PEAK HOUR

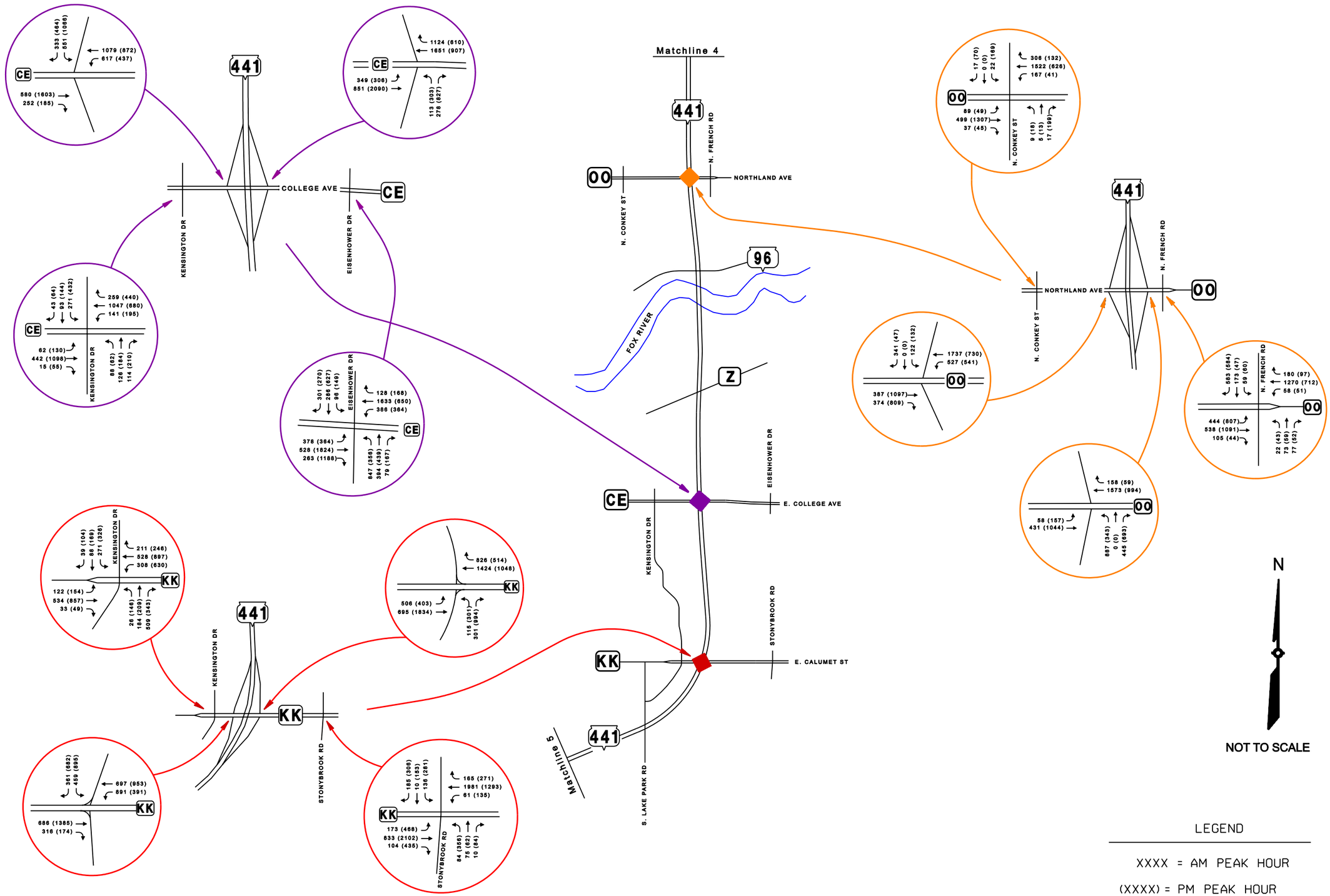
(XXXX) = PM PEAK HOUR

HNTB

Exhibit D-15
WIS 441 / US 10 Butte de Morts to S. Telulah Ave.
Sheet 8 of 9

WIS 441

2035 BALANCED TURNING MOVEMENT COUNTS



N

NOT TO SCALE

LEGEND

XXXX = AM PEAK HOUR

(XXXX) = PM PEAK HOUR

HNTB

Exhibit D-15

WIS 441/US10

CTH KK to CTH OO

Sheet 9 of 9