

M-153 (Ford Road) at I-275 Area Traffic and Environmental Study

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Final Traffic Operations Report

Prepared for:

The Michigan Department of Transportation



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Contents

Executive Summary	1
1.0 Introduction	4
1.1 Existing Traffic Volumes	4
1.2 Existing (2012) Synchro Model Development and Calibration	5
1.3 Existing Conditions Traffic Operations Analysis	6
1.4 Existing (2012) Freeway Operations	7
2.0 Traffic Forecasting	9
2.1 Description of Construction Alternative Traffic Forecasting	9
2.2 Traffic Forecast Results	11
2.2.1 No-Build Alternative Traffic Forecast Results	12
2.2.2 Alternative 2 Traffic Forecast Results	15
2.2.3 Additional Modifications to Alternative 2 and Introduction of Alternative 3	16
2.2.4 Alternative 4 Traffic Forecast Results	19
2.2.5 Alternative 5 Traffic Forecast Results	23
2.3 Operational Analysis Input	25
3.0 Traffic Analysis – Project Year (2035)	26
3.1 Alternative 1 No-Build (2035) Traffic Operations Analysis	26
3.1.1 Alternative 1 No-Build Intersection Operations	26
3.1.2 Alternative 1 No-Build (2035) Freeway Operations	28
3.2 Practical Alternative 2 (2035) Traffic Operations Analysis	30
3.2.1 Alternative 2 (2035) Signalized Intersection Operations	30
3.2.2 Alternative 2 (2035) Freeway Operations	31
3.3 Preferred Alternative 3 (2035) Traffic Operations Analysis	31
3.3.1 Alternative 3 (2035) Freeway Operations	34
3.4 Alternative 4 Traffic Operations Analysis	34
3.4.1 Alternative 4 (2035) Signalized Intersection Operations	34
3.4.2 Alternative 4 (2035) Freeway Operations	35
3.5 Alternative 5 Traffic Operations Analysis	36
3.5.1 Alternative 5 (2035) Signalized Intersection Operations	38
4.0 Sensitivity Analysis	44
4.1 Alternative Truck Route Sensitivity Check	44
4.2 Future Lotz Road Development Sensitivity Check	44

5.0 Conclusion46

Figures

Figure 1 - Project Limits and Traffic Locations.....4
 Figure 2: I-275 @ M-153 (Alternative 4) 11
 Figure 3: 2035 SEMCOG No-Build AM Period LOS 12
 Figure 4: 2035 SEMCOG Select Link Analysis (M-153) – AM Period No-Build..... 13
 Figure 5: 2035 SEMCOG Select Link Analysis (M-153) – PM Period No-Build..... 14
 Figure 6: 2035 SEMCOG LOS (M-153) – PM Peak Period No-Build 15
 Figure 7: SEMCOG LOS (M-153) – PM Peak Period Alternative 2 16
 Figure 8: Alternative 2 Select Link Analysis (AM Period)..... 19
 Figure 9: M-153 @ Haggerty – AM Peak Period No-Build.....20
 Figure 10: M-153 @ Haggerty – AM Peak Period Alternative 420
 Figure 11: 2035 SEMCOG No-Build – PM Peak Period Volume21
 Figure 12: SEMCOG Alternative 4 – PM Peak Period Volume.....22
 Figure 13: SEMCOG No-Build – PM Peak Period Volume23
 Figure 14: SEMCOG Alternative 5 – PM Peak Period Volume.....24
 Figure 15: M-153 @ Haggerty Road – AM Peak Period Alternative 5.....25
 Figure 16: Indirect Lefts at M-153 and Haggerty Road.....33
 Figure 17: Alternative 5 Warren Road Interchange37
 Figure 18: Alternative 5 Cherry Hill Road Interchange38
 Figure 19: Lotz Road Development Geometric Improvements.....45

Tables

Table 1: Existing Intersections with Overall Intersection LOS E or F6
 Table 2: Existing Mainline I-275 Level of Service 7
 Table 3: Existing I-275 Ramp Level of Service 8
 Table 4: AM Period Traffic Volumes and Directional Lanes by Location 17
 Table 5: PM Period Traffic Volumes and Directional Lanes by Location 18
 Table 6: Alternative 1 Mainline I-275 Level of Service29
 Table 7: Alternative 1 M-153 / I-275 Ramp Level of Service30
 Table 8: Alternative 4 M-153 / I-275 Ramp Level of Service36
 Table 9: Projected Alternative 5 Mainline I-275 Level of Service.....41
 Table 10: Alternative 5 Warren Road / I-275 Ramp Level of Service42
 Table 11: Alternative 5 SB I-275 Weave Segment Level of Service43
 Table 12: Lotz Development Traffic Check.....45

Appendices

- Appendix A: Traffic Count Locations
- Appendix B1: Individual Movement Volume Graphics
- Appendix B2: LOS Graphics
- Appendix B3: Travel Demand Modeling Graphics
- Appendix C: Existing SIM Traffic Reports
- Appendix D1: LOS Tables
- Appendix D2: Synchro HCS Reports
- Appendix E: Freeway HCS Reports
- Appendix F1: Travel Demand Model Memo #1
- Appendix F2: Traffic Meeting #3 Notes

Executive Summary

Traffic analysis was performed within the M-153 (Ford Road) at I-275 study area to evaluate existing and future traffic operations. Existing traffic data was gathered and projected to the design year (2035) at a rate of 0.5 % per year based on coordination with the study team including; MDOT, Southeast Michigan Council of Governments (SEMCOG) and Canton Township.

MDOT provided Synchro base models for the M-153 corridor for the AM peak, PM peak, and off-peak which were coded with 2012 traffic counts and calibrated to documented and observed field conditions. The 2035 future traffic volumes were then calculated based on the 0.5 % growth rate. These volumes were utilized to develop the future Synchro models. Freeway segments merge and diverge operations were analyzed using Highway capacity Software, version 5.3 (HCS+).

The SEMCOG Travel Demand Model (TDM) was used for testing construction alternatives for M-153 / I-275 intended to alleviate existing and projected traffic concerns. CDM Smith coded the network changes associated with these construction alternatives into the TDM and changes in traffic volumes observed in the TDM were coded in alternative Synchro model.

The No-Build and four build alternatives were analyzed for the future traffic conditions in the study area and are summarized below.

Alternative 1 - No-Build Alternative

Alternative 1 provided a “No-Build” option to be used as a benchmark for comparison of the construction alternatives. Alternative 1 included minor improvements to the existing signal network such as phasing optimization and split modifications. Operational performance results are summarized below:

- Overall LOS degraded along M-153 between 2012 existing and 2035 No-Build, primarily at the intersections of Haggerty Road, Lilley Road and Sheldon Road
- Existing 2012 LOS E (61.0 seconds of delay per vehicle) degraded to LOS F (94.7s) for the 2035 No-Build, during the off-peak hour at Sheldon Road.
- Delay at Haggerty Road increased from 99 seconds (LOS F) existing 2012, to 114.7 seconds (LOS F) No-Build during the PM peak hour

Alternative 2 – Operational Improvements

Alternative 2 provided basic geometric improvements to enhance operations primarily along the M-153 corridor, based on the existing configuration. An additional WB through lane was added from I-275 to Sheldon Road and a EB through lane from I-275 to Lilley Road. Alternative 2 also included signal improvements such as phasing optimization and split modifications. Operational performance results are summarized below:

- Attracts approximately 15-20 % more EB and WB vehicles based on the TDM results

- Additional EB and WB left turn lanes required at M-153/Lilley Road, and additional NB, SB, EB and WB left turn lanes required at M-153/Haggerty Road. With these capacity increases operations are still predicted to fail with Overall LOS E at M-153/Haggerty Road.

Alternative 3 – Ford Road Boulevard

Alternative 3 provides a boulevard along the M-153 corridor with 4 lanes from Sheldon Road to Lilley Road (WB) and Ikea Drive (EB) and 3 WB lanes from Lilley Road/IKEA Drive to I-275. The boulevard section will be tapered to the existing cross section beyond these limits. Michigan left intersections (no direct left turns) are proposed at each of the main signalized intersections (Sheldon Road, Morton Taylor Road, Lilley Road, and Haggerty Road). A boulevard median u-turn will be provided on north and south Haggerty Road, to prevent the need for a u-turn on M-153 east of Haggerty Road, which would create operational difficulties with the close proximity of the I-275 SB exit ramp terminal. Operational performance results are summarized below:

- Improves overall intersection operations along the boulevard portion of M-153 to a LOS C or better, and overall LOS D or better for remaining intersections.
- Improves individual turning movements along M-153 to LOS D or better

Alternative 4 – WWTIP Study

Alternative 4 was based on the Western Wayne Transportation Improvement Study alternative, which provides additional I-275 SB exit ramps to Haggerty Road at the M-153 interchange. The SB exit ramp develops into a 3-way split to Haggerty Road north, M-153, and Haggerty Road south. A NB auxiliary lane is proposed east of I-275 between Cherry Hill Road and M-153. The goal of this alternative was to divert traffic away from the M-153 and Haggerty Road intersection. No additional improvements were analyzed on M-153. Operational performance results are summarized below:

- Haggerty ramp terminal intersections operate at overall LOS C or better
- M-153 and Haggerty Road operates at overall LOS D during the AM and off-peak, and LOS F (157.7) during the PM Peak.
- Further M-153 improvements required.

Alternative 5 –Warren and Cherry Hill Interchanges

Alternative 5 provides two additional full access I-275 interchanges at Warren Road and Cherry Hill Road. New signals are proposed at each of the four ramp terminals, and a 5 lane section is proposed on Warren Road. The goal of this alternative was to divert traffic away from the M-153 and Haggerty Road intersection. No additional improvements were analyzed on M-153. Operational performance results are summarized below:

- Diverts up to approximately 10 percent of Ford traffic to new interchanges.
- Overall intersection LOS for the new ramps at the Warren Road and Cherry Hill Road interchanges are projected to operate at LOS D or better.

- All individual turning movements are projected to operate at LOS D or better, with the exception of the SB Warren Ramp terminal EB right which is projected to operate at LOS F (83.4s) during the AM period and LOS E (79.2s, 78.2s) during the PM and off-peak periods.
- The Warren Road and Haggerty Road intersection is projected to operate at LOS D or better with several movements at LOS E, even with the geometric enhancements
- Further M-153 corridor and M-153 and Haggerty Road intersection improvements required.

1.0 Introduction

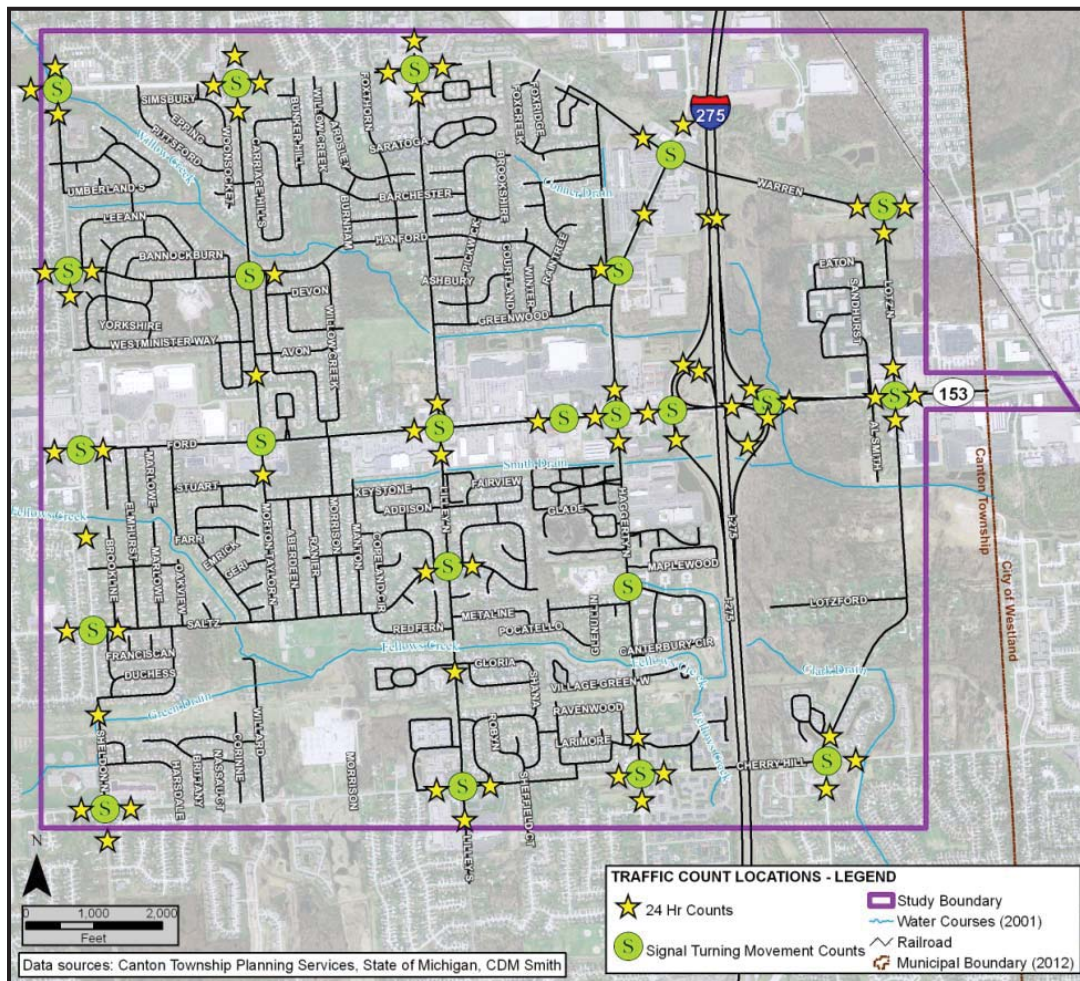
A traffic analysis was performed as part of the M-153 (Ford Road) at I-275 Area, Traffic and Environmental Study. This traffic memorandum is intended to provide information on the traffic analysis and results, as a supplement to the main report under separate title ***M-153 (Ford Road) Area, Traffic and Environmental Study, Final Report.***

The focus of the traffic analysis was to test the operational performance of each of the alternatives based on the existing network traffic conditions projected to 2035 traffic volumes. This memorandum documents the analysis procedures and any operational deficiencies identified for each alternative.

1.1 Existing Traffic Volumes

Existing traffic volumes were collected within the project study limits as displayed below in **Figure 1**. The data collected included individual movement counts (AM peak hour, PM peak hour, and Off-Peak hour) and 24-Hour traffic counts. MDOT also provided traffic signal design and timing Plans.

Figure 1 - Project Limits and Traffic Locations



The 24-hour traffic counts (including vehicle classification) were performed between Monday, March 19, 2012 and Monday, April 2, 2012 and encompassed the surface street network in the vicinity of the M-153 / I-275 interchange and the existing I-275 interchange ramps at the M-153, Ann Arbor Road, and Michigan Ave interchanges.

In addition to 24-hour traffic counts, individual movement counts (including vehicle classification and pedestrian counts) were also provided at each of the project area signalized intersections. The individual movement counts were performed between Monday, March 19, 2012 and Tuesday, April 3, 2012 and captured the morning, evening, and off-peak time periods. Morning (AM) peak hour counts were performed between 7:00 am and 8:15 am, evening (PM) peak hour counts were performed from 4:30 pm to 6:00 pm and the Off-Peak (OP) counts were performed on Saturday afternoons between noon and 4:15 pm. **Appendix A** details the count locations.

Individual movement volumes for each of the study area intersections were reasonably balanced where appropriate. Due to the extent of both residential and commercial development within the project area and the distance between several of the project area intersections, traffic volume balancing was limited to primarily the segment of M-153 between Haggerty Road and Lotz Road due to the lack of access points within this stretch of roadway. The existing weekday morning, evening, and off-peak traffic volumes are shown in **Appendix B1**.

1.2 Existing (2012) Synchro Model Development and Calibration

Separate AM peak, PM peak, and off-peak Synchro base models were provided by MDOT for the entire portion of M-153 within the project limits, with the exception of the M-153/Lotz Road intersection. These base models were supplemented with the remaining project area intersections based upon field data gathered (link lengths, lane configurations, speed limits, traffic signal timing/phasing, etc.) and according to the guidelines presented in the MDOT Michigan Signal Optimization Guidelines.

After the base Synchro models were developed, the models were calibrated to ensure the models replicate actual field conditions. Per the MDOT Michigan Signal Optimization Guidelines, the primary calibration measure was the use of SimTraffic reports for Volume Exited (see **Appendix C** for the SimTraffic Volume Exited reports). This report was utilized to assure that the actual volume levels observed in the field were replicated by the SimTraffic model. The greater of $\pm 10\%$ or ± 20 vehicles was considered a reasonable threshold for model validation. On approaches where the volume was very low, the ± 20 vehicle rule was applied. Field-collected videos of the existing traffic operations and queuing were utilized as a second measure for the calibration of the existing SimTraffic models. Existing queuing and signal timings were compared to the SimTraffic output to verify the models were accurately replicating not only the traffic volumes serviced, but also the level of performance the actual existing intersections provide. Minor modifications to the default model input parameters were performed until the SimTraffic thresholds described above were met.

1.3 Existing Conditions Traffic Operations Analysis

Based upon the existing traffic counts, traffic signal timing permits, field observations, traffic peaking characteristics, and intersection geometry, a level of service (LOS) analysis was conducted for the project area intersections, mainline I-275 freeway links both north and south of M-153, and the M-153/I-275 interchange ramps. Synchro (v7) was utilized to evaluate the existing signalized intersections while HCS+ was utilized to evaluate the existing mainline I-275 and M-153/I-275 interchange operations.

The existing operations are documented in **Appendix B2**, which graphically presents the overall LOS operations, **Appendix D1**, which displays the LOS tables for each intersection per individual movement and **Appendix D2** which shows the Synchro output reports.

The majority of the intersections are currently operating at acceptable overall intersection LOS D or better each peak period, with exceptions noted in **Table 1**.

Table 1: Existing Intersections with Overall Intersection LOS E or F

Intersection	Period of <u>Overall Intersection</u> LOS E or F
M-153 & Haggerty Road	AM & PM Peak Hour
M-153 & Lilley Road	PM & Off-Peak Hour
M-153 & Sheldon Road	Off-Peak Hour
Warren & Haggerty Road	AM Peak Hour

It is important to note that although the overall level of service at all intersections is LOS D or higher, individual lane movements may currently operate at LOS E or F (see **Appendix D1**).

The results shown in **Table 1** above were verified based upon field observations. The intersection of M-153/Haggerty Road was observed to cause significant queues during the AM, PM, and off-peak hours. WB M-153 traffic queues from the Haggerty Road intersection extend through the SB I-275 ramp intersection to the east and onto the SB ramp, particularly during the evening peak hour. This is due to the short distance between this intersection and the M-153/I-275 SB exit ramp (approximately 730 feet), the high volume of M-153 traffic, the high volume of SB I-275 exit traffic turning right onto WB M-153, and the high volume of traffic at the M-153/Haggerty Road intersection. The WB queues from M-153/Haggerty Road and onto SB I-275 were observed to extend onto mainline I-275 affecting operations on mainline SB I-275 during the evening peak hour. While queues at the remaining intersections were not observed to be as significant as those at the Haggerty Road and SB I-275 ramp intersection, significant queues were also observed at the remaining M-153 signalized intersections during all of the analysis periods. Based on public observations, WB traffic also reportedly queues from

Haggerty Road to east of Lotz Road occasionally. This condition was not observed during field reviews of the peak and off-peak hours noted in the “Existing Traffic Volumes” portion of this report or in the SimTraffic simulation.

In addition, field observations at the Warren Road/Haggerty Road intersection during the AM peak hour showed extensive northbound Haggerty Road queues. Currently, the NB Haggerty Road approach at this intersection consists of an exclusive left-turn lane, an exclusive through lane, and an exclusive right-turn lane. The existing exclusive right-turn lane forms as a through lane drop at the intersection. North of the intersection, a lane taper exists to drop what appears to have been a second northbound through lane in the past. During the morning peak hour, aggressive driving behaviors were observed, including through vehicles often queued in the existing exclusive right-turn lane during red light phases utilizing this existing lane drop taper north of the intersection to merge with the remaining through traffic.

1.4 Existing (2012) Freeway Operations

As shown in **Appendix B2** and **Table 2** below, I-275 traffic currently experiences acceptable (LOS D or better) operations during the study periods throughout the project area. See **Appendix E** for the HCS output reports detailing the LOS analysis results for the mainline Freeway segments and ramp junctions.

Table 2: Existing Mainline I-275 Level of Service

Freeway Segment	Existing (2012) Conditions		
	AM Peak	PM Peak	Off-Peak
	LOS / Density (vphpl)	LOS / Density (vphpl)	LOS / Density (vphpl)
NB I-275 from US-12 to M-153	C / 22.3	C / 24.2	B / 14.3
SB I-275 from US-12 to M-153	C / 22.4	C / 24.7	B / 13.5
NB I-275 from M-153 to Ann Arbor Road	D / 31.5	C / 26.0	B / 17.6
SB I-275 from M-153 to Ann Arbor Road	C / 22.9	D / 34.1	C / 19.8

As discussed earlier, while SB I-275 between Ann Arbor Road and M-153 is shown to operate at LOS C under existing PM peak conditions, field observations show this section of I-275 may occasionally experiences congested operations due to queuing from the Haggerty Road / M-153 and SB I-275 Exit Ramp / M-153 intersections onto the freeway.

Table 3 presents the LOS analyses results for the ramp junctions on I-275 within the project limits. All ramp junctions are currently calculated to operate at LOS D or better during all analysis periods however, the SB I-275 exit ramp to M-153 occasionally was observed to queue onto SB I-275 due to the operations at the existing M-153/SB I-275 exit ramp intersection operations.

Table 3: Existing I-275 Ramp Level of Service

Ramp From / To	Merge / Diverge	Existing (2012) Conditions		
		AM Peak	PM Peak	Off Peak
		LOS / Density (pcpmpl)	LOS / Density (pcpmpl)	LOS / Density (pcpmpl)
NB I-275 to M-153	Diverge	D / 28.3	D / 29.9	C / 20.5
EB M-153 to SB I-275	Merge	C / 25.3	C / 26.8	B / 16.4
EB M-153 to NB I-275	Merge	D / 31.1	C / 24.6	B / 19.2
WB M-153 to SB I-275	Merge	B / 18.6	C / 21.7	A / 9.7
WB M-153 to NB I-275	Merge	D / 32.4	C / 27.7	B / 19.7
SB I-275 to M-153	Diverge	C / 22.9	D / 31.1	C / 21.9

2.0 Traffic Forecasting

The 2012 existing traffic volumes were forecast to 2035 design year traffic volumes utilizing the 2035 Southeast Michigan Council of Governments (SEMCOG) regional travel demand model (TDM) for the No-Build and build alternative. The traffic volume distribution presented in this section may be different than those developed for the operational analysis, which is expected because the traffic volumes developed from this analysis were based upon the regional model for testing of changes in macro level traffic patterns rather than analyzing traffic patterns specific to the study area (micro level analysis). The outputs of the SEMCOG 2035 regional model for the tested alternatives can be found in **Appendix B3** of this report and include maps of the AM, PM and mid-day periods for the defined study area.

A critical element of this study was the development of 2035 volumes for input into the operational analysis. These traffic volumes included not only the future No-Build option but, also each of the construction alternatives. The study team met with MDOT, SEMCOG and Canton Township to determine the appropriate forecasting method and assumptions. This method was documented in a memo from the project team dated May 24th, 2012, located in **Appendix F1**.

The study team agreed that a growth rate of 0.5% per year should be applied which is aggressive and greater than the 0.3% network growth embedded in the SEMCOG model, however it captures the higher growth anticipated in the smaller study area over the short and mid-term. The following forecasting approach was established, utilizing the SEMCOG Travel Demand Model (TDM) as a base:

- For analysis of base conditions, the collected 2012 traffic count data was used as an input to the micro-simulation model (Synchro v7).
- For development of the No-Build forecast, the 0.5% growth rates were applied to the traffic count data.
- For testing of alternatives for M-153 / I-275, CDM Smith coded the network changes into the TDM. Changes in traffic volumes observed in the TDM were adjusted to the forecast counts for inputs into Synchro based on the percentage difference between the TDM No-Build and construction alternatives.

2.1 Description of Construction Alternative Traffic Forecasting

Using the 2035 SEMCOG Regional Travel Demand Model, four alternatives plus the No-Build were tested. As agreed upon by the study team, a fixed trip table approach was used for this analysis. The advantage to using a fixed trip table for the No-Build and construction alternative networks was that the results can be compared easily and the differences based purely on changes in travel time and congestion relief. The following provides a brief description of the traffic operations for each alternative analyzed in the TDM. A detailed discussion of each alternative is included below in **Section 3.0**.

Alternative 1 – No-Build

Alternative 1 is based on the SEMCOG long range plan network. The only change made to the SEMCOG network was the additional coding of Lotz Road from Cherry Hill to M-153. The road was coded as a local street in the alternatives, but the speed was lowered to 15mph in all alternatives to reflect the dirt surface.

Alternative 2 Operational Improvements

Alternative 2 was originally developed using the same geographic layout as the No-Build with the addition of a westbound lane of capacity on M-153 between the eastern side of the I-275 interchange through to the intersection with Sheldon Road, and no-additional EB capacity. This alternative was later modified to include an additional eastbound lane between Lilley Road and Haggerty Road based on input received at a team meeting as documented in **Appendix F2**. This alternative also includes the lowered speed on Lotz Road from M-153 to Cherry Hill.

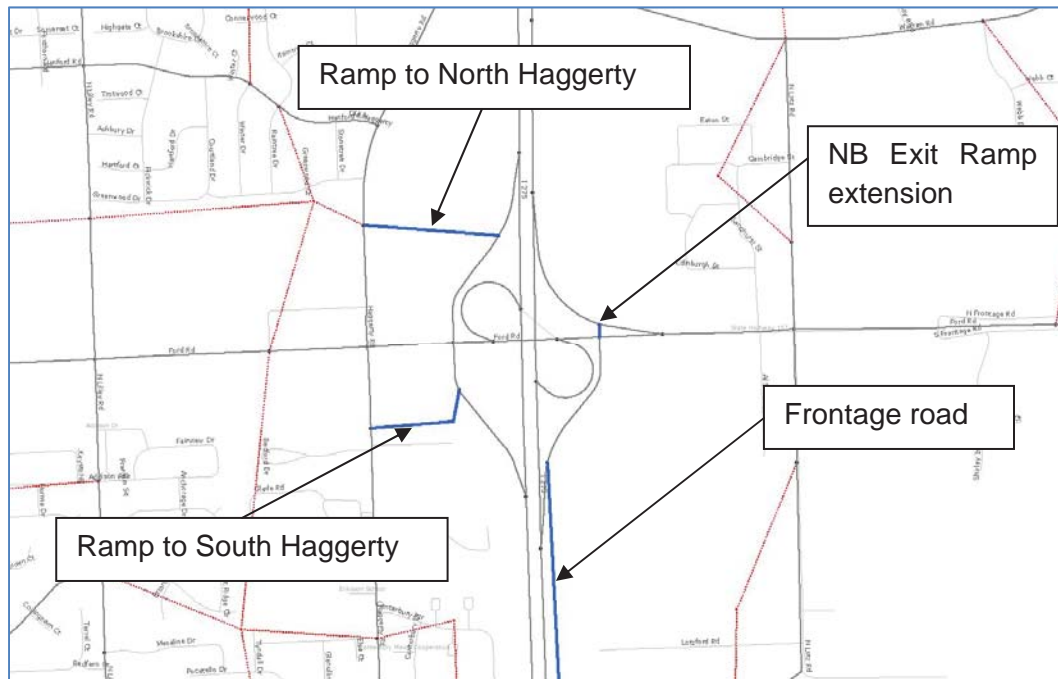
Alternative 3 – M-153 Boulevard

Alternative 3 includes a boulevard on M-153 from Sheldon Road to the SB I-275 ramps. This alternative was originally not modeled as the segment lanage closely matched the no-build conditions, and the model does not allow intersections to be modeled, therefore the results would have been very similar. Later in the study the boulevard roadway section was widened to three lanes WB between Haggerty Road and Lilley Road and three EB lanes between the Ikea drive and Haggerty Road. Therefore Alternative 3 was subsequently modeled based on input received at a team meeting as documented in **Appendix F2**. The geographic layout was coded similar to Alternative 1 traffic movements with the additional lanage on M-153. This alternative also includes the lowered speed on Lotz Road from M-153 to Cherry Hill.

Alternative 4

Alternative 4 generally assumes the same traffic movements as the No-Build configuration of M-153 (see **Figure 2**), with the exception of the following elements:

- Frontage Road: One way frontage road connecting Cherry Hill to the Northbound on Ramp from I-275 providing access to M-153 or NB I-275 on-ramp.
- I-275 NB Ramp: connection from NB off ramp to NB on ramp to provide NB access to I-275 for frontage road.
- I-275 SB off Ramps: additional connections provide access to Haggerty north and south of M-153 from existing I-275 ramps.

Figure 2: I-275 @ M-153 (Alternative 4)**Alternative 5 Description**

Alternative 5 provides full access interchanges at Warren Road and Cherry Hill Road. An auxiliary lane will connect the Warren Road interchange SB I-275 entrance ramp to the exit ramp to M-153. Both interchanges will consist of a diamond ramp configuration for all ramp movements exempt for a loop ramp for the NB exits. Alternative 5 generally assumes the same traffic movements as the No-Build configuration of M-153 with the exception of the new interchanges and operational improvements along Warren Road and Cherry Hill Road within the vicinity of the interchanges

Three variations of alternative 5 were modeled:

- Warren and Cherry Hill Interchanges
- Cherry Hill only
- Warren only

This report focuses on the results of alternative 5a.

2.2 Traffic Forecast Results

The intent of each alternative was to improve operations on M-153 within the study area. Based on the outputs of the SEMCOG Model, some of the alternatives were more successful than others. The TDM outputs and link ID's for each alternative are located in **Appendix B3**.

2.2.1 No-Build Alternative Traffic Forecast Results

To understand the impact of the alternatives on the conditions within the study area, it is important to first understand how the SEMCOG Model views the conditions in 2035. **Figure 3** below shows the study area with each model link colored by the AM Period LOS based on the volume to capacity ratio. The capacities used in the calculation are those used by the model. Note that the model volumes are based on peak period with a 2-hour AM period, 3-hour PM period, and a 6-hour off peak period.

Figure 3: 2035 SEMCOG No-Build AM Period LOS

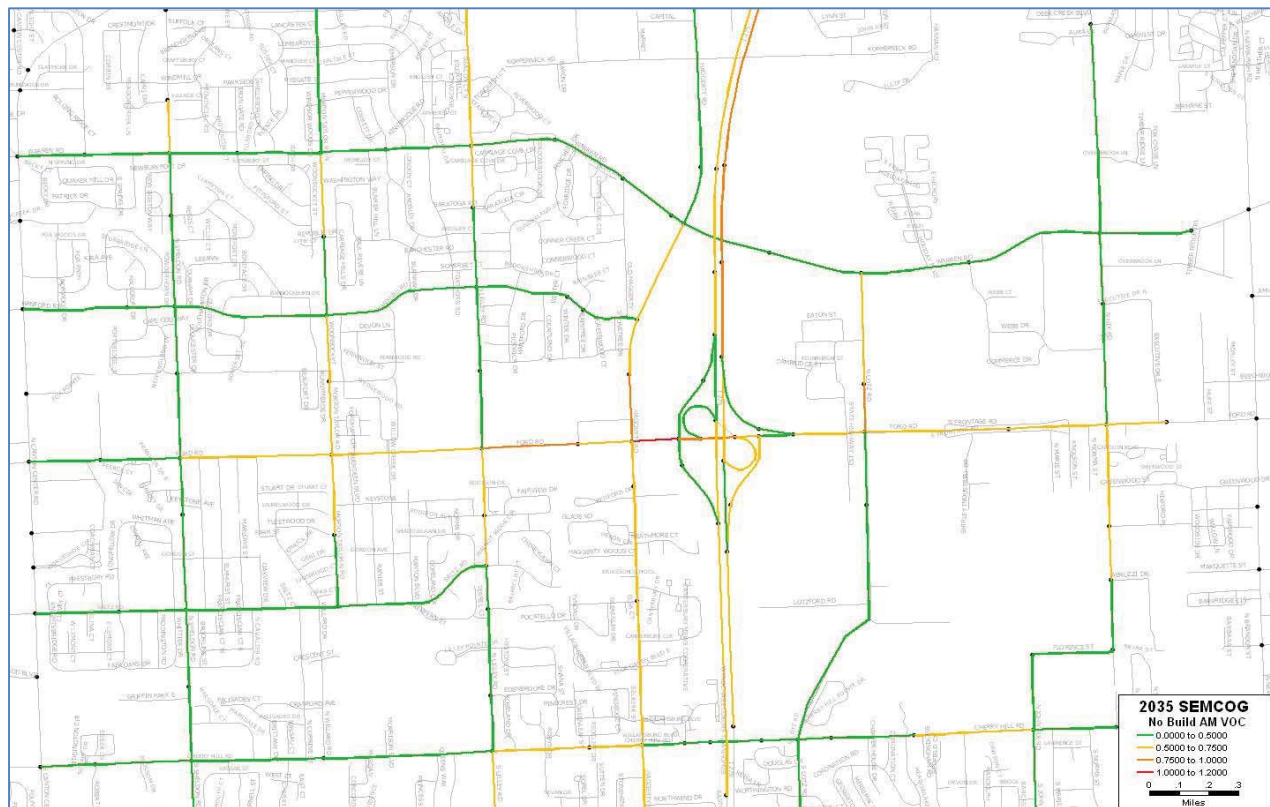


Figure 3 not only depicts the poor conditions on M-153 throughout the study area, but also high levels of congestion on Haggerty Road from Warren Road to south of Cherry Hill Road. The worst area of congestion is between the I-275 SB ramps and Haggerty Road on M-153 with a V/C ratio exceeding 1.0. Realizing that this particular link is of high congestion, it was important to understand the distribution of traffic through this link as it has bearing on the success of the alternatives.

To understand the utilization of M-153 between the I-275 SB ramps and Haggerty Road, a select link analysis was done using the SEMCOG Model on the No-Build alternative in the WB direction for AM and PM conditions as shown below in **Figures 4-5**. The following figures show graphically the utilization of this link and how the volumes disseminate through the system.

The weighted lines and period volumes show that the significant movement on M-153 WB is the through movement at Haggerty Road, but also important is the volume of the left turn traffic that appears to be generated from the SB off ramp. In the AM Peak Period, 85% of the vehicles making the left turn are generated from the I-275 SB off ramp. This percentage is consistent with the PM peak period as well. This conclusion was based on running an additional select link analysis on the I-275 SB off ramp.

Figure 4: 2035 SEMCOG Select Link Analysis (M-153) – AM Period No-Build

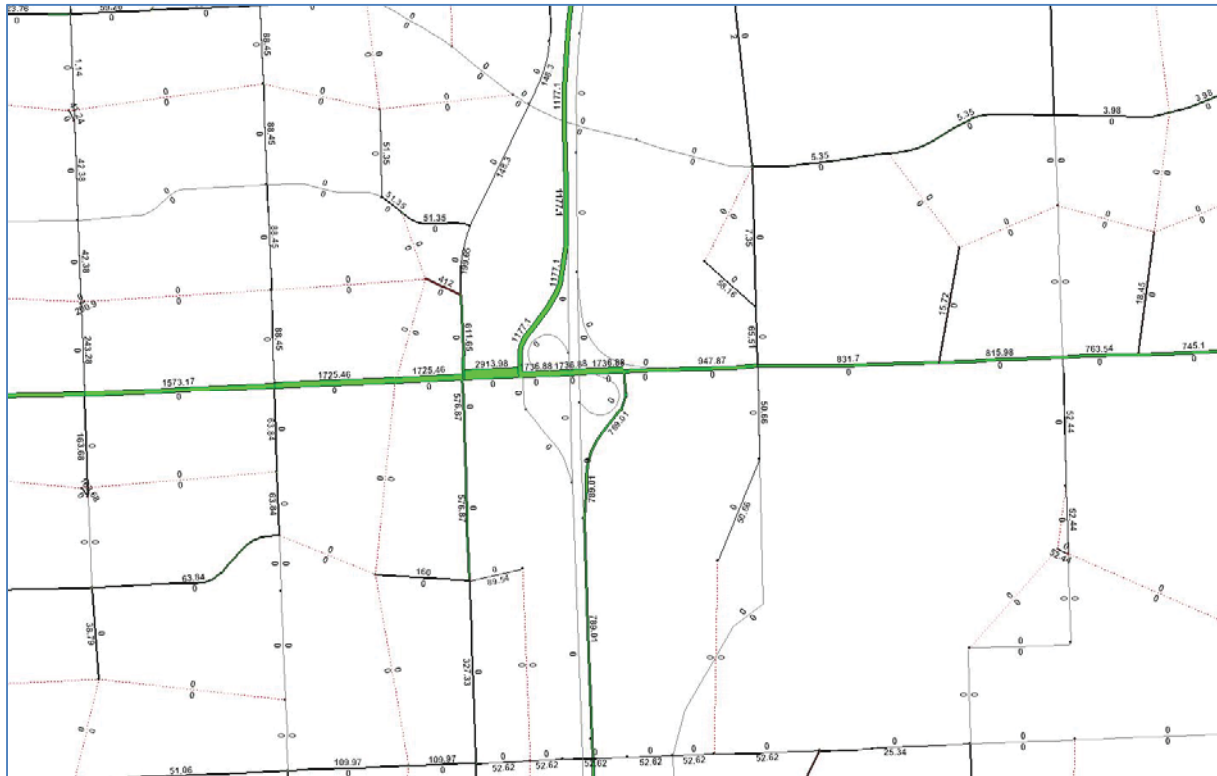
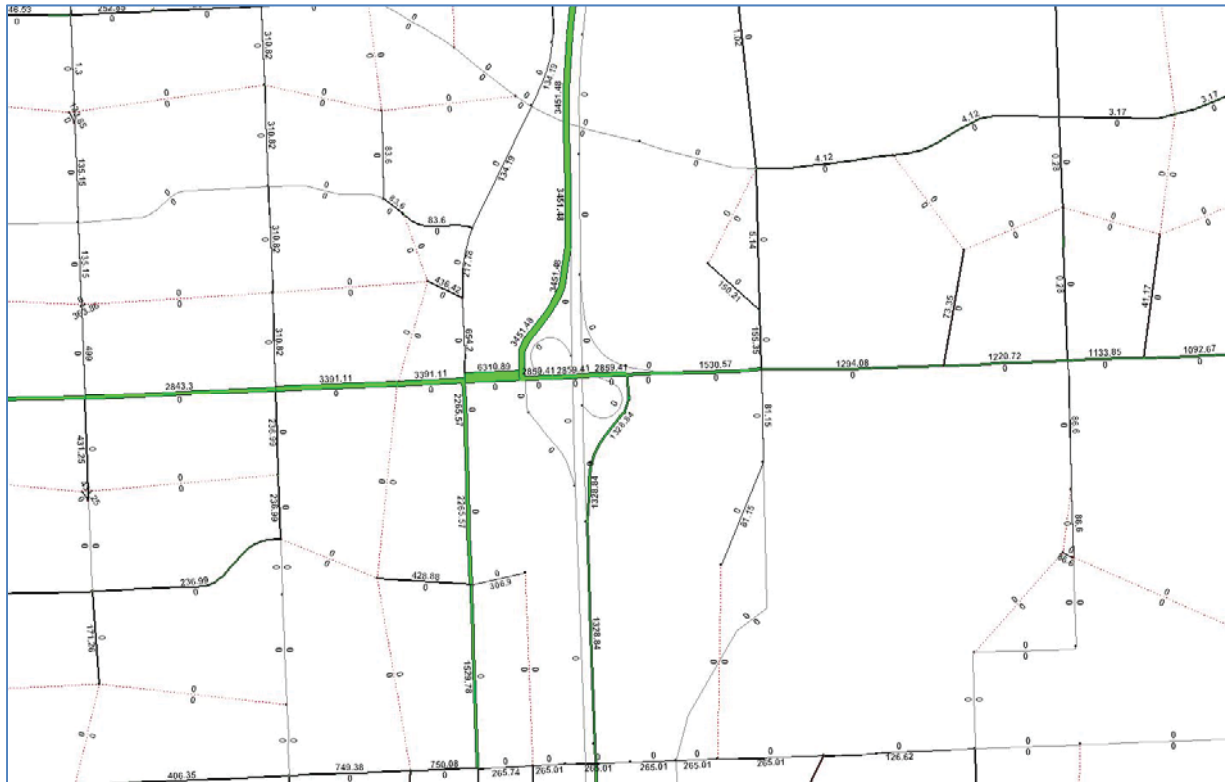


Figure 5: 2035 SEMCOG Select Link Analysis (M-153) – PM Period No-Build



2.2.2 Alternative 2 Traffic Forecast Results

The intent of Alternative 2 was to reduce the congestion on M-153 between the I-275 interchange and Sheldon Road. Based on the initial travel demand model effort with only westbound capacity improvements, an unintended consequence of the additional capacity was an increase in traffic on the WB lanes. To understand the impact of the alternative, the following graphics (**Figures 6-7**) were developed to compare the PM peak period volumes along M-153 under the No-Build and Alternative 2 scenarios. The links are colored by level of service ranges based on the volume to capacity ratio.

Figure 6: 2035 SEMCOG LOS (M-153) – PM Peak Period No-Build

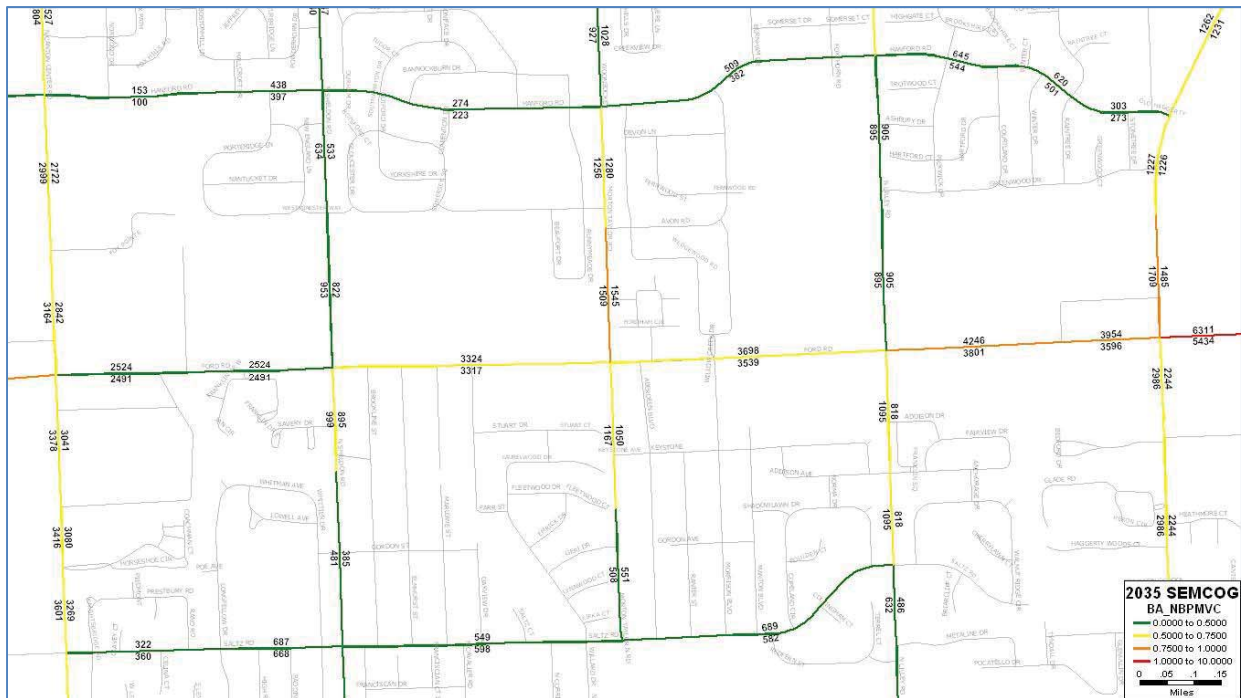
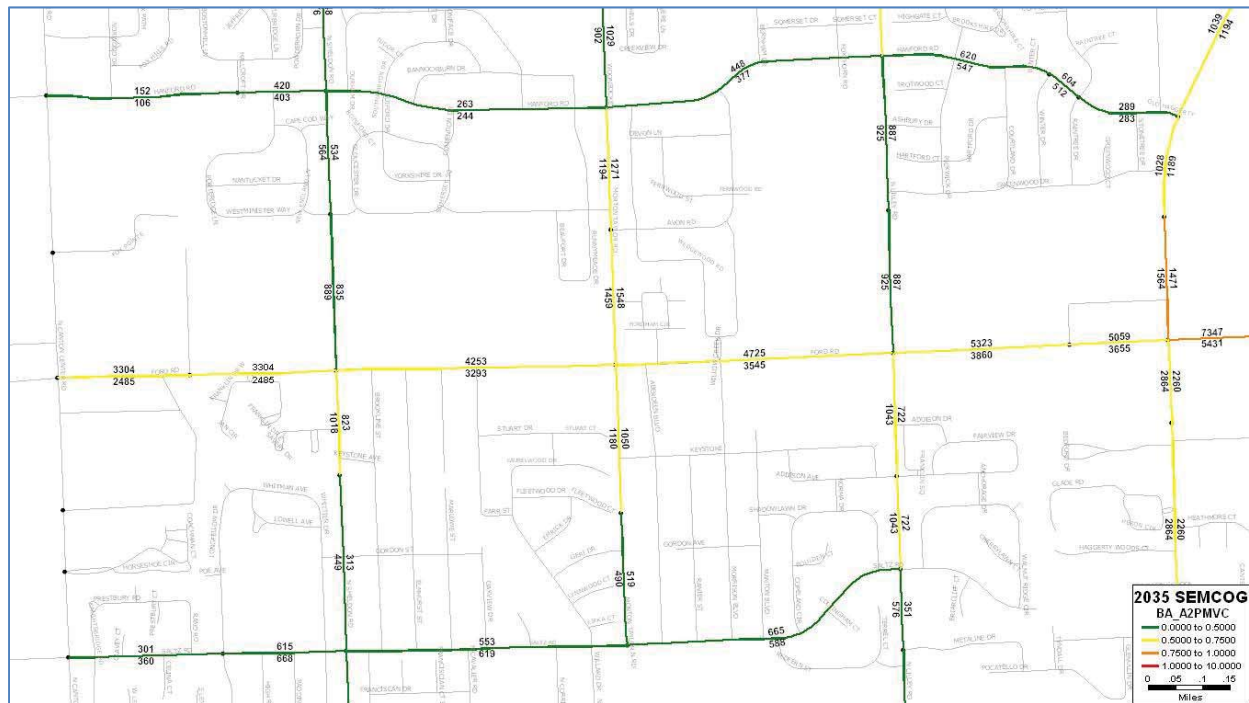


Figure 7: SEMCOG LOS (M-153) – PM Peak Period Alternative 2



The travel demand model calculated volume to capacity ratio or LOS for Alternative 2 in the WB direction slightly improves operations between I-275 and Lilley Road despite the addition of nearly 25 % more vehicles in the section east of Lilley Road. West of Lilley Road to Sheldon Road, the LOS maintains at the same level or worsens because of the increased traffic drawn by the increased WB capacity. Note that this LOS does not account for intersection operations and LOS.

2.2.3 Additional Modifications to Alternative 2 and Introduction of Alternative 3

Alternative 2 was modified to reflect modifications made to the alternative during the study, which included additional EB capacity between Lilley Road and Haggerty Road. Alternative 3 was also modeled based on additional capacity introduced during the project, which included an additional WB lane between Lilley Road and Haggerty Road and an additional EB lane between the Ikea Drive and Haggerty Road. The intent of the revised modeling was to provide an “apples to apples” comparison of anticipated volume increases for both alternatives that were reflective of the latest geometry. **Tables 4 and 5** below document the changes to the segment volumes for each alternative in comparison to the Alternative 1 - No-Build case for the AM and PM peak periods for some key locations in the study area.

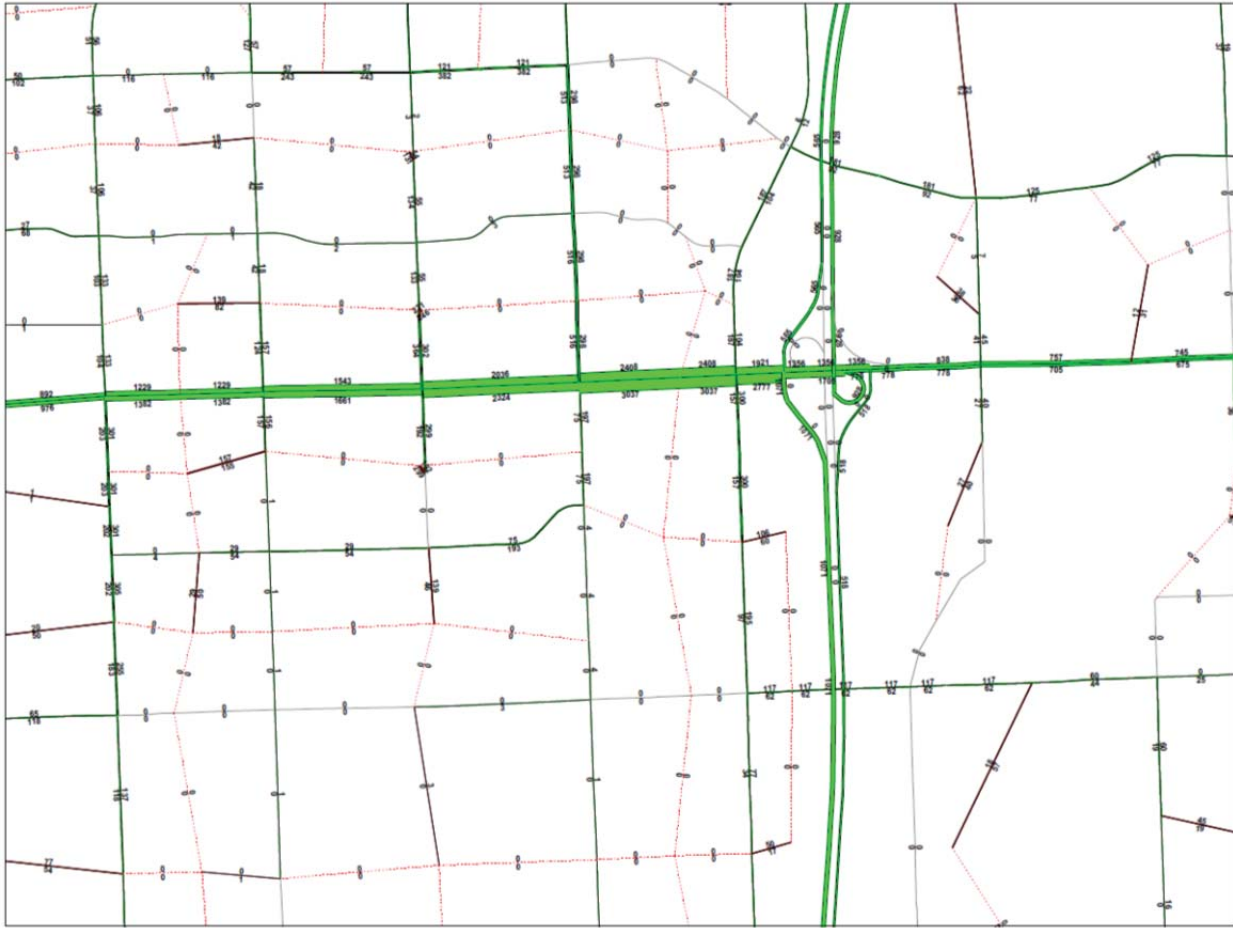
Table 4: AM Period Traffic Volumes and Directional Lanes by Location

Road	Location	Direction	REF	ALT2	ALT3	REF	ALT2	ALT3
Ford	I-275 to Haggerty	EB	4024	4511	4511	2	3	3
		WB	2917	3102	3063	2	3	3
	E of Lilley	EB	2697	3202	3196	2	3	2/3
		WB	2207	2460	2392	2	3	3
	W of Lilley	EB	2308	2530	2526	2	2	2
		WB	2043	2204	2132	2	3	2
Haggerty	N of Ford	NB	1045	1008	1009			
		SB	769	763	755			
	S of Ford	NB	1926	1926	1917			
		SB	925	901	906			
Lilley	N of Ford	NB	501	530	531			
		SB	354	617	616			
	S of Ford	NB	628	577	576			
		SB	256	250	250			

Table 5: PM Period Traffic Volumes and Directional Lanes by Location

Road	Location	Direction	REF	ALT2	ALT3	REF	ALT2	ALT3
Ford	I-275 to Haggerty	EB	5434	5994	6020	2	3	3
		WB	6311	7464	7350	2	3	3
	E of Lilley	EB	3811	4376	4350	2	3	2/3
		WB	4231	5344	5089	2	3	3
	W of Lilley	EB	3541	3713	3689	2	2	2
		WB	3681	4745	3993	2	3	2
Haggerty	N of Ford	NB	1482	1420	1426			
		SB	1709	1591	1577			
	S of Ford	NB	2237	2265	2254			
		SB	3007	2960	3013			
Lilley	N of Ford	NB	902	794	1063			
		SB	907	1033	974			
	S of Ford	NB	813	714	698			
		SB	1097	888	1044			

As expected, Alternatives 2 and 3 provide additional capacity to the Ford Road corridor, and thus are able to accommodate more traffic. A select link analysis was completed for M-153, west of Haggerty Road for Alternative 2 during the AM peak to understand the change in traffic that was drawn to the improved corridor in comparison to Alternative 1 (**Figure 4**) as displayed below in **Figure 8**.

Figure 8: Alternative 2 Select Link Analysis (AM Period)

The pattern of traffic between Alternative 2 and 3 is nearly identical, which shows the some additional traffic on M-153 in the peak direction coming from the western end of the study area.

2.2.4 Alternative 4 Traffic Forecast Results

Alternative 4 was intended to reduce the congestion at the M-153 and Haggerty Road intersection by providing direct access to Haggerty Road from the I-275 SB off ramps as shown above in **Figure 2: I-275 @ M-153 (Alternative 4)**. A significant amount of the WB left turns at M-153 and Haggerty Road derive from the I-275 WB off ramp, therefore by providing direct access to Haggerty Road it will reduce some of the traffic demand at M-153 and Haggerty Road. **Figures 9-10** shows the select link analysis of the reduction in WB left turning traffic between No-Build and Alternative 4.

Figure 9: M-153 @ Haggerty – AM Peak Period No-Build

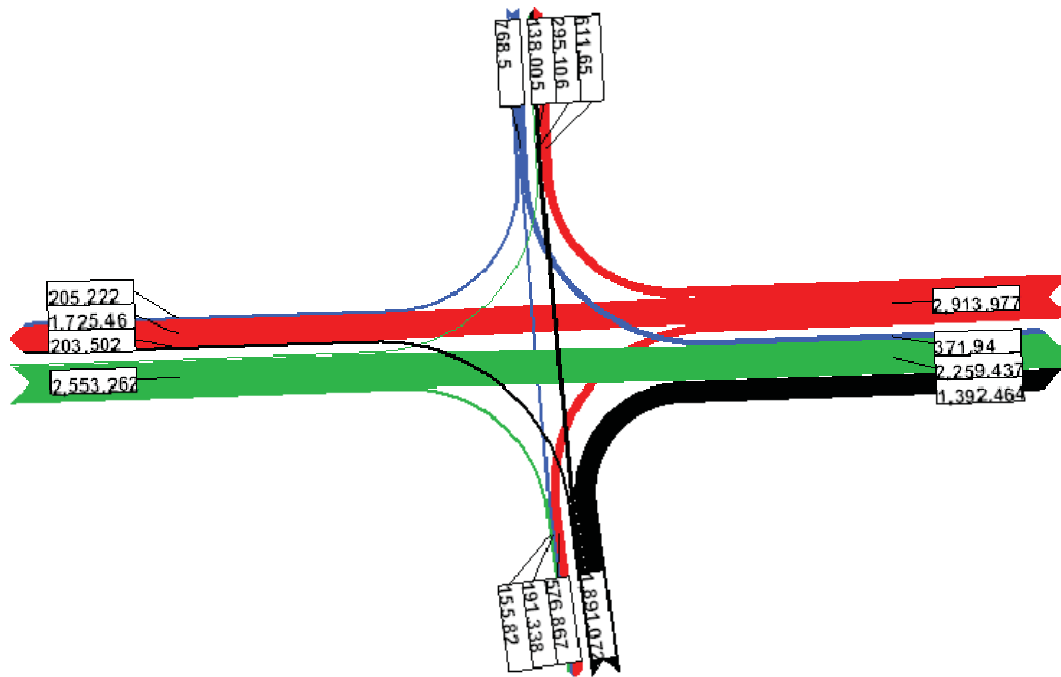
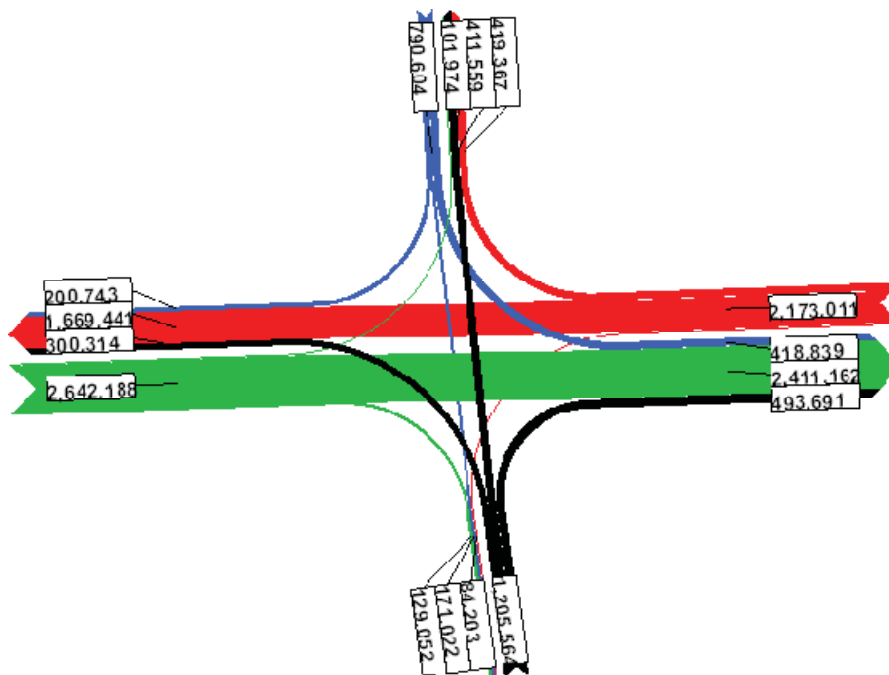


Figure 10: M-153 @ Haggerty – AM Peak Period Alternative 4



Figures 11-12 below shows the volume comparison for the PM peak period between the No-Build alternative and Alternative 4. The net result shows a slight decrease in volume on M-153 west of the interchange as seen in the above figures.

Figure 14: SEMCOG Alternative 5 – PM Peak Period Volume

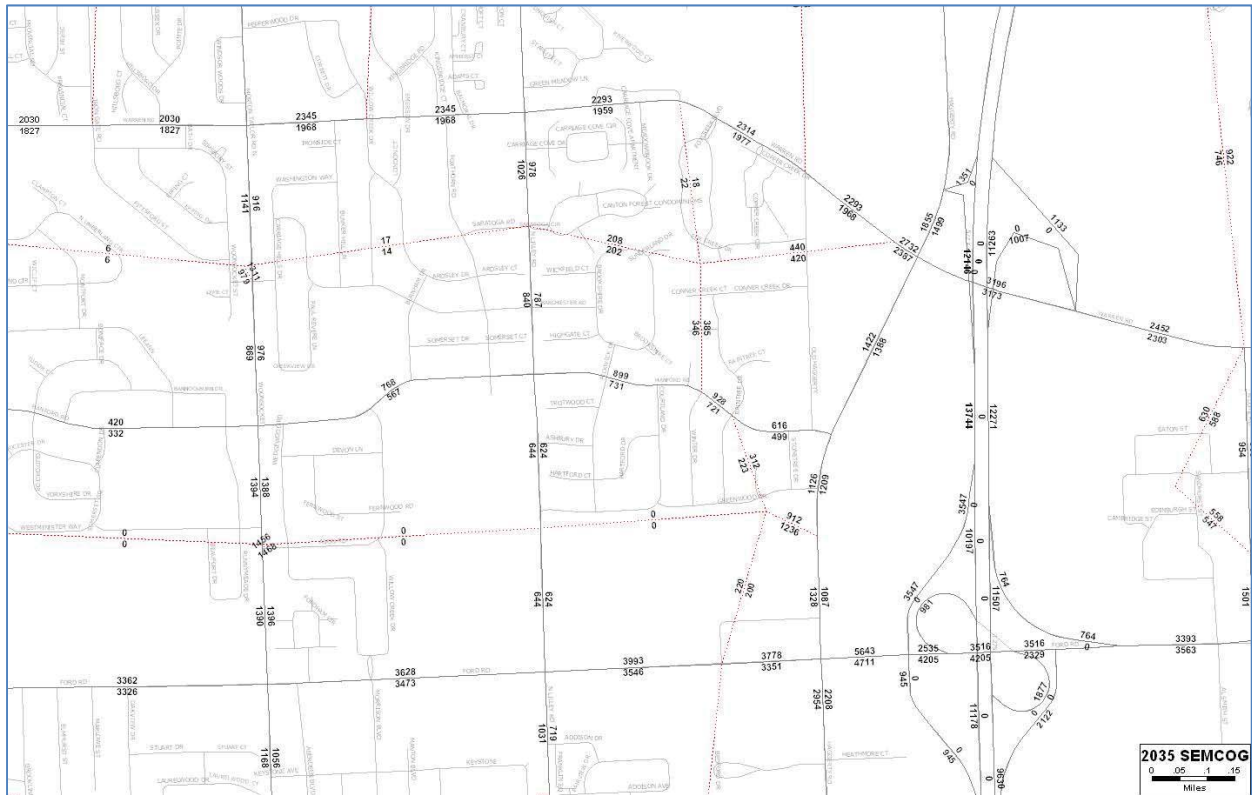
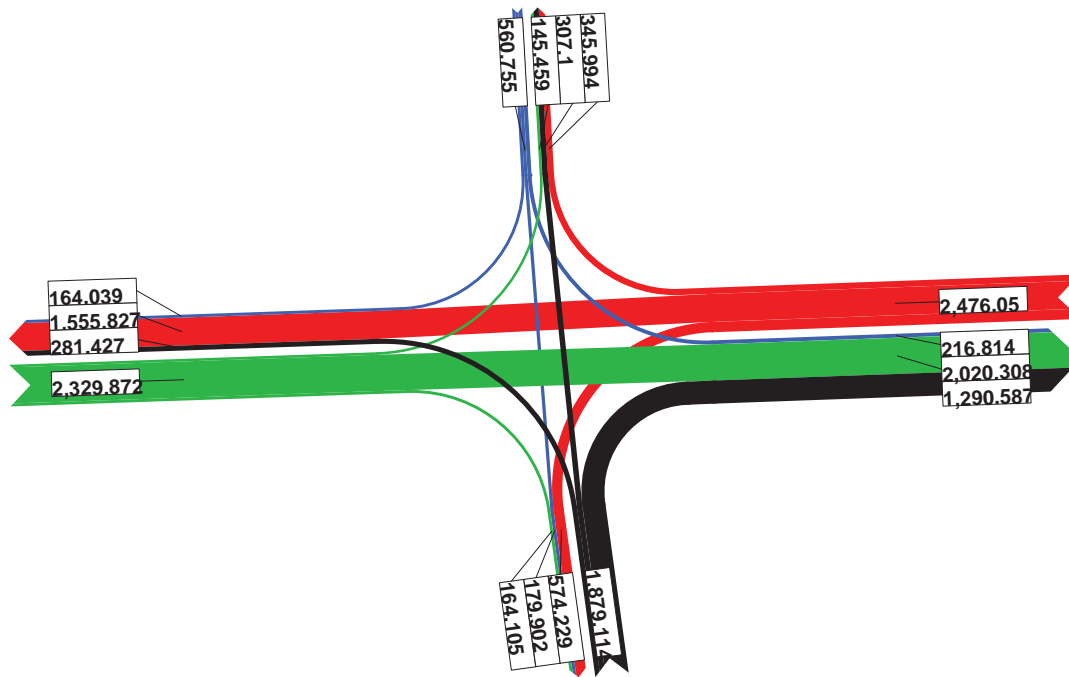


Figure 15 below shows the AM peak period individual volumes at Haggerty Road and M-153 for Alternative 5 which compared to the No-Build condition (**Figure 9: M-153 @ Haggerty – AM Peak Period No-Build**) shows a nearly identical WB left turn demand, and approximately a 10 % decrease in WB through traffic.

Figure 15: M-153 @ Haggerty Road – AM Peak Period Alternative 5



2.3 Operational Analysis Input

As discussed previously in this chapter, the use of the SEMCOG 2035 period traffic assignments were used to provide a basis for adjustments to the 2012 existing condition traffic counts. From the SEMCOG 2035 period traffic assignments for the No-Build, Alternatives 2, 4 and 5, the link level directional volumes were provided in tabular format to the traffic operations team. Using this information, the directional forecast volumes for the AM, Off-Peak and PM Peak hours were adjusted based on the impact of each alternative and the turn movements were adjusted accordingly for each alternative.

3.0 Traffic Analysis – Project Year (2035)

As described above the 2035 SEMCOG traffic forecast was utilized to generate 2035 hourly individual volumes for the AM peak, PM peak, and OP periods for each of the project alternatives. Intersection capacity analyses were performed for the No-Build (2035) conditions as well as for each of the four construction alternatives (2035) in the study area.

- Practical Alternative 1 – No-Build
- Practical Alternative 2 – Operational Improvements
- Preferred Alternative 3 – Boulevard
- Alternative 4 – Western Wayne Transportation Improvement Plan (WWTIP)
- Alternative 5 – New Interchanges at Warren Road and Cherry Hill Road

A detailed discussion of the selection process for advancing alternatives to the practical or preferred status is included in the main document under separate title ***M-153 (Ford Road) at I-275 Area, Traffic and Environmental Study, Illustrative Alternatives Final Report.***

The analysis focused on the M-153 corridor from Sheldon Road to Lotz Road and interchange / ramp terminal modifications where applicable to an alternative. Failing intersections and movements outside of the M-153 corridor are identified for consideration by Wayne County Department of Public Services (DPS) for future projects, but were not included in this analysis.

The alternatives LOS operations are highlighted in **Appendix B2**, which graphically presents the overall LOS operations, **Appendix D1**, which displays the LOS tables for each intersection per individual movement and **Appendix D2** which shows the Synchro output reports.

3.1 Alternative 1 No-Build (2035) Traffic Operations Analysis

As described in the **Traffic Forecasting** section, a growth factor of 0.5% per year was used to develop the Alternative 1 No-Build (2035) traffic volumes. It was assumed that without any major capacity improvement(s), the traffic patterns would remain the same as the existing under No-Build conditions. The analysis procedure for Alternative 1 - No-Build was to optimize the signal phase splits and offsets along M-153 and keep all geometry unchanged. This was to provide a true No-Build alternative for comparison of results to the build options.

The existing condition Synchro models were used as the base and No-Build traffic volumes were input to develop the Alternative 1 No-Build AM, OP and PM Synchro models.

Appendix B2 presents a graphical summary of the overall LOS during the design year (2035) weekday AM, PM, and off-peak hours of traffic after the implementation of Alternative 1 based on the Synchro and HCS analyses.

3.1.1 Alternative 1 No-Build Intersection Operations

The existing cycle lengths were reviewed and found to be optimal for the 2035 No-Build conditions, and were therefore not modified. As discussed in **Section 1.3** of this document, the

majority of the intersections are currently operating at acceptable overall intersection LOS D or better each peak period.

The following describes the failing individual movements in the Alternative 1 No-Build 2035 AM, PM peak, and OP hour scenarios, given no geometric or capacity improvements.

AM Peak Hour Analysis

- M-153 and Haggerty Road Intersection: This intersection operates at overall LOS F with overall control delay of 132.5 seconds
- M-153 and Lilley Road Intersection: Overall LOS D (42.4s) with most of the individual movements operating at LOS D or better. However, the NB through movement operates at LOS E with 67.3 seconds in delays.
- Warren Road and Haggerty Road Intersection: Overall LOS D (42.3s) with all the movements operating at LOS D or better except NB through at LOS F with 85.1 seconds in delays per vehicle.

PM Peak Analysis

- M-153 and Lotz Road Intersection: Overall LOS C (35.0s) with all lane groups at this intersection operating at a LOS of D or better except SB through, which will operate at LOS E with overall control delay of 75.5 seconds.
- M-153 and Haggerty Road Intersection: Overall LOS F with control delay of 114.7 seconds. Most of the individual movements operating at LOS E or F.
- M-153 and Lilley Road Intersection: Overall LOS F with control delay of 80.2 seconds. Most of the individual movements operating at LOS E or F. Only SB right, EB right and WB right turns will operate at LOS D or better.
- M-153 and Sheldon Road Intersection: Overall LOS D (49.7s) with EB left, WB left, NB right, SB left and SB through movements operating at LOS E and F.
- Haggerty Road and Cherry Hill Road: Overall LOS E with 77.9 seconds in control delays. Most of the individual movements operating at LOS E or F.
- Cherry Hill Road & Lilley Road: Overall LOS E with 75.7 seconds of control delay. EB left, EB through, and SB left movements operating at LOS F, and WB through, NB left and SB through operating at LOS E.
- Warren Road and Haggerty Road: Overall LOS E with overall control delay of 59.2 seconds. The EBL, WBL and SBL operate at LOS E and SBT operates at LOS F.
- Warren Road and Lilley Road: Overall LOS C (30.4s) with most individual movements operating at LOS D or better except the EB left, which will operate at LOS F with 194.5 seconds of delay per vehicle.

Off-Peak Analysis

- M-153 and Lotz Road Intersection: Overall LOS D (46.3s) with EB left operating at LOS E and SB through at LOS F.

- M-153 and Haggerty Road Intersection: Overall LOS D (53.9s) with WB left, NB left, NB right, and SB left operating at LOS F, and SB through at LOS E.
- M-153 and Lilley Road Intersection: Overall LOS E with delay of 70.6 seconds per vehicle. Most individual movements operating at LOS E or F. Only the EB right, WB right, and SB right turns will operate at LOS D or better.
- M-153 and Sheldon Road Intersection: Overall LOS F with 94.7 seconds of control delay per vehicle. The EB left and through, WB left and through, NB through and right, and SB left movements operating at LOS F.
- Haggerty Road and Cherry Hill Road: Overall LOS E with 57.7 seconds of control delay. EB left and through, and WB through movements operating at LOS F.
- Cherry Hill Road & Lilley Road: Overall LOS D (43.0s) with most of the individual movements operating at LOS D or better except the EB and WB through movements, which will operate at LOS E.
- Warren Road and Haggerty Road: Overall LOS D with 52.3 seconds in control delays per vehicle. NB right, WB left, EB through, and WB through will operate at LOS E or F.
- Warren Road and Lilley Road: Overall LOS C (20.8s) with almost all of the individual movements operating at LOS D or better except the EB left, which will operate at LOS E (65.0s).

3.1.2 Alternative 1 No-Build (2035) Freeway Operations

The No-Build freeway segment and junction operations were analyzed using HCS software. See **Appendix E** for the HCS LOS analysis results for the mainline freeway segments and junctions (merge/diverge). As shown in **Appendix B2** and **Table 6** below, the majority of I-275 traffic is projected to experience acceptable (LOS D or better) operations during the study periods under Alternative 1 - No-Build, with the exception of the NB I-275 segment between Ann Arbor Road and M-153 which is projected to operate at LOS E during the AM peak hour, and the SB I-275 segment between Ann Arbor Road and M-153 which is projected to operate at LOS F during the Off Peak hour. Due to the scope of this project, additional capacity improvements on I-275 were not examined. It is recommended that a corridor study incorporating these segments of I-275 be performed to better understand the projected future operations and potential mitigations required.

Table 6: Alternative 1 Mainline I-275 Level of Service

Freeway Segment	Alternative 1 No-Build (2035) Conditions		
	AM Peak	PM Peak	Off-Peak
	LOS / Density (vphpl)	LOS / Density (vphpl)	LOS / Density (vphpl)
NB I-275 from US-12 to M-153	D / 26.9	D / 29.7	B / 16.3
SB I-275 from M-153 to US-12	D / 27.0	D / 30.5	B / 15.5
NB I-275 from M-153 to Ann Arbor Road	E / 41.8	D / 32.6	C / 20.2
SB I-275 from Ann Arbor Road to M-153	D / 27.7	F / 45.7	C / 23.2

Table 7 below presents the LOS analyses results for the M-153 interchange ramp junctions with I-275. All ramp junctions are projected to operate at LOS D or better during each of the studied analysis periods, with the exception of the SB I-275 diverge to M-153 which is projected to operate at LOS F during the PM Peak hour and M-153 WB on ramp to I-275 NB, which is projected to operate at LOS E during the AM peak hour. The LOS F is based on the freeway segment LOS F and not the ramp volume. Adding a second exit ramp lane would improve the ramp operations which should be considered as a potential freeway improvement, however is beyond the scope of this project and therefore not included.

Table 7: Alternative 1 M-153 / I-275 Ramp Level of Service

Ramp From / To	Merge / Diverge	Alternative 1 No-Build (2035) Conditions		
		AM Peak	PM Peak	Off Peak
		LOS / Density (pcpmpl)	LOS / Density (pcpmpl)	LOS / Density (pcpmpl)
NB I-275 to M-153	Diverge	D/31.1	D / 32.6	C / 22.6
SB I-275 to M-153	Diverge	C/25.1	F / *	C / 24.3
WB M-153 to NB I-275	Merge	E/36.2	D / 30.9	C / 22.0
EB M-153 to NB I-275	Merge	D/34.8	C / 25.8	C / 21.5
WB M-153 to SB I-275	Merge	C / 21.2	C / 24.6	B / 11.2
EB M-153 to SB I-275	Merge	D/28.1	D / 29.9	B / 18.2
*LOS F due to V_R capacity violation				

3.2 Practical Alternative 2 (2035) Traffic Operations Analysis

Alternative 2 has a similar layout to Alternative 1 No-Build with the addition of an extra WB M-153 lane from Lotz Road to west of Sheldon Road and an additional EB M-153 through lane from Lilley Road to Haggerty Road. The SEMCOG model run with this increased capacity on M-153 predicted approximately 15-20 % more traffic, which was drawn from Warren Road, and Cherry Hill Road.

Appendix B2 presents a graphical summary of the overall LOS during the design year (2035) weekday AM, PM, and off-peak hours of traffic after the implementation of Alternative 2 based on the Synchro and HCS analyses.

3.2.1 Alternative 2 (2035) Signalized Intersection Operations

The Alternative 2 intersection analysis focused mainly on the core M-153 corridor from Sheldon Road to Lotz Road. All other intersections and respective individual movements in the study area operate the same as Alternative 1 No-Build at LOS D or better, with the exception of the Warren Road intersections at Lilley Road and Haggerty Road and Cherry Hill Road and Haggerty Road intersection which have some movements at LOS E or F. These movements with poor LOS were not corrected as part of this alternative analysis and should be considered by Wayne County DPS for future improvements as LOS deteriorates over time.

Dual EB and WB M-153 left turn lanes were added at Haggerty Road and Lilley Road as protected phases. Due to the third WB M-153 thru lane at Morton Taylor Road and Sheldon Road the EB M-153 left turn signal phases were changed to protected only. At the M-153 and Sheldon Road, Morton Taylor Road and Lilley Road intersections, the existing dedicated SB

and NB right turn lanes were converted to SB shared thru and right lanes, with the necessary lane drop tapers on the receiving end of the intersection.

At the M-153 and Lotz Road intersection, the dedicated WB right turn lane was converted to a shared thru/right turn lane, with a lane drop on the receiving side of the intersection. A protected/permitted SB and NB left turn phase was added to the existing permitted only phase. A dedicated SB right turn bay which provides 100 ft of storage should also be added. With these changes the signal is projected to operate with overall LOS C or better with no movement worse than LOS D.

The following describes the failing individual movements in the Alternative 2 2035 AM, PM peak, and OP hour scenarios, along the M-153 corridor. All other intersections are projected to operate similarly to alternative 1 as described above.

AM Peak Hour Analysis

- M-153 and Haggerty Road Intersection: Overall LOS E with control delay of 66.9 seconds. EB through, and SB left movements operating at LOS F (111.4s) and E (60.6s), respectively.

PM Peak Hour Analysis

- M-153 and Haggerty Road Intersection: Overall LOS E with 60.3 seconds of delays per vehicle. Most individual movements operating at LOS E or F.
- M-153 and Lilley Road Intersection: Overall LOS D (51.4s) with only the WB left, WB through, WB right, NB through and right, SB through, and SB right turns operating at LOS D or better.

Off Peak Hour Analysis

- M-153 and Lilley Road Intersection: Overall LOS D (51.4s) with SB left turning movement operating at LOS F.
- M-153 and Sheldon Road Intersection: Overall LOS D (49.5s) with EB left, NB left, NB through and right, SB left and SB through and right turning movements operating at LOS E or F.

3.2.2 Alternative 2 (2035) Freeway Operations

I-275 and ramp volumes for all analysis periods were observed to be very close to the Alternative 1 No-Build volumes therefore, no additional freeway analysis was performed for Alternative 2. Refer to **Alternative 1 No-Build – Freeway Operations** for results.

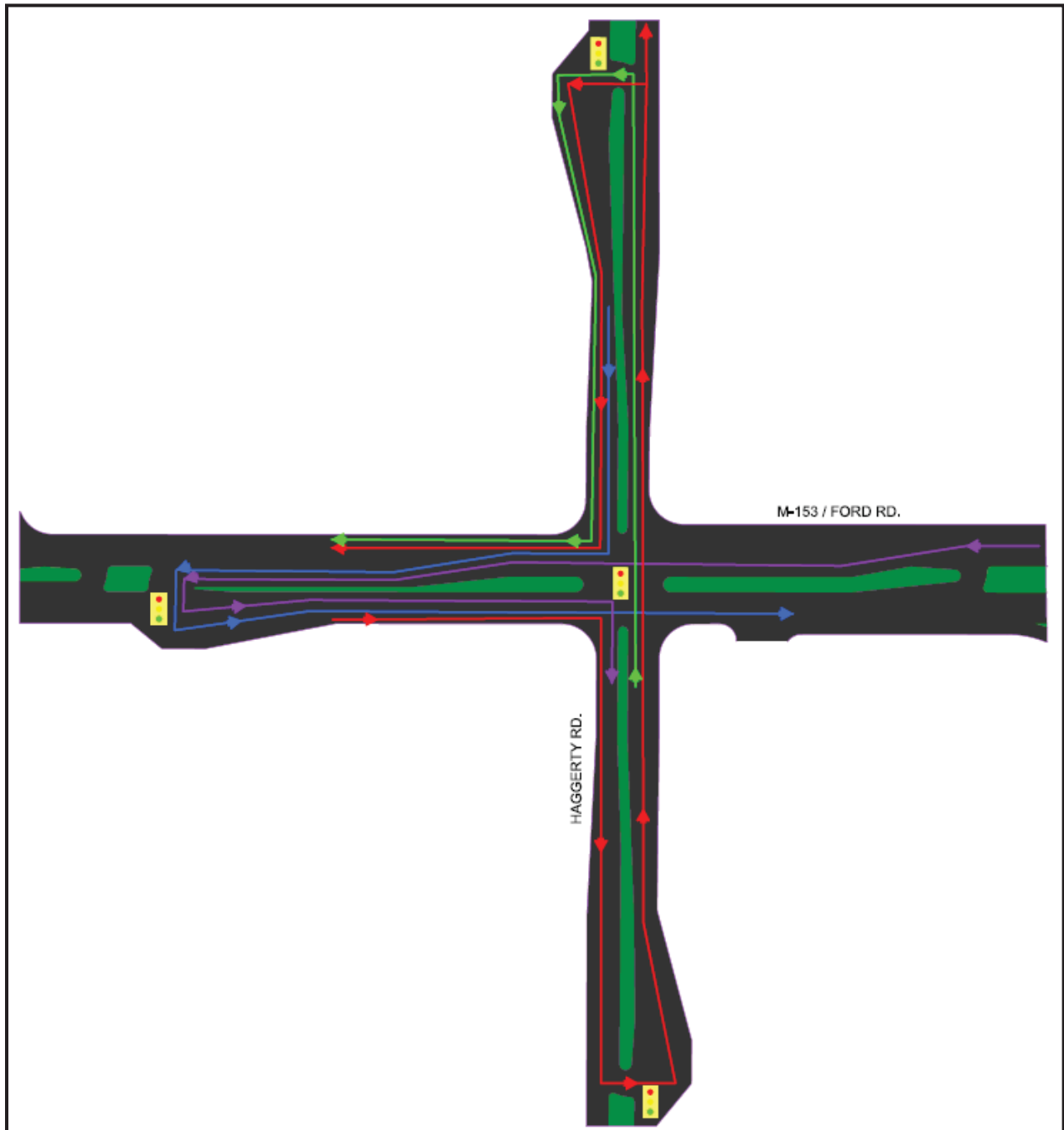
3.3 Preferred Alternative 3 (2035) Traffic Operations Analysis

Similar to Alternative 2, this alternative's intersection analysis is focused mainly on the core M-153 corridor from Sheldon Road to Lotz Road. All other intersections and respective individual movements in the study area operate the same as Alternative 1 No-Build at LOS D or better, with the exception of the Warren Road intersections at Lilley Road and Haggerty Road and

Cherry Hill Road and Haggerty Road intersection which have some movements at LOS E or F. These movements with poor LOS were not corrected as part of this alternative analysis and may be considered by Wayne County DPS for future improvements as LOS deteriorates over time.

The main M-153 corridor between Sheldon Road and I-275 SB ramp terminal was designed as a boulevard section with a 30' median, with no direct lefts allowed. Left turning traffic will be directed to use the indirect left u-turn located in the median east and west of the intersection on M-153, with the exception of M-153 and Haggerty Road. At the Haggerty Road intersection, a u-turn was located west, south and north to eliminate the east u-turn. This was done to prevent the need for a signal adjacent to the I-275 SB ramp terminal which would require an additional signal phase to allow both signals to work as one. This in turn would create additional delay on the ramp. The EB lefts and NB lefts will be required to utilize the turnarounds on Haggerty as displayed below in **Figure 16**. Each of the M-153 indirect lefts will operate as a dual u-turn signalized intersection times in coordination with the main intersection. One of the u-turn lanes will extend through the adjacent main intersection to provide additional capacity.

Figure 16: Indirect Lefts at M-153 and Haggerty Road



At the M-153 and Sheldon Road, Morton Taylor Road and Lilley Road intersections, the existing dedicated SB and NB right turn lanes were converted to SB shared thru and right turn lanes.

At the M-153 and Lotz Road intersection, the dedicated WB right turn lane was converted to a shared thru/right turn lane, with a lane drop on the receiving side of the intersection. A protected/permitted SB and NB left turn phase was added to the existing permitted only phase. A dedicated SB right turn bay which provides 100 ft of storage should also be added. With

these changes the signal is projected to operate with overall LOS C or better with no movement worse than LOS D.

- All M-153 operations are projected to operate at LOS D or better for Alternative 3.

Other Considerations for Alternative 3:

- At the Haggerty Road/M-153 intersection an EBR turn bay is currently proposed based on the 700+ PM peak right turn vehicles which results in a LOS B for the EB through and EBR turn. If ROW becomes an issue during the design phase the EBR turn bay can be eliminated which would result in an overall LOS C for the shared EB through and right
- The EB through movement currently transitions from two to three lanes at the IKEA Drive which provides an acceptable LOS C for EB through traffic at the Lilley Road intersection. If ROW permits during design it would be advantageous to extend the third lane west of Lilley Road to provide lane continuity and enhance driveway access. The outside curb lane will be less utilized due to driveway traffic, and therefore the third lane will act more as an auxiliary lane.

3.3.1 Alternative 3 (2035) Freeway Operations

I-275 freeway and ramp volumes for all analysis periods were observed to be very close to the Alternative 1 No-Build volumes therefore no additional Freeway analysis was performed for Alternative 3. Refer to **Alternative 1 No-Build – Freeway Operations** for results.

3.4 Alternative 4 Traffic Operations Analysis

Alternative 4 was based on the WWTIP alternative which focused on providing alternative routes to and from the I-275 and M-153 interchange and included the following improvements:

- One way (NB) frontage road east of I-275, connecting Cherry Hill Road to the NB I-275 exit ramp providing access to M-153 or the NB I-275 on-ramp.
- Improvements to M-153 to provide acceptable LOS
- Additional connections to provide access to Haggerty north and south of M-153 from the existing SB I-275 exit ramp to M-153.
- Conversion of the existing WB M-153 dedicated right turn lane to a shared thru and right lane from the I-275 SB exit ramp to Lilley Road.

Alternative 4 assumes the same roadway and intersection configurations as Alternative 1 No-Build beyond the improvements limits listed above, therefore the operational analysis provided similar results to those of Alternative 1 No-Build for the non-improved intersections.

Appendix B2 presents a graphical summary of the overall LOS during the design year (2035) weekday AM, PM, and off-peak hours of traffic after the implementation of Alternative 4 based on the Synchro and HCS analyses.

3.4.1 Alternative 4 (2035) Signalized Intersection Operations

After exiting, SB I-275 drivers will face a decision point to exit to the new north Haggerty Road ramp which will terminate at a signal with a single lane approach approximately 700 ft north of M-153. Drivers remaining on the M-153 bound ramp will have a second decision point to turn east or west on M-153 (same as existing) or go straight to access the new south Haggerty Road ramp which will terminate with a single lane approximately 700 ft south of M-153. Both new Haggerty Road ramp terminals are proposed to be signalized. Both intersections are projected to operate at an overall intersection LOS C or better during the AM, PM, and off-peak periods. In addition, all individual movements are projected to operate at LOS C or better during all analysis periods (see **Appendix D2** for additional information).

The M-153 corridor intersections will need the same set of improvements as Alternative 2 or 3 as described earlier, based on the volumes being similar. A small reduction of traffic was projected at the M-153 and Haggerty Road intersection, however not significant enough to alleviate the need for major operational improvements, as summarized below with no geometric improvements:

All Peak Hour Analyses

- M-153 and Haggerty Road Intersection: AM peak, overall LOS F (93.0), PM peak, overall LOS F (99.0s), OP LOS D (40.0). Most individual movements operating at LOS E or F.

3.4.2 Alternative 4 (2035) Freeway Operations

I-275 volumes for all analysis periods were observed to be very close to the Alternative 1 - No-Build volumes therefore no additional freeway segment analyses were performed for Alternative 4. Refer to **Alternative 1 No-Build – Freeway Operations** for segment results.

Table 8 presents the LOS analyses results for the M-153 interchange ramp junctions with I-275. See **Appendix E** for the HCS LOS analysis results. As shown, all ramp junctions are projected to operate at LOS D or better during all analysis periods, with the exception of the SB I-275 diverge to M-153 which is projected to operate at LOS F during the PM Peak and Off Peak hours. The LOS F's are based on the freeway segment LOS F and not the ramp volume. Adding a second exit ramp lane would improve the ramp operations which should be considered as a potential freeway improvement, however is beyond the scope of this project and therefore not included.

Table 8: Alternative 4 M-153 / I-275 Ramp Level of Service

Ramp From / To	Merge / Diverge	Alternative 4 (2035) Conditions		
		AM Peak	PM Peak	Off Peak
		LOS / Density (pcpmpl)	LOS / Density (pcpmpl)	LOS / Density (pcpmpl)
NB I-275 to M-153	Diverge	C / 25.0	D / 30.8	C / 20.2
SB I-275 to M-153	Diverge	C / 25.3	F /	F /
WB M-153 to NB I-275	Merge	E / 40.6	D / 32.3	C / 23.9
EB M-153 to NB I-275	Merge	C / 20.9	C / 23.3	B / 15.5
WB M-153 to SB I-275	Merge	B / 19.9	C / 23.0	B / 10.3
EB M-153 to SB I-275	Merge	C / 27.8	D / 29.3	B / 17.4
*LOS F due to V_R capacity violation				

3.5 Alternative 5 Traffic Operations Analysis

Alternative 5 proposes to construct a full access interchange at Warren Road and Cherry Hill Road. (Figure 17 and 18 below). Based upon review of the traffic volumes for this alternative, it was observed that the impacts associated with this alternative were primarily confined to the Warren Road and Cherry Hill Road corridors. Traffic volumes throughout the remainder of the study area were similar to those presented in Alternatives 2 and 3 with some traffic diversion away from the Haggerty Road and M-153 intersection. Therefore, the operational analysis for this alternative was limited to the Warren Road and Cherry Hill Road corridors and the proposed interchanges. Similar operations to those of Alternative 1 or Alternatives 2 and 3 (with improvements) will be realized throughout the remainder of the study area under this alternative.

Figure 17: Alternative 5 Warren Road Interchange



Figure 18: Alternative 5 Cherry Hill Road Interchange

3.5.1 Alternative 5 (2035) Signalized Intersection Operations

Detailed level of service analysis results for the Warren Road and Cherry Hill Road corridor intersections are presented in **Appendix D1**. **Appendix B2** - LOS Maps graphically presents the locations with where LOS operations are calculated under 2035 conditions.

Warren Road Interchange

As discussed in the **Traffic Forecasting** section of this report, the proposed interchange ramps are projected to attract a significant volume of traffic. Due to the traffic generated by the development of these ramps, exclusive left and right-turn lanes from the surface street network are proposed to safely accommodate the projected individual traffic movements to the proposed entrance ramps. The proposed SB I-275 ramp intersection is located approximately 350 ft from the existing Warren Road / Haggerty Road intersection. Although the SB I-275 intersection was calculated to operate at acceptable LOS with a single EB through lane and an exclusive right-turn lane, due to the high volume of traffic travelling EB on Warren Road, the higher volume of traffic accessing SB I-275 at this ramp, and the proximity of the ramps intersection to the Haggerty Road intersection, two EB through lanes with an exclusive, channelized, free-flow

right-turn are recommended at the SB I-275 ramps intersection to prevent EB Warren Road queuing from impacting operations at the existing Warren Road / Haggerty Road intersection. In addition, exclusive left and right-turn lanes will be required on both NB and SB I-275 exit ramp terminals at Warren Road. With these layouts, both intersections are projected to operate at an overall intersection LOS B or better during the AM, PM, and off-peak periods. In addition, all individual movements are projected to operate at LOS D or better during all analysis periods. Permitted/protected left-turn phasing would be provided to not only ensure acceptable operations at these intersections but, also provide safe operations.

The majority of the existing intersection approaches are projected to operate at acceptable LOS D or better without mitigation however, due to the projected increase in traffic on Warren Road with this alternative, minor improvements, primarily at the Haggerty Road and Lilley Road intersections with Warren Road will be required to provide acceptable LOS on all approaches at these intersections with the implementation of Alternative 5.

As illustrated in **Appendix D1**, the Haggerty Road / Warren Road intersection currently operates at an overall LOS E during the AM peak hour. In addition to a poor overall intersection LOS during the AM peak hour, several individual movements were calculated to operate at LOS E or F under existing evening peak and off-peak conditions. These operations are projected to continue to degrade through 2035 with the additional background traffic and traffic generated by the proposed interchange without mitigation. Based upon Synchro analysis, the following modifications to the existing laneage at the intersection will be required to provide acceptable LOS:

- Additional eastbound Warren Road through lane
- Additional westbound Warren Road through lane
- Re-stripe the existing southbound shared through/right-turn lane as a through lane and add an exclusive right-turn lane
- Add westbound dual left-turn lanes (to limit queuing to the proposed SB I-275 ramps intersection)

The remainder of the intersections along the Warren Road corridor are projected to operate at acceptable levels of service during all analysis periods with only minor signal timing adjustments.

It is important to note that despite the close proximity of the proposed SB I-275 ramps / Warren Road intersection to the existing Warren Road / Haggerty Road intersection and the large volumes of traffic, both of these intersections are projected to accommodate the projected traffic without queuing issues. Based upon a review of the SimTraffic simulations for this alternative, the proposed SB I-275 ramps / Warren Road intersection occasionally produces eastbound queues, however, these queues quickly dissipate and do not impact operations at the existing Warren Road / Haggerty Road intersection.

Cherry Hill Road Interchange

Due to the traffic generated by the development of the proposed I-275 / Cherry Hill Road ramps, exclusive left and right-turn lanes from the surface street network are proposed to accommodate the projected individual traffic movement to the proposed entrance ramps. Due to the high volume of eastbound left-turning traffic during the AM peak hour at the NB I-275 entrance ramp (873 left-turns), dual left-turn lanes should be provided for this movement. The two lanes required on the entrance ramp to accommodate these dual left-turn lanes should merge into a single lane prior to accessing NB I-275. In addition, exclusive left and right-turn lanes will be required on both NB and SB I-275 exit ramp terminals at Cherry Hill Road. Due to the high volume of both left and right-turning traffic on the SB I-275 ramp during the off-peak period, an exclusive left-turn lane, shared left/right-turn lane, and an exclusive right-turn lane should be provided on its approach to Cherry Hill Road. With these layouts, both intersections are projected to operate at an overall intersection LOS C or better during the AM, PM, and off-peak periods. In addition, all individual movements are projected to operate at LOS D or better during all analysis periods. Permitted/protected left-turn phasing would be provided at the SB I-275 ramp while protected only phasing would be provided at the NB I-275 ramps (due to the proposed dual left-turn lanes) to not only ensure acceptable operations at these intersections but, also provide safe operations.

As illustrated in **Appendix D1**, several individual movements throughout the Cherry Hill Road corridor currently operate at LOS E or LOS F during both the PM peak and off-peak periods. These operations are projected to continue to degrade through 2035 with the additional background traffic and traffic generated by the proposed interchange without mitigation. Currently, the Cherry Hill Road corridor primarily consists of a two-lane two-way roadway with appropriate turn lanes at each intersection with the exception of at the existing Sheldon Road intersection, where a short four-lane segment is present on either side of Sheldon Road. Based upon Synchro analysis, a second through lane would be required in both the eastbound and westbound directions of travel throughout the Cherry Hill corridor to provide acceptable LOS in 2035 under this construction scenario. Based upon field review, approximately 25-30 ft of green space is located on either side of Cherry Hill throughout the corridor. Therefore it is not anticipated that Right-of-Way impacts will be realized with these lane addition.

In addition to eastbound and westbound through lanes, exclusive right-turn lanes would be required on the northbound and southbound approaches of the Cherry Hill Road / Lotz Road intersection. Based upon Synchro analysis excessive queues and poor LOS were calculated without the addition of these exclusive right-turn lanes during all peak periods.

As with the Warren Road corridor, minor signal timing modifications would be required to provide acceptable LOS on all approaches of the Cherry Hill Road corridor during all analysis periods. As mentioned earlier, permitted/protected or protected only left-turn phasing should be implemented at the proposed I-275 ramp intersections. In addition, permitted/protected left-turn phasing should be implemented at the Lilley Road intersection. The existing eighty (80) second cycle length currently present during the morning and off peak periods should be extended to ninety (90) seconds during both periods while the existing ninety (90) second cycle length

currently present during the evening peak period should be extended to one hundred (100) seconds. In addition, based upon the MDOT *Michigan Signal Optimization Guidelines*, intersections spaced within ¼ mile should be investigated for coordination. Due to the introduction of traffic signals at the NB and SB I-275 ramp intersections and the close proximity between these signals and the existing Cherry Hill Road / Haggerty Road and Cherry Hill Road / Lotz Road intersections, coordination of these traffic signals should be provided.

The remainder of the intersections along the Cherry Hill Road corridor are projected to operate at acceptable levels of service during all analysis periods with only minor signal timing adjustments.

3.5.2 Alternative 5 (2035) Freeway Operations

See **Appendix E** for the LOS analysis results for the mainline Freeway segments. As shown in **Appendix B2** and **Table 9** below, many segments of I-275 traffic are projected to experience acceptable LOS D or better during the study periods under Alternative 5. However, due to the projected attraction of traffic to the proposed Warren Road and Cherry Hill Road interchanges, several freeway segments are projected to operate at LOS E or F during both the AM and PM peak periods. Due to the scope of this project, additional capacity improvements on I-275 were not examined. It is recommended that a corridor study incorporating the segment of I-275 be performed to better understand the projected future operations and potential mitigations required.

Table 9: Projected Alternative 5 Mainline I-275 Level of Service

Freeway Segment	Alternative 5 (2035) Conditions		
	AM Peak	PM Peak	Off-Peak
	LOS / Density (vphpl)	LOS / Density (vphpl)	LOS / Density (vphpl)
NB I-275 from Warren Road to Ann Arbor Road	E / 43.8	E / 37.9	C / 22.1
SB I-275 from Warren Road to Ann Arbor Road	D / 27.0	F / 45.2	C / 23.3
NB I-275 from M-153 to Warren Road	E / 43.5	E / 36.8	C / 22.3
SB I-275 from M-153 to Warren Road	See Weave Segment Discussion for LOS		
NB I-275 from M-153 to Cherry Hill Road	See Weave Segment Discussion for LOS		
SB I-275 from M-153 to Cherry Hill Road	D / 27.0	F / 55.7	C / 25.4
NB I-275 from Michigan Ave to Cherry Hill Road	D / 29.3	C / 21.5	B / 15.1
SB I-275 from Michigan Ave to Cherry Hill Road	E / 39.6	F / 49.7	C / 20.3

Table 10 presents the LOS analyses results for the proposed Warren Road and Cherry Hill Road interchange ramp junctions with I-275. See **Appendix E** for detailed LOS results. As shown, all ramp junctions are projected to operate at LOS D or better during all analysis periods with the exception of the SB I-275 to Cherry Hill Road diverge and the Cherry Hill Road to SB I-275 merge ramps during the PM peak period. Based upon HCS calculations, these poor LOS are a result of the very high volumes on SB I-275 and lack of sufficient capacity to accommodate these high freeway volumes rather than due to the proposed ramp traffic. It is anticipated that if additional capacity were added to these freeway segments to accommodate the anticipated freeway traffic volumes, the proposed ramp junctions would operate at acceptable LOS.

Table 10: Alternative 5 Warren Road / I-275 Ramp Level of Service

Ramp From / To	Merge / Diverge	Existing (2012) Conditions		
		AM Peak	PM Peak	Off Peak
		LOS / Density (pcpmpl)	LOS / Density (pcpmpl)	LOS / Density (pcpmpl)
Warren Road to NB I-275	Merge	D / 31.6	D / 29.2	B / 19.5
Warren Road to SB I-275	Merge	See Weave Segment Analysis		
NB I-275 to Warren Road	Diverge	D / 34.8	D / 32.8	C / 24.0
SB I-275 to Warren Road	Diverge	C / 26.5	D / 34.5	C / 23.5
NB I-275 to Cherry Hill Road	Diverge	D / 28.1	C / 20.9	B / 14.7
SB I-275 to Cherry Hill Road	Diverge	D / 31.2	E / 35.5	C / 22.0
Cherry Hill Road to NB I-275	Merge	See Weave Segment Analysis		
Cherry Hill Road to SB I-275	Merge	D / 34.1	F / 38.4	C / 22.2

Table 11 presents the LOS analyses results for the proposed weave movements created between: 1) the existing SB I-275 exit ramp at M-153 and the proposed SB I-275 entrance ramp from Haggerty Road, and 2) the existing NB I-275 exit ramp at M-153 and the proposed NB I-275 entrance ramp from Cherry Hill Road. Due to the close spacing between these ramp pairs, an auxiliary lane is proposed to connect the ramps. See **Appendix E** for the LOS analysis results for detailed LOS results. As shown, due to the high volume of traffic projected to utilize the proposed Warren Road, Cherry Hill Road, and existing M-153 interchanges, these weaving segments are projected to operate at LOS E or F during all peak periods. Improvements to the project LOS are limited due to the available distance between Warren Road, Cherry Hill Road, and M-153. Additional review of these weave segments will be required if this alternative is progressed as a preferred alternative.

Table 11: Alternative 5 SB I-275 Weave Segment Level of Service

Weave Segment From / To	Existing (2012) Conditions		
	AM Peak	PM Peak	Off Peak
	LOS / Density (pcpmpl)	LOS / Density (pcpmpl)	LOS / Density (pcpmpl)
SB I-275 between Warren Road and M-153	F / *	F / *	F / *
NB I-275 between Cherry Hill Road and M-153	F / *	F / *	E / 35.8

* Density not provided for segments with LOS F

4.0 Sensitivity Analysis

A sensitivity analysis was completed for two potential future scenarios that were not directly analyzed as part of the alternatives traffic analysis. The intent was to identify the impacts to Preferred Alternative 3 based on the two scenarios tested which were:

1. Alternative truck route to access north Haggerty Road from the I-275 interchange via Lotz Road and Warren Road.
2. Future Development off Lotz Road, north and south of Ford Road.

Each scenario was tested individually based on the anticipated traffic loads added to the 2035 Alternative 3 traffic network. AM, PM and Off-peak hour traffic conditions were analyzed.

4.1 Alternative Truck Route Sensitivity Check

This scenario included rerouting trucks from Haggerty Road, north of Warren Road destined to the I-275 interchange via Haggerty Road and Ford Road. This potential truck route would redirect trucks to Warren Road and Lotz Road, therefore avoiding the heavily congested Haggerty Road and Ford Road Intersection.

Approximately 2000 trucks per week access the commercial development on Haggerty Road, which were accounted for in the Alternative 3 traffic analysis. This equates to 30 peak hour trucks which were re-routed through the Lotz Road and Ford Road intersection.

Based on the Synchro analysis the additional trucks can be accommodated with the proposed Alternative 3 geometry with operational performance of LOS D or better for all individual movements.

4.2 Future Lotz Road Development Sensitivity Check

This scenario included the potential future development on Lotz Road identified by Canton township, which was indirectly included in the traffic projections on a system-wide macro level by increasing the yearly growth rate from 0.36% to 0.5%. The intent of this analysis was to assess the required additional geometric improvements at the Lotz Road and Ford Road intersection in the case of the potential developments being fully built out in the future.

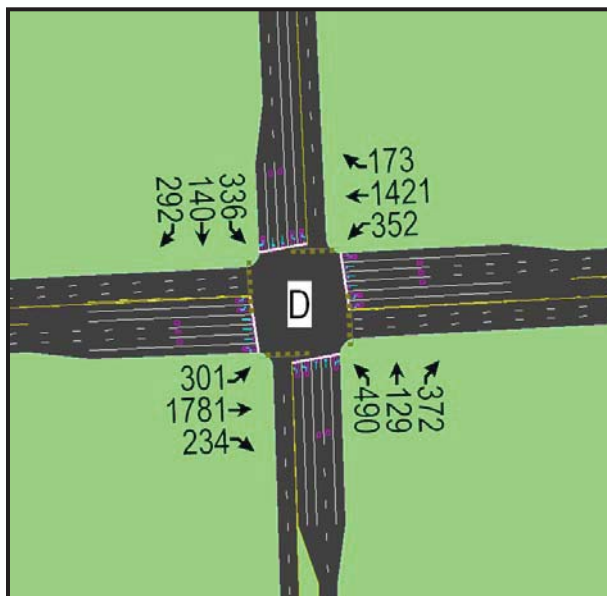
Anticipated trips were calculated based on the ITE Trip Generation Manual, 9th Edition for the PM peak hour as a worst case scenario which were then distributed and overlaid on top of the Alternative 3 network traffic for each 2035 peak periods. **Table 12** shows the calculated trips for the four site developments.

Table 12: Lotz Development Traffic Check

Site	Area	Proposed Use	Trip Gen ID	Acreage	Hourly Rate	Unit		New Trips	Distribution (in/out)
A	10 acre Shopping Center (Northwest of Lotz and Ford)	Commercial	820	10	3.73	4	1000 SF/acre	150	49/51
B	General Light Industrial (Northwest of Lotz and Ford)	Industrial	110	75	8.77	1	acre	660	30/70
C	300,000 sq ft Shopping Center (Southwest of Lotz and Ford)	Commercial	820	--	3.73	350	1000 SF	1310	49/51
D	General Light Industrial (Southeast of Lotz and Ford)	Industrial	110	40	8.77	1	acre	350	30/70

Table 12 shows that 2470 new trips are anticipated, which were distributed in/out of each site. The additional volumes were then added to the Lotz Road and Ford Road intersection traffic and modeled with improvements for each peak period to provide LOS D or better for each through movement, and LOS E or better for each turning movement. This resulted in significant geometric expansion from the Alternative 3 geometry which included; dual left turn and a right turn bay for each approach, an additional EB through lane, and an additional NB and SB through lane as shown in **Figure 19** below.

Figure 19: Lotz Road Development Geometric Improvements



5.0 Conclusion

The alternatives development process from Illustrative to Practical to Preferred, is documented in the main report under separate title ***M-153 (Ford Road) at I-275 Area, Traffic and Environmental Study, Final Report***. From a traffic operations perspective, Alternatives 4 and 5 were not carried forward from illustrative to practical due to the anticipated high costs and environmental issues. Practical Alternative 1 was considered practical to provide a measure of the No-Build option for comparison purposes to the remaining practical alternatives. Practical Alternative 2 was not selected as the preferred option because it did not adequately address long term congestion issues. Preferred Alternative 3 was selected as the preferred option as it alleviated most congestion on the M-153 corridor, therefore best meeting the project purpose and need.

Appendices

- Appendix A: Count Locations
- Appendix B1: Turning Volumes Maps
- Appendix B2: LOS Maps
- Appendix B3: TDM Maps
- Appendix C: SIM Traffic Reports
- Appendix D1: LOS Tables
- Appendix D2: Synchro Reports
- Appendix E: HCS Outputs
- Appendix F1: TDM Memo
- Appendix F2: Traffic Meeting #3 Notes

Appendix A: Count Locations

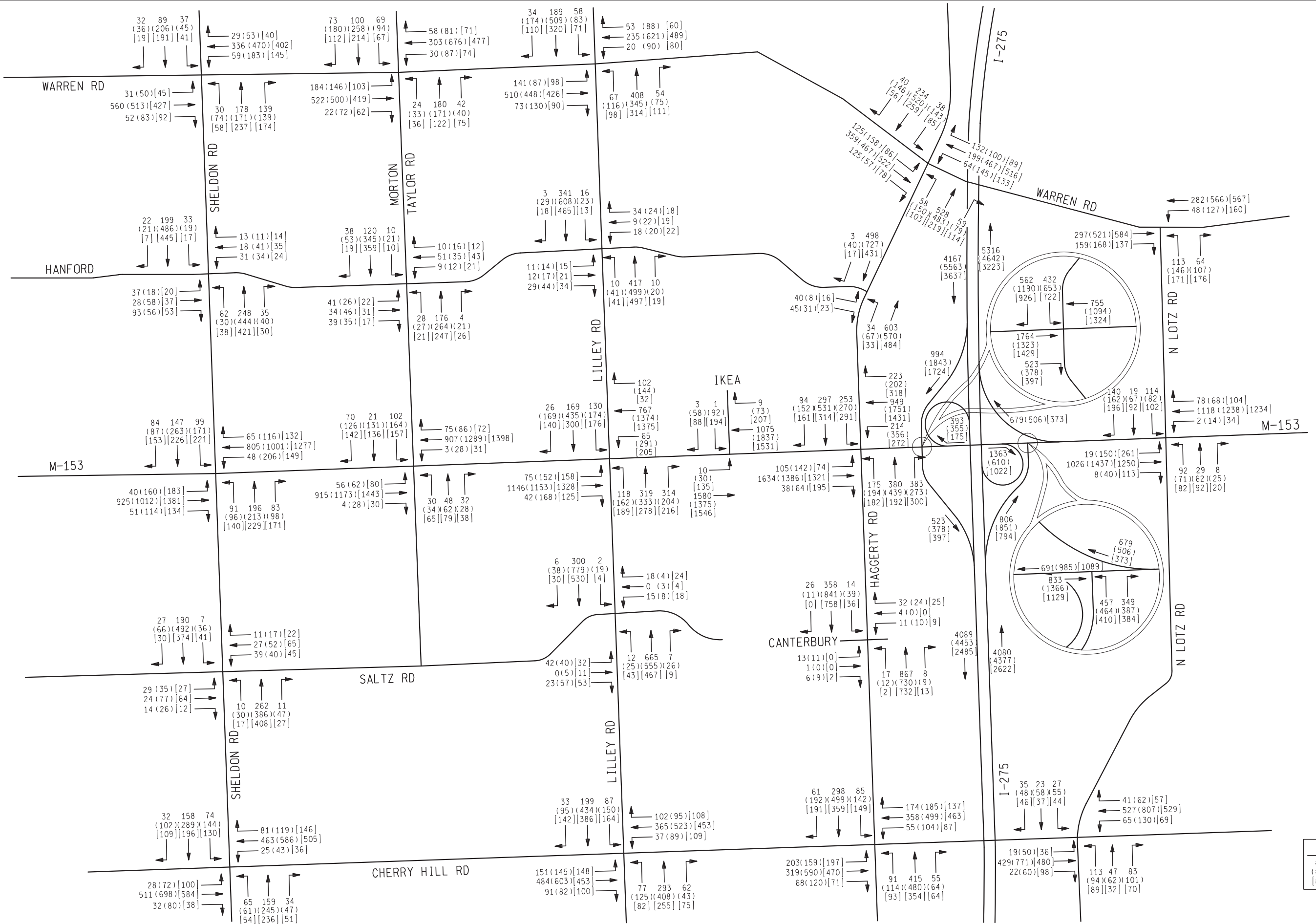
Intersection	Date Completed		
	AM Count	PM Count	Saturday Count
1) Sheldon Rd & Warren Rd	Tuesday, March 27, 2012	Monday, March 19, 2012	Saturday, March 24, 2012
2) Sheldon Rd & Hanford Rd	Tuesday, March 20, 2012	Tuesday, March 20, 2012	Saturday, March 24, 2012
3) Sheldon Rd & Ford Rd	Wednesday, March 21, 2012	Wednesday, March 21, 2012	Saturday, March 24, 2012
4) Sheldon Rd & Saltz Rd	Thursday, March 22, 2012	Thursday, March 22, 2012	Saturday, March 24, 2012
5) Sheldon Rd & Cherry Hill Rd	Monday, March 19, 2012	Monday, March 19, 2012	Saturday, March 24, 2012
6) Morton Taylor Rd & Warren Rd	Tuesday, March 20, 2012	Tuesday, March 20, 2012	Saturday, March 24, 2012
7) Morton Taylor Rd & Hanford Rd	Wednesday, March 21, 2012	Wednesday, March 21, 2012	Saturday, March 24, 2012
8) Morton Taylor Rd & Ford Rd	Thursday, March 22, 2012	Monday, March 26, 2012	Saturday, March 24, 2012
9) Lilley Rd & Warren	Tuesday, March 27, 2012	Monday, March 19, 2012	Saturday, March 24, 2012
10) Lilley Rd & Hanford Rd	Tuesday, March 20, 2012	Tuesday, March 20, 2012	Saturday, March 24, 2012
11) Lilley Rd & Ford Rd.	Wednesday, March 21, 2012	Thursday, March 22, 2012	Saturday, March 24, 2012
12) Lilley Rd & Saltz Rd	Thursday, March 29, 2012	Monday, March 26, 2012	Saturday, March 24, 2012
13) Lilley Rd & Cherry Hill Rd.	Thursday, March 29, 2012	Monday, March 26, 2012	Saturday, March 24, 2012
14) Haggerty Rd & Warren Rd.	Tuesday, March 27, 2012	Monday, March 19, 2012	Saturday, March 24, 2012
15) Haggerty Rd & Hanford Rd	Tuesday, March 20, 2012	Tuesday, March 20, 2012	Saturday, March 24, 2012
16) Haggerty Rd & Ford Rd	Wednesday, March 21, 2012	Thursday, March 22, 2012	Saturday, March 24, 2012
17) Haggerty Rd & Eriksson Elementary	Tuesday, April 03, 2012	Monday, March 26, 2012	Saturday, March 24, 2012
18) Haggerty Rd & Cherry Hill Rd.	Friday, March 30, 2012	Monday, March 26, 2012	Saturday, March 24, 2012
19) Lotz Rd & Warren Rd	Monday, March 19, 2012	Monday, March 19, 2012	Saturday, March 31, 2012
20) Lotz Rd & Ford Rd	Tuesday, March 20, 2012	Tuesday, March 20, 2012	Saturday, March 31, 2012
21) Lotz Rd & Cherry Hill Rd	Wednesday, March 21, 2012	Thursday, March 22, 2012	Saturday, March 31, 2012
22) Ford Rd & IKEA Dr.	Wednesday, March 28, 2012	Wednesday, March 28, 2012	Saturday, March 31, 2012
23a) I-275 & Ann Arbor Rd EB ramps	Tuesday, March 27, 2012	Monday, March 19, 2012	Saturday, March 24, 2012
23b) I-275 & Ann Arbor Rd WB ramps	Wednesday, March 28, 2012	Wednesday, March 28, 2012	Saturday, March 31, 2012
24a) I-275 & Ford Rd EB ramps	Tuesday, March 20, 2012	Wednesday, March 21, 2012	Saturday, March 24, 2012
24b) I-275 & Ford Rd WB ramps	Tuesday, March 20, 2012	Tuesday, March 20, 2012	Saturday, March 24, 2012
25a) I-275 & Michigan Ave EB ramps	Tuesday, March 27, 2012	Friday, March 30, 2012	Saturday, March 31, 2012
25b) I-275 & Michigan Ave WB ramps	Tuesday, March 27, 2012	Friday, March 30, 2012	Saturday, March 31, 2012

	Road	Date Put Down	Box Number
1)	Sheldon Rd & Warren Rd		
	WB Warren E of Sheldon	Monday, March 19, 2012	21762
	EBWarren E of Sheldon	Tuesday, March 20, 2012	21279
	EB Warren W of Sheldon	Wednesday, March 21, 2012	21278
	WB Warren E of Sheldon	Thursday, March 22, 2012	21760
	Sheldon N of Warren	Friday, March 23, 2012	21764
	Sheldon S of Warren	Saturday, March 24, 2012	21761
2)	Sheldon Rd & Hanford Rd	Sunday, March 25, 2012	
	Hanford W of Sheldon	Monday, March 26, 2012	21759
	Hanford E of Sheldon	Tuesday, March 27, 2012	21763
For North/South data used other counts (see Sheldon S of Warren and Shledon N of Ford)			
3)	Sheldon Rd & Ford Rd		
	Sheldon S of Ford	Monday, March 19, 2012	21278
	Sheldon N of Ford	Tuesday, March 20, 2012	21766
	EB Ford W of Sheldon	Tuesday, March 27, 2012	21763
	WB Ford W of Sheldon	Tuesday, March 27, 2012	21278
	EB Ford E of Shledon	Thursday, March 29, 2012	21762
	WB Ford W of Sheldon	Thursday, March 29, 2012	21760
4)	Sheldon Rd & Saltz Rd		
	Sheldon N of Saltz	Tuesday, March 20, 2012	21278
	Sheldon S of Saltz	Tuesday, March 20, 2012	21279
	Saltz W of Sheldon	Wednesday, March 21, 2012	21761
	Saltz E of Sheldon	Wednesday, March 21, 2012	21764
5)	Sheldon Rd & Cherry Hill Rd		
	Sheldon S of Cherry Hill	Wednesday, March 21, 2012	21760
	Cherry Hill W of Sheldon	Wednesday, March 21, 2012	21759
	Cherry Hill E of Sheldon	Wednesday, March 21, 2012	21760
*For Sheldon N of Cherry Hill see Sheldon S of Saltz			
6)	Morton Taylor Rd & Warren Rd		
	Morton Taylor N of Warren	Tuesday, March 20, 2012	21761
	Morton Taylor S of Warren	Wednesday, March 21, 2012	21764
* Warren E and W of Morton Taylor see Warren W of Lilley and Warren E of Sheldon			
7)	Morton Taylor Rd & Hanford Rd		
	Hanford E of Morton Taylor	Tuesday, March 20, 2012	21766
for North/South data see Morton Taylor S of Warren and Morton Taylor N of Ford			
for West data see Hanford E of Sheldon			
8)	Morton Taylor Rd & Ford Rd		
	Morton Taylor N of Ford	Tuesday, March 20, 2012	21763
	Morton Taylor S of Ford	Tuesday, March 20, 2012	21759
	EB Ford W of Morton Taylor	Thursday, March 29, 2012	21762
	WB Ford W of Morton Taylor	Thursday, March 29, 2012	21760
	EB Ford E of Morton Taylor	Thursday, March 29, 2012	21761
	WB Ford E of Morton Taylor	Thursday, March 29, 2012	21764
9)	Lilley Rd & Warren		
	Warren W of Lilley	Tuesday, March 27, 2012	21759
for South Data see Lilley N of Hanford			
for East data see Warren W of Haggerty			
* No South Hose Count			

20) Lotz Rd & Ford Rd		
Lotz S. of Ford	Monday, March 26, 2012	21764
Lotz N. of Ford	Monday, March 26, 2012	21766
EB Ford E. of Lotz	Thursday, March 29, 2012	01091
EB Ford W. of Lotz	Thursday, March 29, 2012	00337
WB Ford E. of Lotz	Thursday, March 29, 2012	00995
WB Ford W. of Lotz	Thursday, March 29, 2012	21278
21) Lotz Rd & Cherry Hill Rd		
Lotz S. of Cherry Hill	Monday, March 26, 2012	21764
Lotz N. of Cherry Hill	Monday, March 26, 2012	21759
Cherry Hill W. of Lotz	Monday, March 26, 2012	21761
Cherry Hill E. of Lotz	Monday, March 26, 2012	21762
22) Ford Rd & IKEA Dr.		
For East/West data see Ford W of Haggerty		
NO NORTH OR SOUTH DATA TAKEN		
23a) I-275 & Ann Arbor Rd EB ramps		
I-275 SB Ann Arbor EB	Wednesday, March 28, 2012	21761
I-275 NB Ann Arbor EB	Wednesday, March 28, 2012	21760
I-275 NB Ann Arbor EB	Wednesday, March 28, 2012	00037
23b) I-275 & Ann Arbor Rd WB ramps		
I-275 NB Ann Arbor WB	Wednesday, March 28, 2012	21278
I-275 SB Ann Arbor WB	Wednesday, March 28, 2012	21279
I-275 SB Ann Arbor WB	Wednesday, March 28, 2012	21763
24a) I-275 & Ford Rd EB ramps		
I-275 SB Ford	Monday, April 02, 2012	21764
I-275 NB Ford	Monday, April 02, 2012	21763
I-275 NB Ford	Monday, April 02, 2012	21760
24b) I-275 & Ford Rd WB ramps		
I-275 NB Ford	Monday, April 02, 2012	21759
I-275 SB Ford	Monday, April 02, 2012	21761
I-275 SB Ford	Monday, April 02, 2012	21278
25a) I-275 & Michigan Ave EB ramps		
I-275 SB Mich Ave EB	Wednesday, March 28, 2012	01091
I-275 NB Mich Ave EB	Wednesday, March 28, 2012	00165
I-275 NB Mich Ave EB	Wednesday, March 28, 2012	21764
25b) I-275 & Michigan Ave WB ramps		
I-275 NB Mich Ave WB	Wednesday, March 28, 2012	21766
I-275 SB Mich Ave WB	Wednesday, March 28, 2012	21767
I-275 SB Mich Ave WB	Wednesday, March 28, 2012	21759

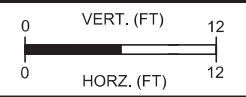
10) Lilley Rd & Hanford Rd		
Lilley N of Hanford	Tuesday, March 20, 2012	21762
For South Data see Lilley N of Ford		
For East/West data see Hanford E of Morton Taylor and Hanford E of Haggerty		
11) Lilley Rd & Ford Rd.		
Lilley N of Ford	Monday, March 26, 2012	21763
Lilley S of Ford	Monday, March 26, 2012	21278
For North/South data see EB and WB Ford E of Morton Taylor and EB and WB Ford W of Haggerty		
12) Lilley Rd & Saltz Rd		
*all hose counts are accounted for on other intersections		
For North/South data see Lilley S of Ford and Lilley N of Cherry Hill		
For West data see Saltz E of Shledon		
13) Lilley Rd & Cherry Hill Rd.		
Lilley N of Cherry Hill	Wednesday, March 21, 2012	21278
Lilley S of Cherry Hill	Wednesday, March 21, 2012	21279
Cherry Hill E of Lilley	Wednesday, March 21, 2012	21766
For West Data see Cherry Hill E of Sheldon		
14) Haggerty Rd & Warren Rd.		
Haggerty N of Warren	Monday, March 26, 2012	00995
NB Haggerty S of Warren	Monday, March 26, 2012	21279
SB Haggerty S of Warren	Monday, March 26, 2012	01091
Warren E of Haggerty	Monday, March 26, 2012	00337
Warren W of Haggerty	Tuesday, March 27, 2012	21762
15) Haggerty Rd & Hanford Rd		
Hanford W of Haggerty	Monday, March 26, 2012	00165
*T intersection, no E of Haggerty count		
For North/South data see NB and SB Haggerty S of Warren and NB and SB Haggerty N of Ford		
16) Haggerty Rd & Ford Rd		
NB Haggerty N of Ford	Tuesday, March 27, 2012	21766
SB Haggerty N of Ford	Tuesday, March 27, 2012	21764
EB Ford W of Haggerty	Thursday, March 29, 2012	21766
WB Ford W of Haggerty	Monday, March 26, 2012	21279
17) Haggerty Rd & Eriksson Elementary		
NB Haggerty S of Ford	Tuesday, March 27, 2012	00165
SB Haggerty S of Ford	Tuesday, March 27, 2012	00995
Haggerty S of Eriksson	Tuesday, March 27, 2012	01091
*because of school drive there is no East or West Hose Count		
18) Haggerty Rd & Cherry Hill Rd.		
Cherry Hill E. of Haggerty	Monday, March 26, 2012	21761
For North data see Haggerty S of Erkiison. NO SOUTH DATA TAKEN		
For West data see Cherry Hill W of Lotz		
19) Lotz Rd & Warren Rd		
Lotz S. of Warren	Monday, March 26, 2012	21766
Warren E. of Lotz	Monday, March 26, 2012	21760
Warren W. of Lotz	Monday, March 26, 2012	00337

Appendix B1: Turning Volume Maps



KEY		
####	=	AM PEAK
(###)	=	PM PEAK
[###]	=	OFF PEAK

FINAL ROW PLAN REVISIONS						
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH

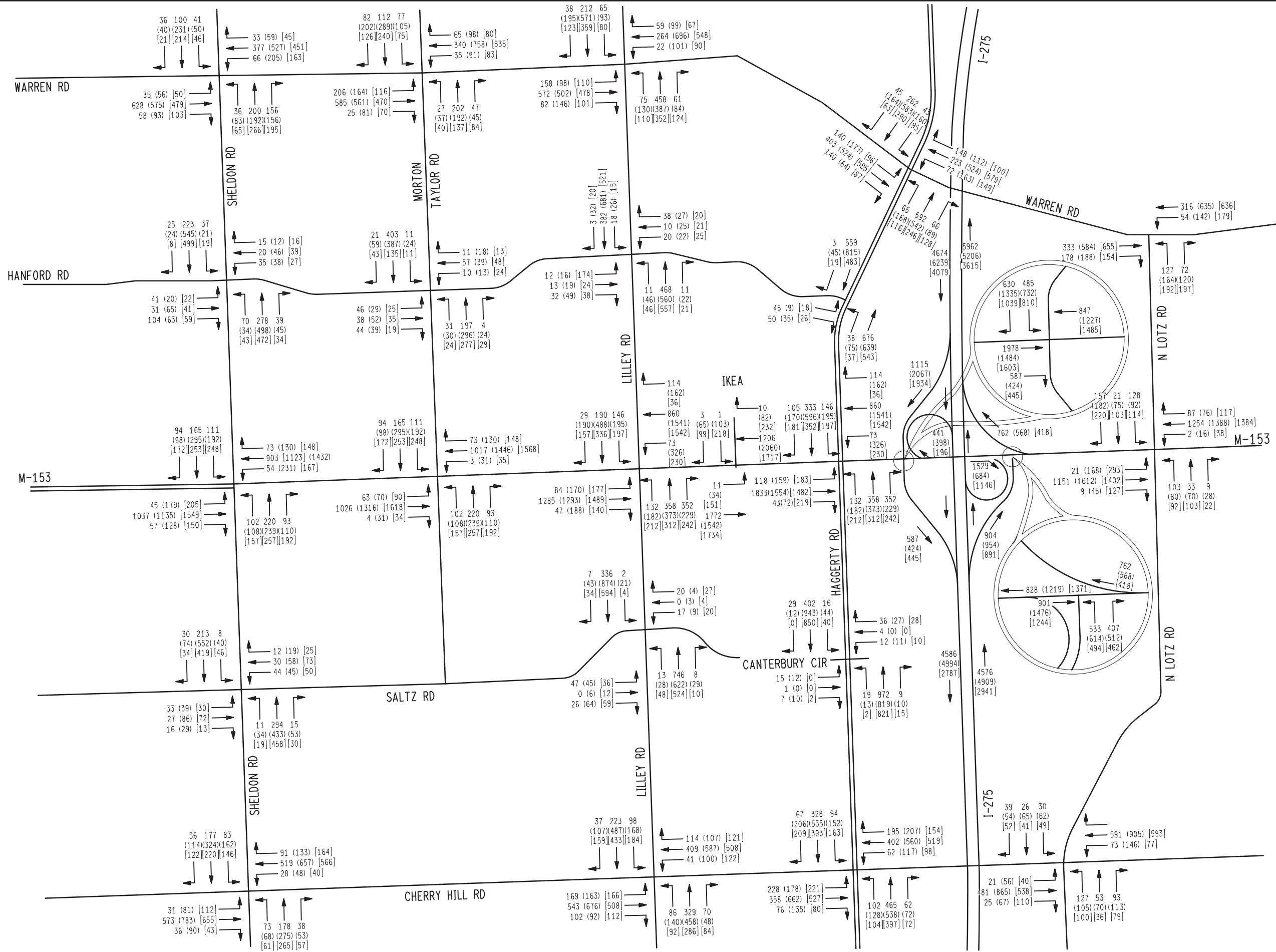


FILE: M-99 TYP01.dgn

DATE:
DESIGN UNIT:
TSC:

CS:
JN:

I-275 & M-153 INTERCHANGE
TRAFFIC VOLUMES
DRAWING SHEET



KEY
 ### = AM PEAK HOUR
 ### = PM PEAK HOUR
 ### = OFF PEAK HOUR



DATE:
 DESIGN UNIT: YUNG
 TSC: TAYLOR

CS: 82292
 JN: 115177

I-275 & M-153 INTERCHANGE
 ALTERNATIVE 1 - NO-BUILD
 2035 PEAK HOUR TURNING VOLUMES

DRAWING SHEET



KEY
 ### = AM PEAK HOUR
 (###) = PM PEAK HOUR
 [###] = OFF PEAK HOUR



DATE:
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 TSC: TAYLOR

CS: 82292
 JN: 115177

I-275 & M-153 INTERCHANGE
 ALTERNATIVE 2 - OPERATIONAL IMPROVEMENTS
 2035 PEAK HOUR TURNING VOLUMES

DRAWING SHEET



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 (###) = PM PEAK HOUR
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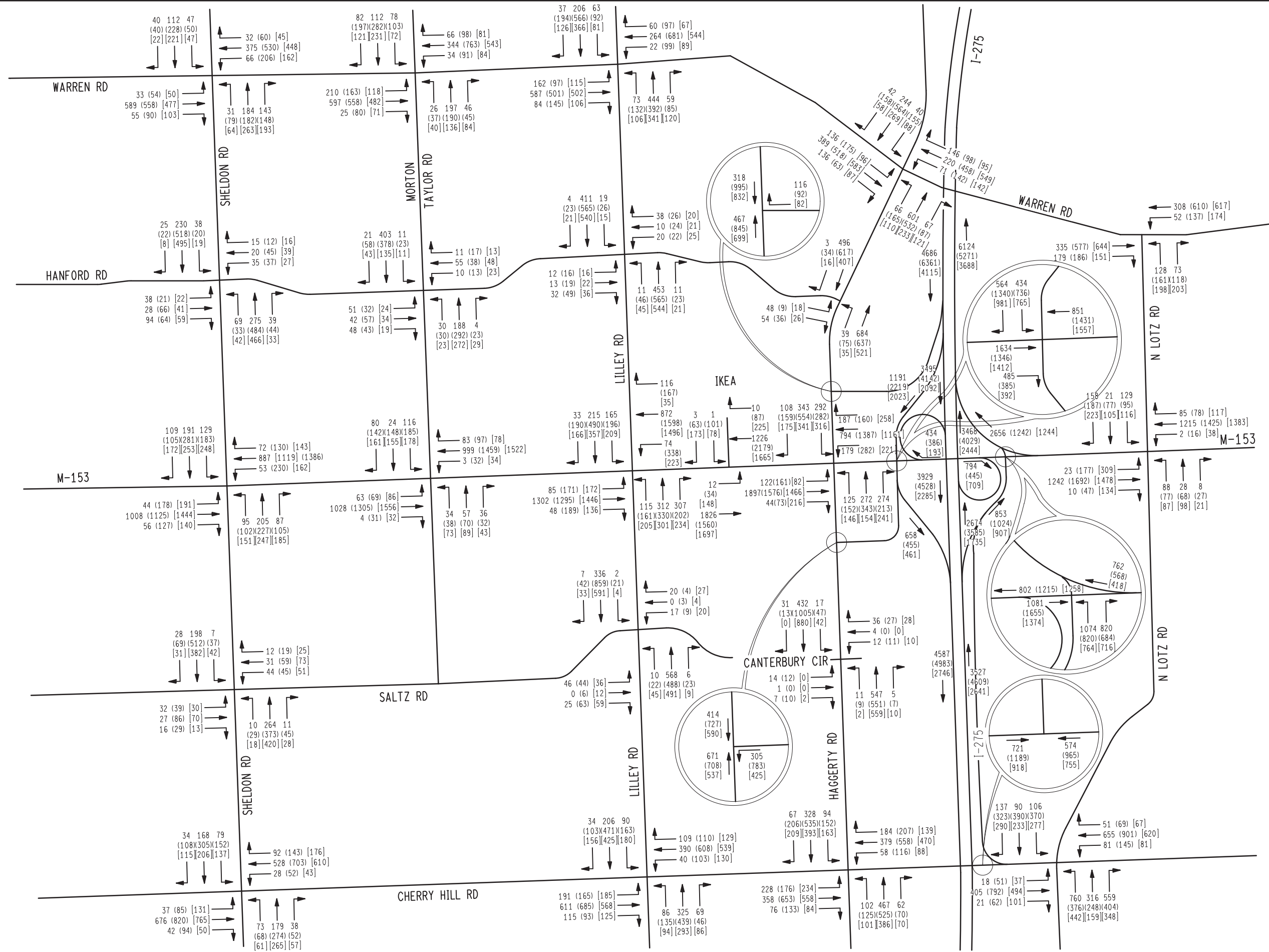


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I-275 & M-153 INTERCHANGE
 ALTERNATIVE 3 BOULEVARD
 2035 PEAK HOUR TURNING VOLUMES

DRAWING SHEET

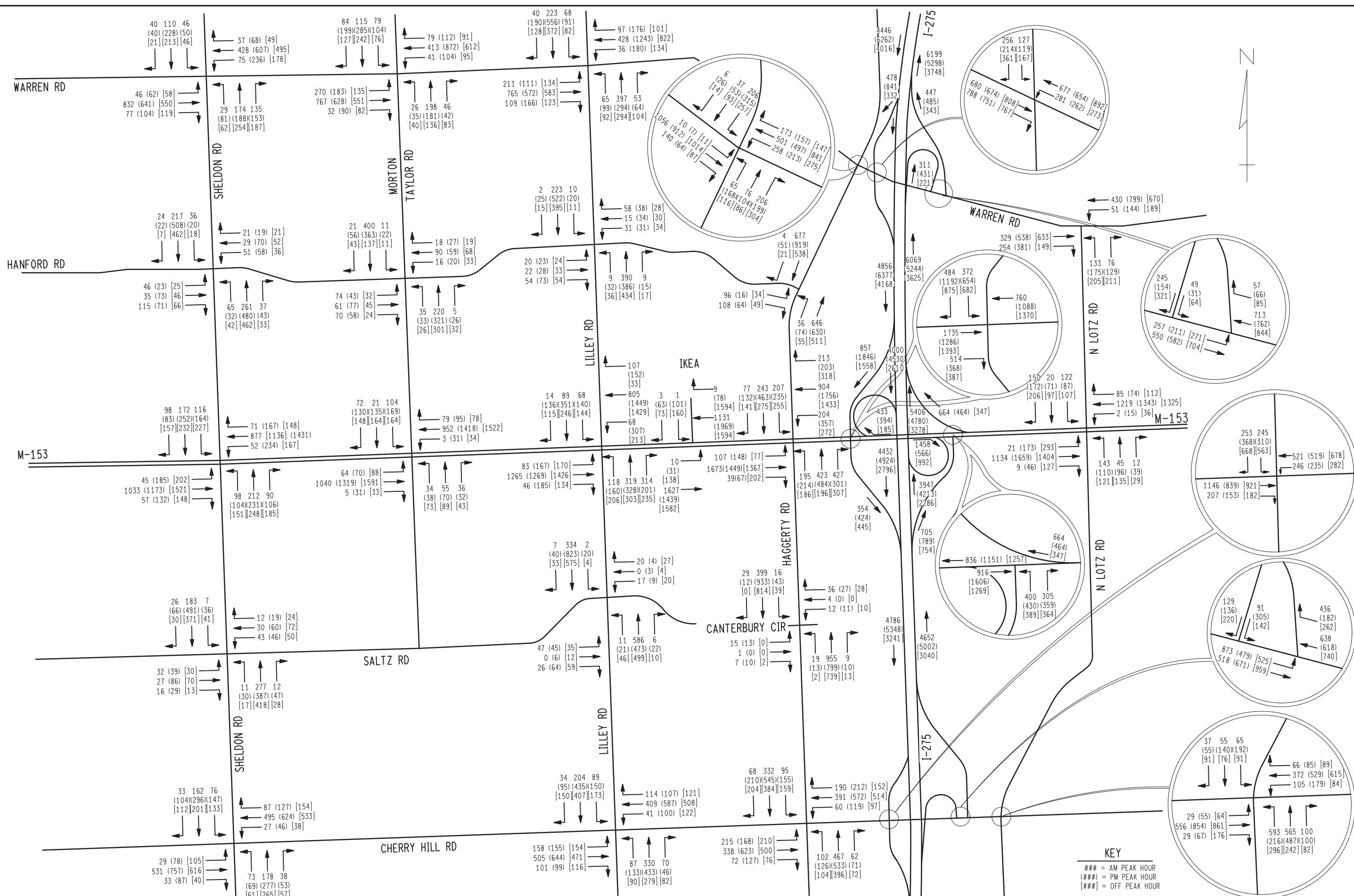


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I-275 & M-153 INTERCHANGE
ALTERNATIVE 4 - WWTIP STUDY
2035 PEAK HOUR TURNING VOLUMES

DRAWING SHEET



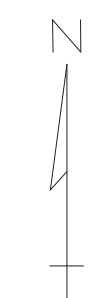
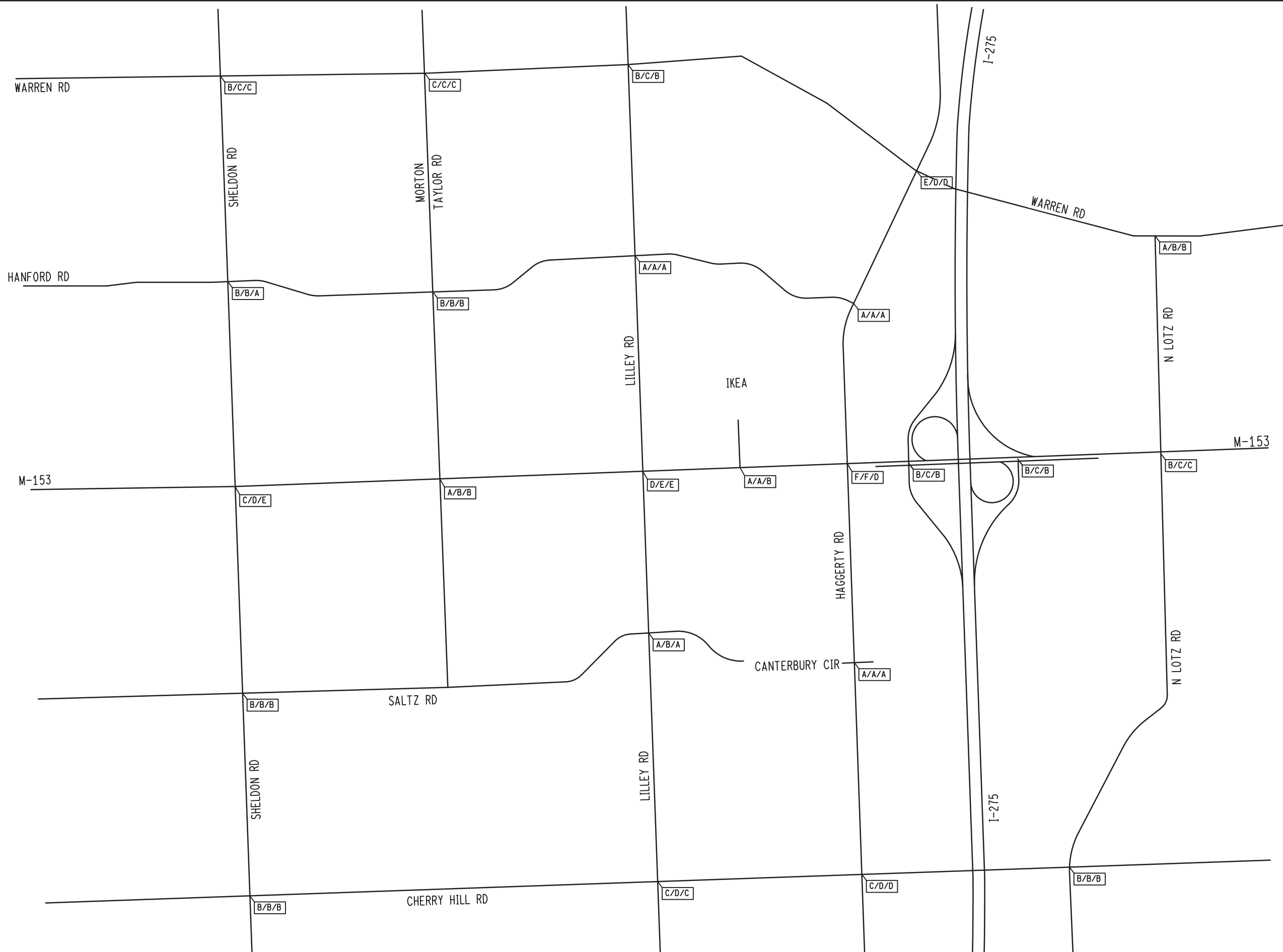
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CS: 82292
 JN: 115177

I-275 & M-153 INTERCHANGE
 ALTERNATIVE 5 - FULL INTERCHANGE AT WARREN ROAD
 2035 PEAK HOUR TURNING VOLUMES

DRAWING SHEET

Appendix B2: LOS Maps



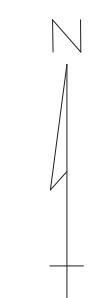
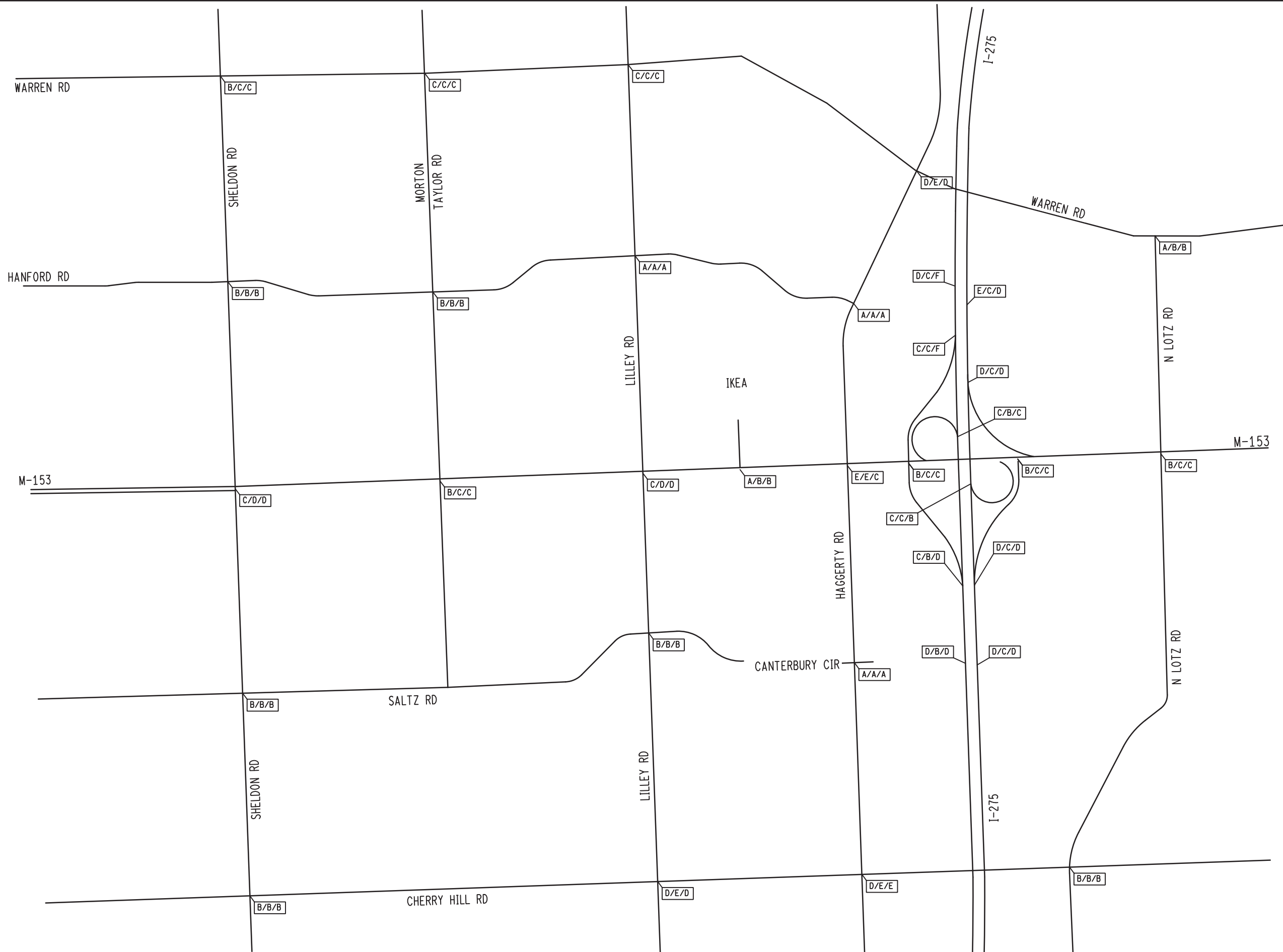
KEY
 X/X/X
 AM PEAK/PM PEAK/OFF PEAK HOUR

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		TSC: TAYLOR				



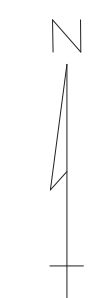
KEY
 X/X/X
 AM PEAK/PM PEAK/OFF PEAK HOUR

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		DESIGN UNIT: YUNG	JN: 115177			
		TSC: TAYLOR				



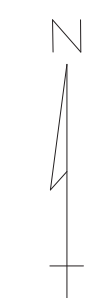
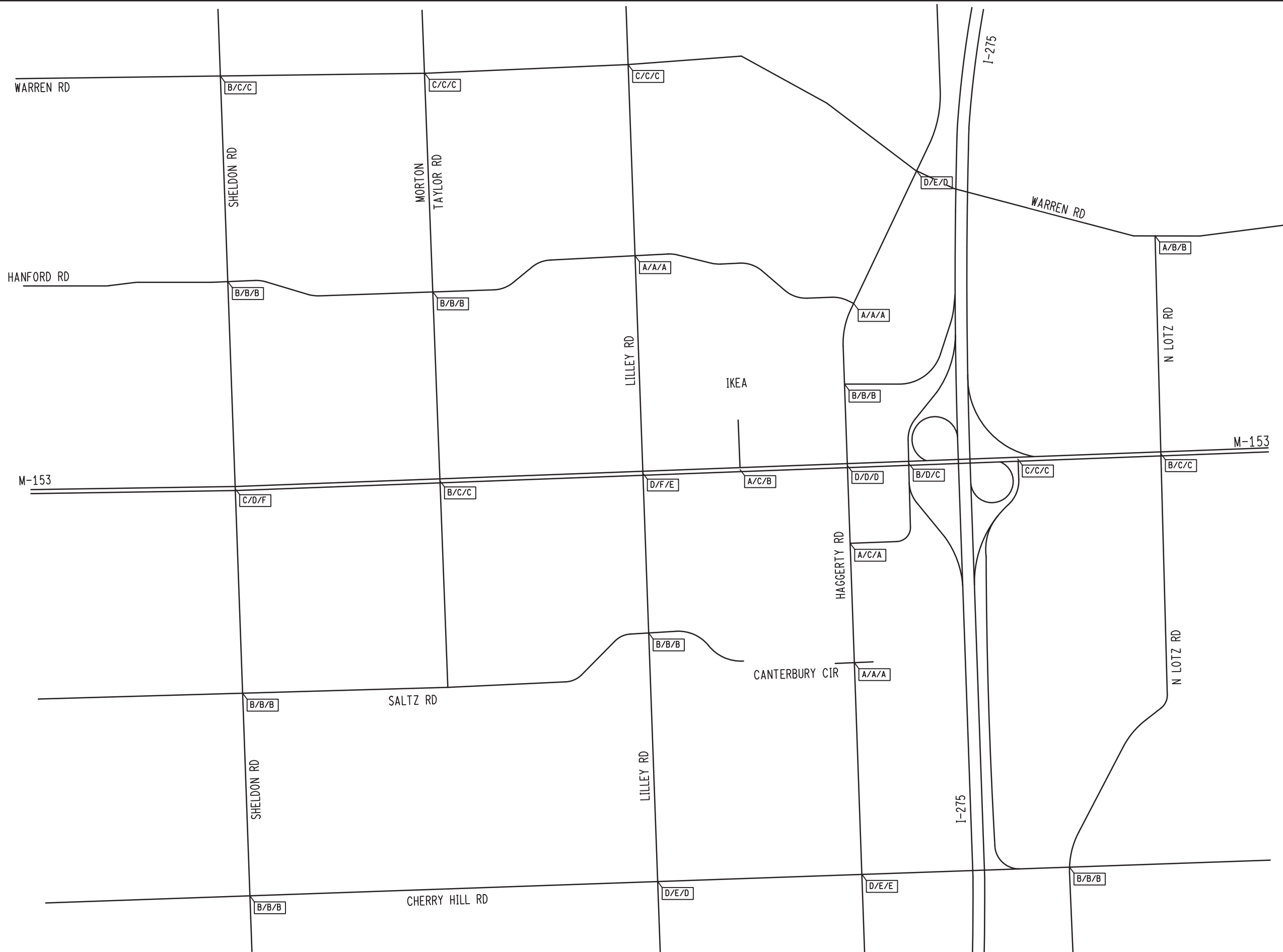
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 AM PEAK/PM PEAK/OFF PEAK HOUR

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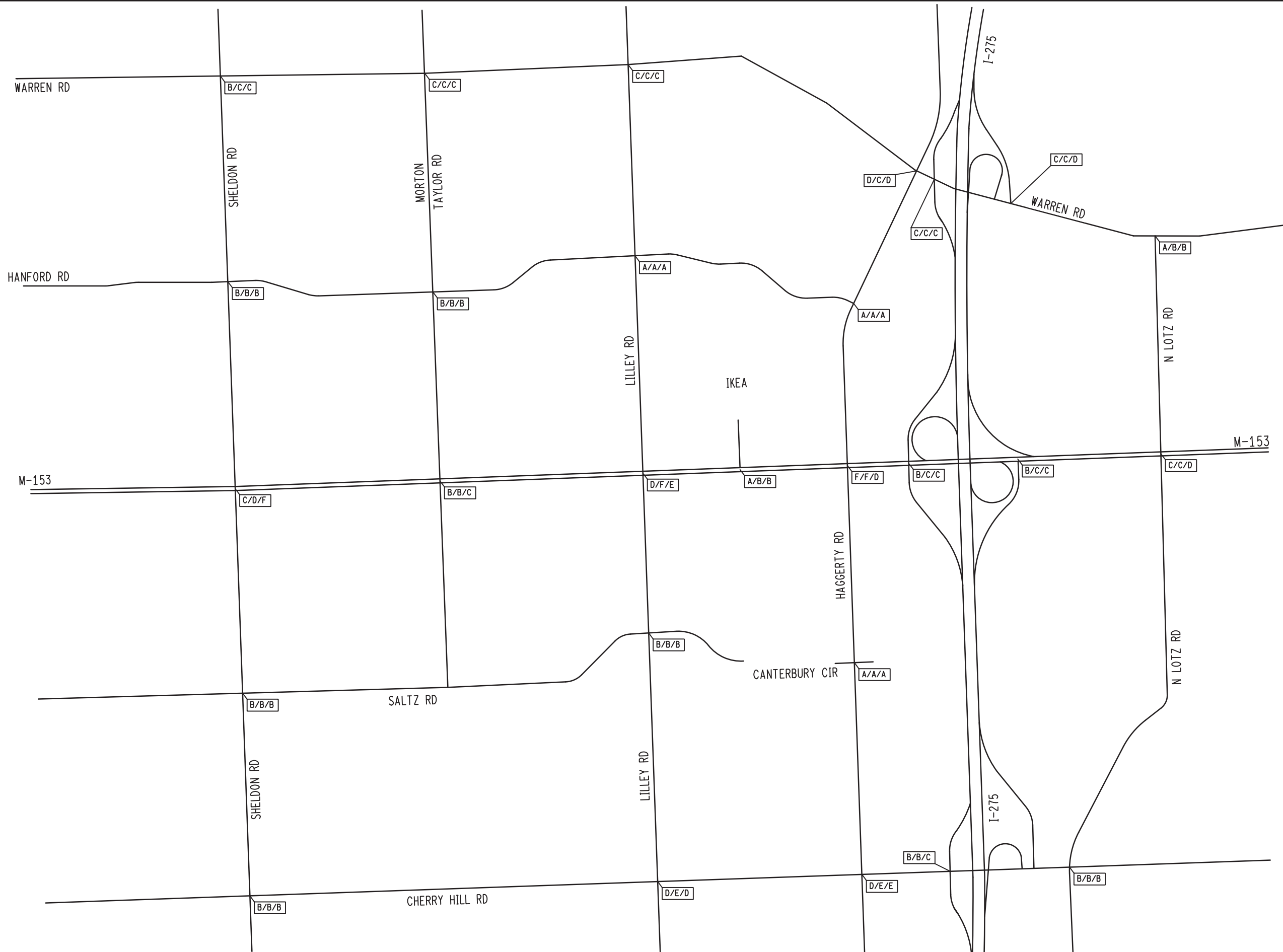
KEY
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 AM PEAK/PM PEAK/OFF PEAK HOUR

	DATE:	CS: 82292	I-275 & M-153 INTERCHANGE ALTERNATIVE 3 BOULEVARD 2035 OVERALL LEVEL OF SERVICE	DRAWING	SHEET
	DESIGN UNIT: YUNG	JN: 115177			
	TSC: TAYLOR				



KEY
 X/X/X
 AM PEAK/PM PEAK/OFF PEAK HOUR

	DATE:	CS: 82292	I-275 & M-153 INTERCHANGE ALTERNATIVE 4 - WWTIP STUDY 2035 OVERALL LEVEL OF SERVICE	DRAWING	SHEET
	DESIGN UNIT: YUNG	JN: 115177			
	TSC: TAYLOR				



KEY
 X/X/X
 AM PEAK/PM PEAK/OFF PEAK HOUR

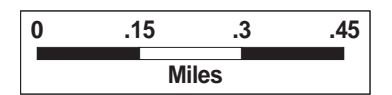
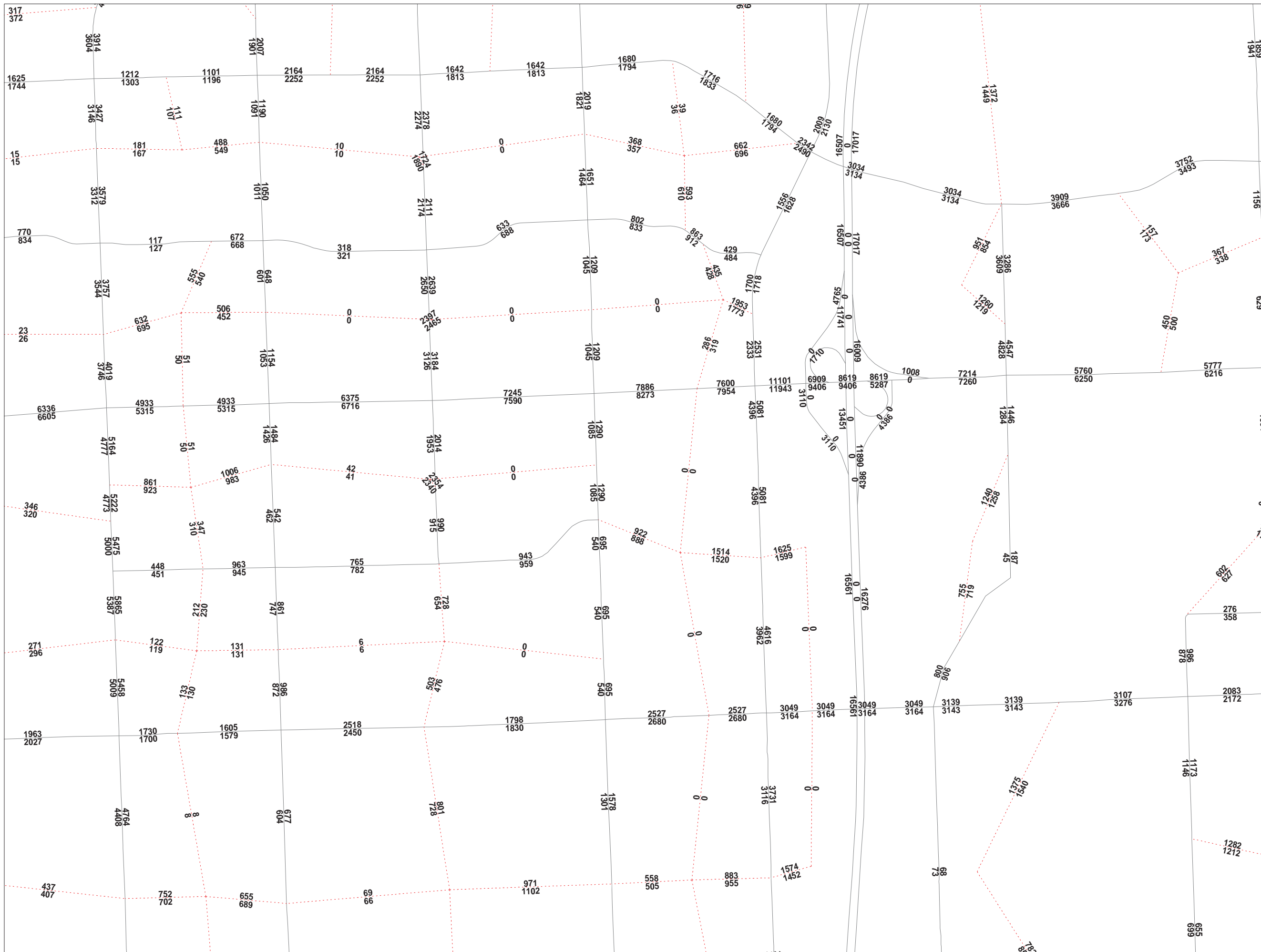
	DATE:	CS: 82292	I-275 & M-153 INTERCHANGE ALT 5 - FULL INTERCHANGE AT WARREN ROAD 2035 OVERALL LEVEL OF SERVICE	DRAWING	SHEET
	DESIGN UNIT: YUNG	JN: 115177			
	TSC: TAYLOR				

Appendix B3: TDM Maps

I-275 @ Ford

ALT: 2035

PERIOD: MD

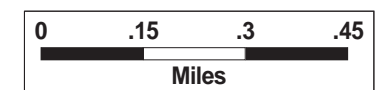
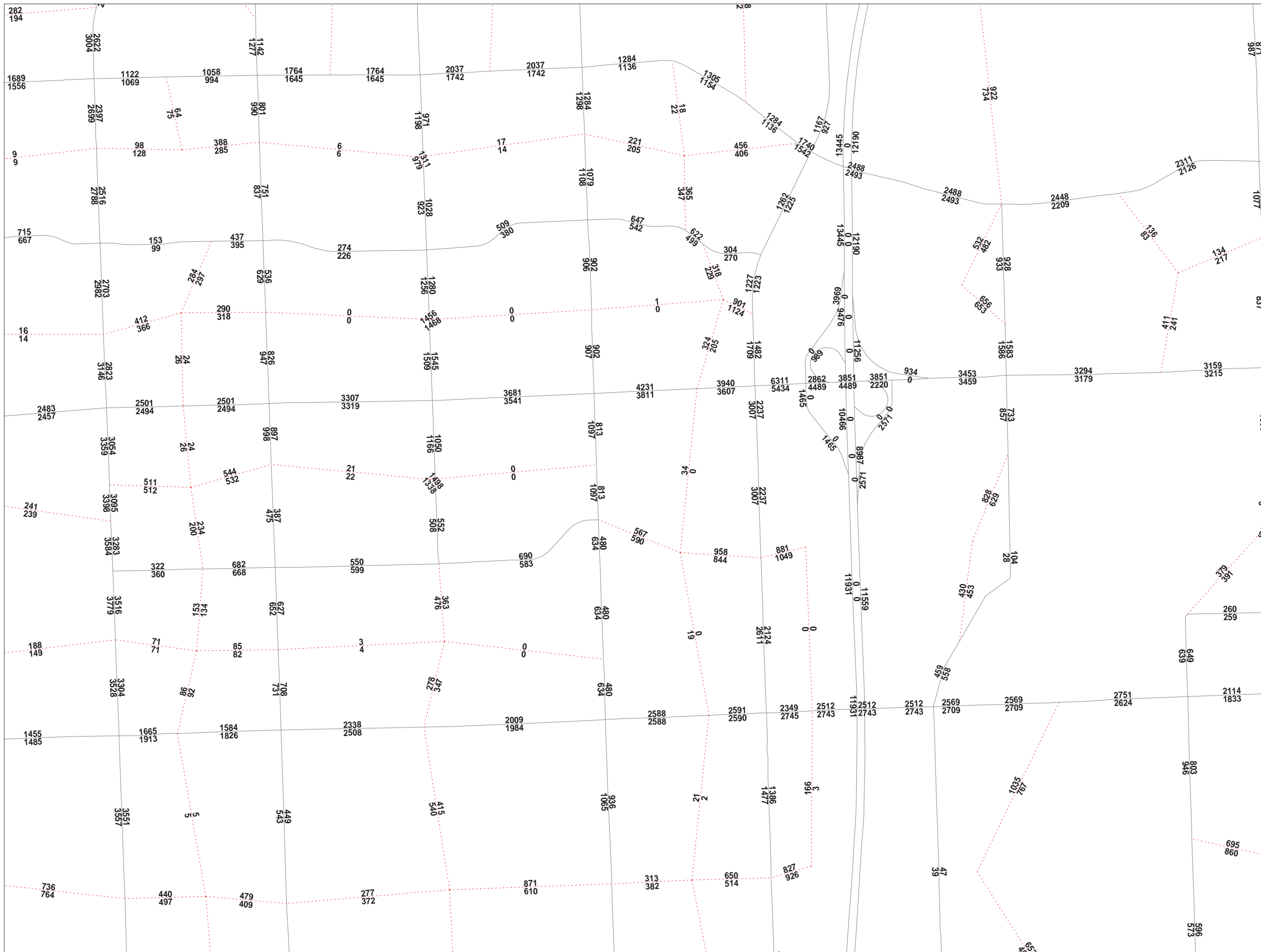


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I-275 @ Ford

ALT: 2035

PERIOD: PM

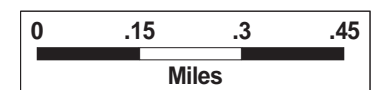
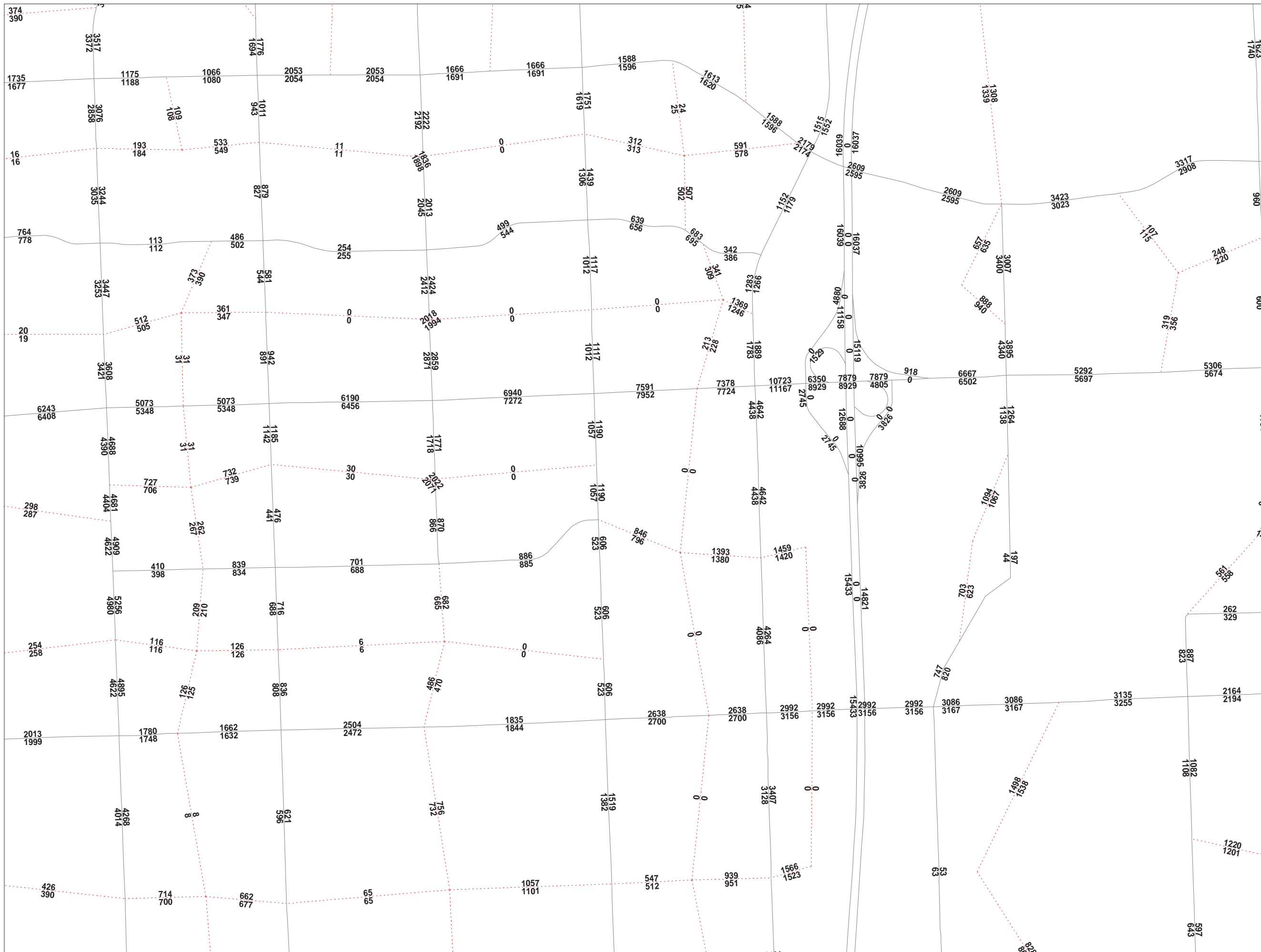


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I-275 @ Ford

ALT: 2035

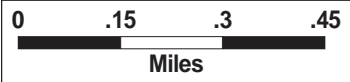
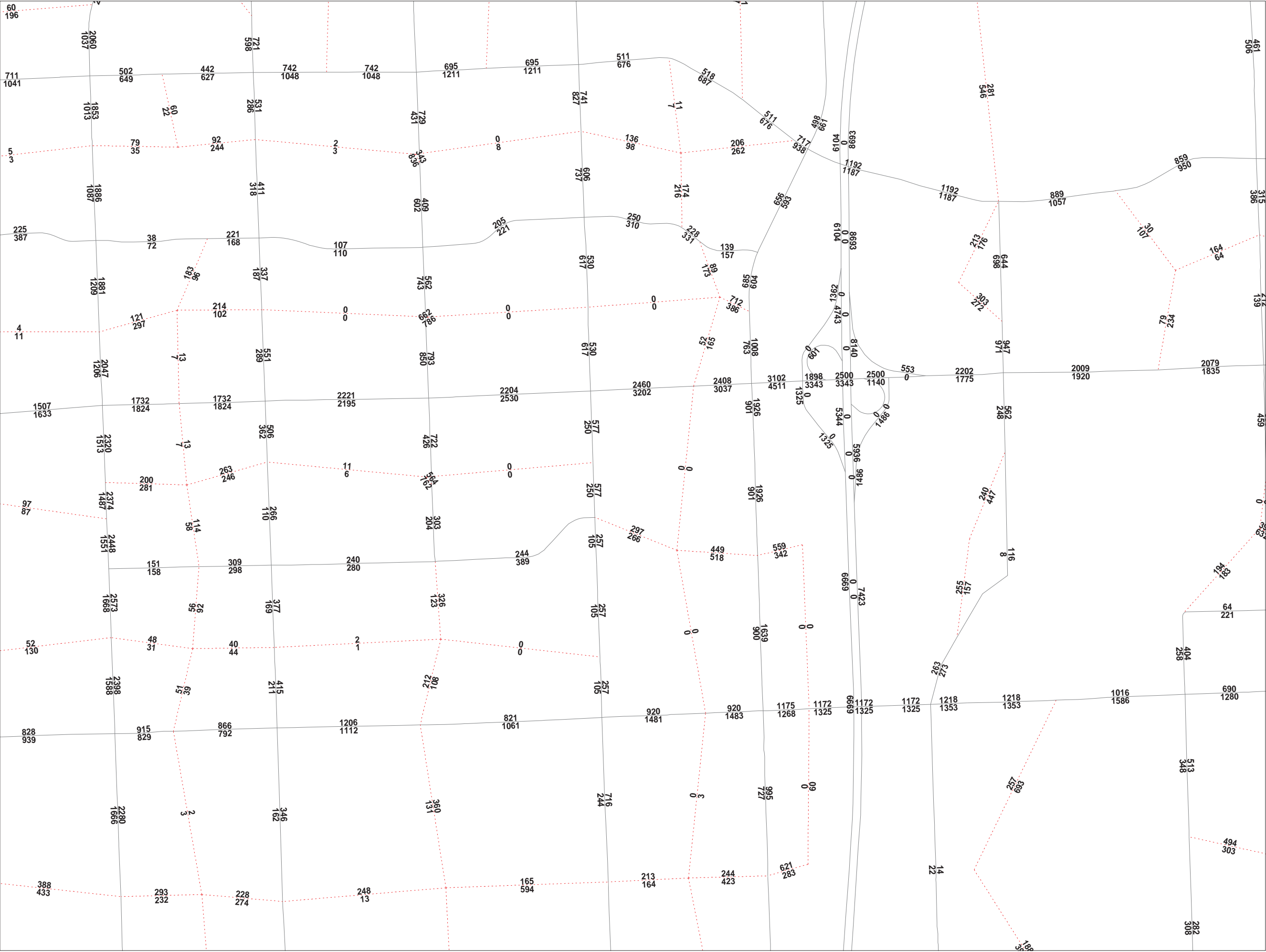
PERIOD: OP



CDM Smith 5/23/2013

I-275 @ Ford

ALT: 2035 ALT2
PERIOD: AM

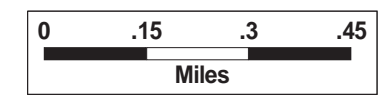
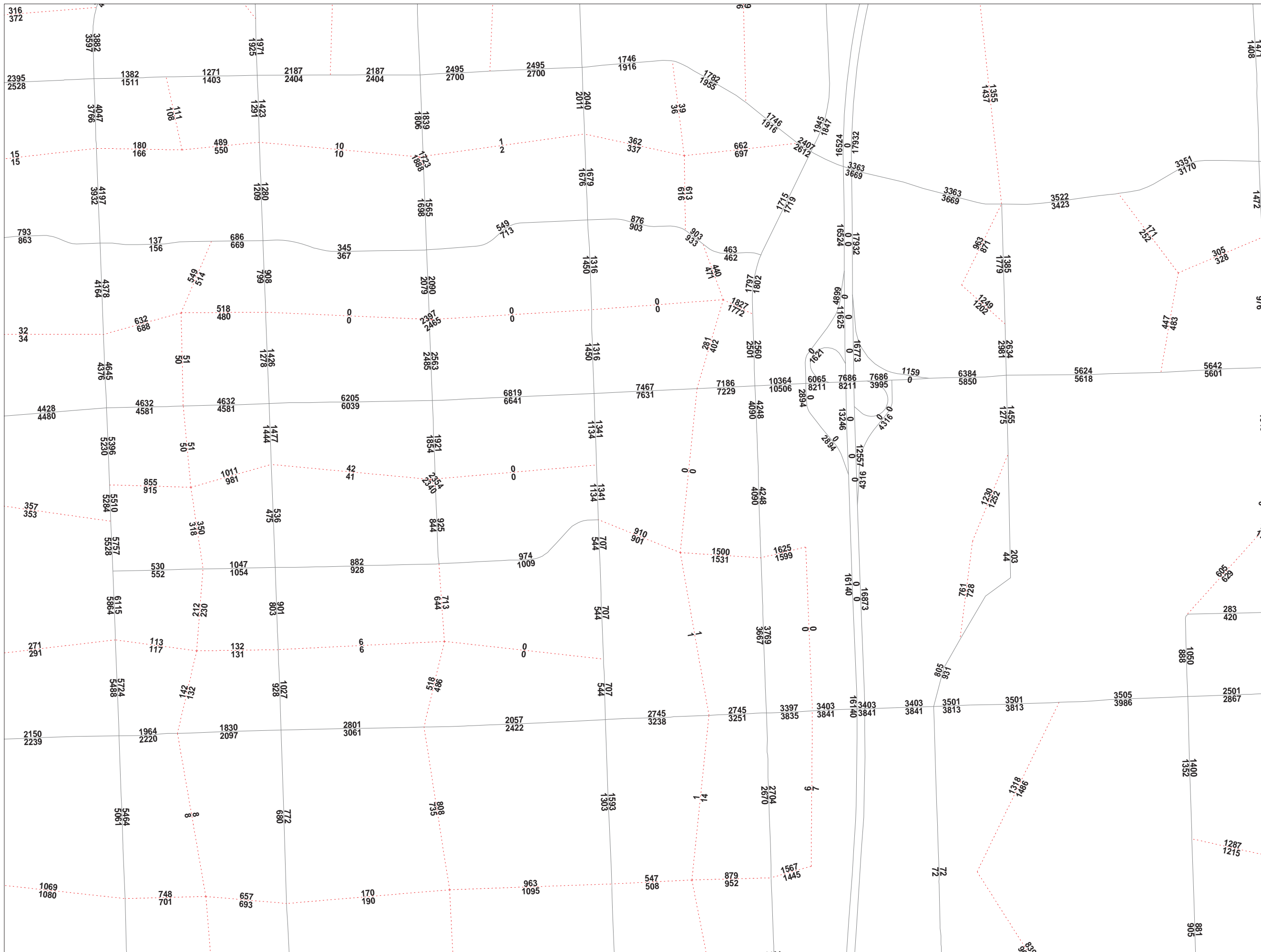


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I-275 @ Ford

ALT: 2035 ALT2

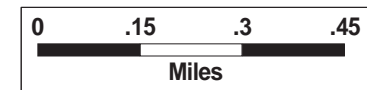
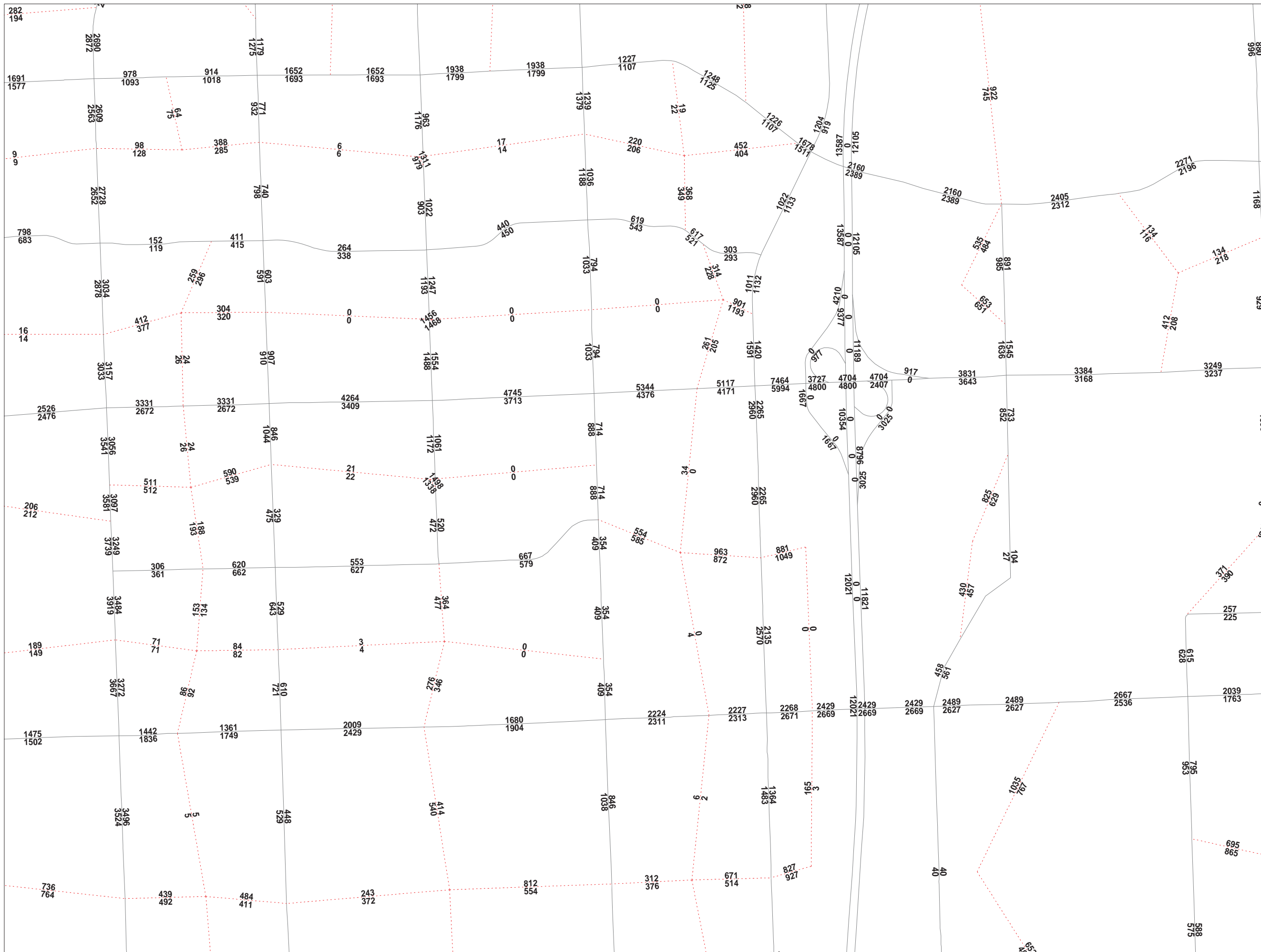
PERIOD: MD



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I-275 @ Ford

ALT: 2035 ALT2
PERIOD: PM

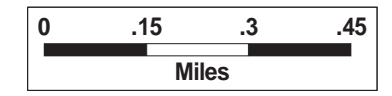
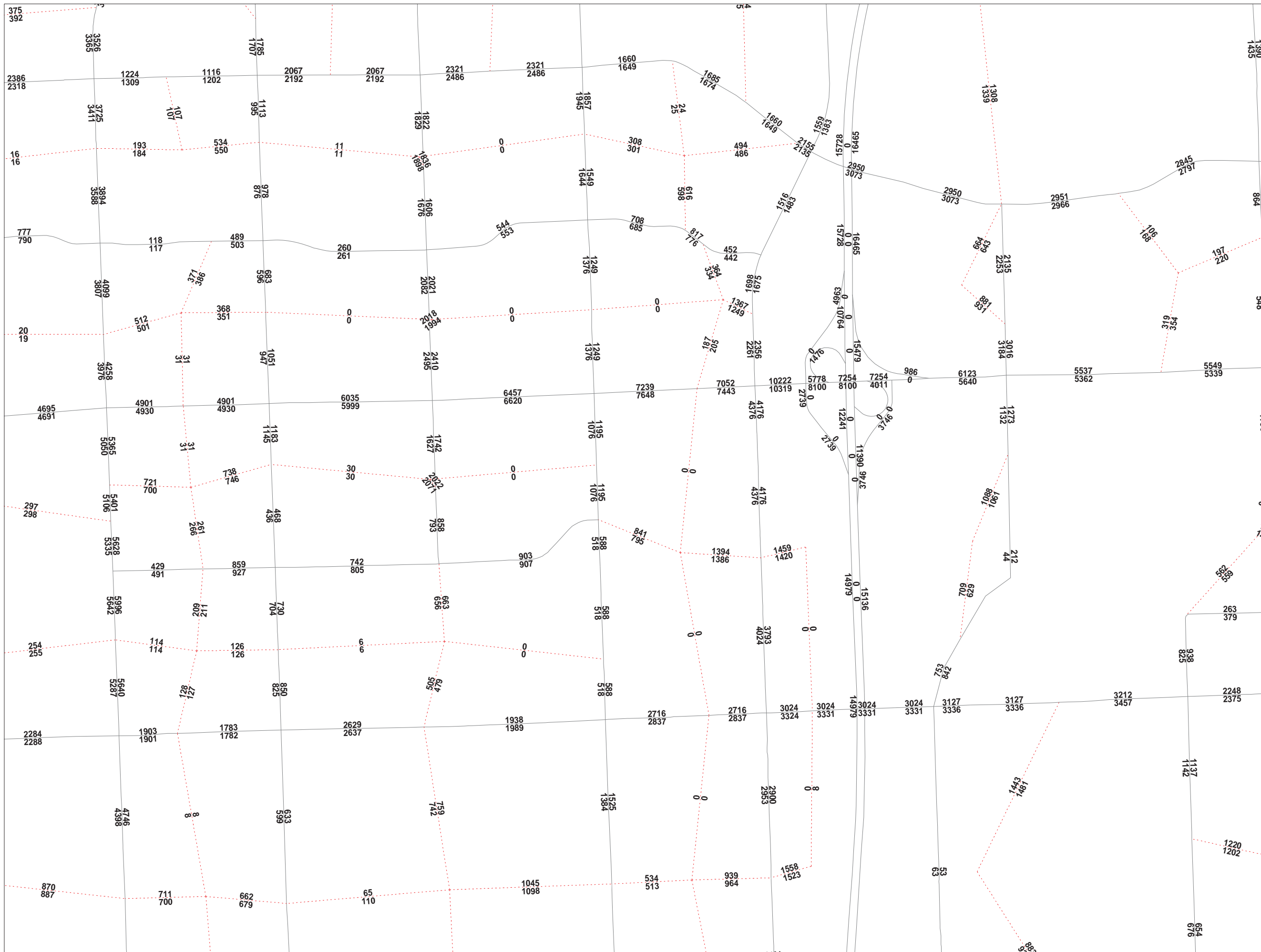


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I-275 @ Ford

ALT: 2035 ALT2

PERIOD: OP

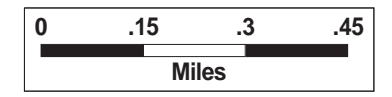
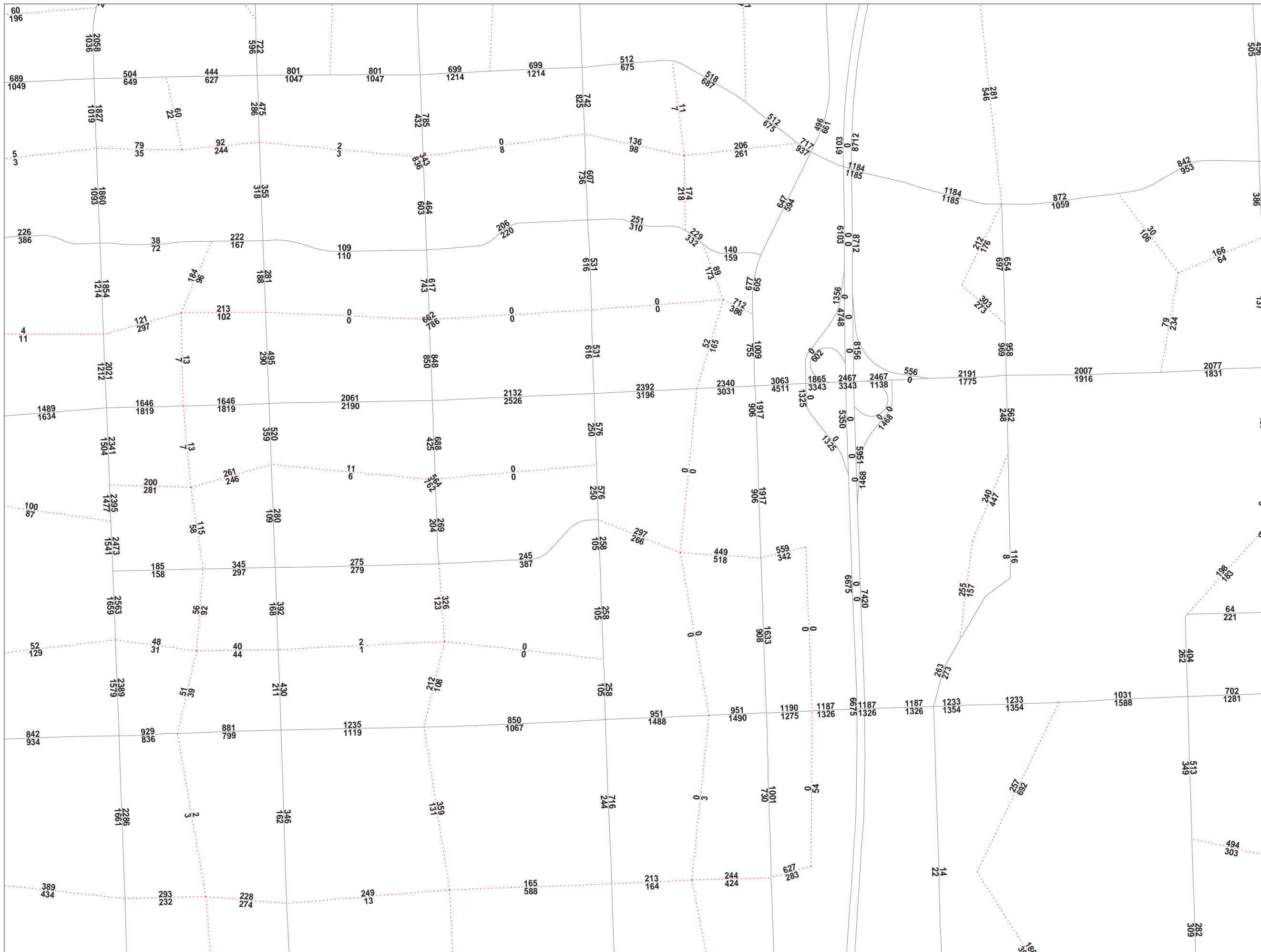


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I-275 @ Ford

ALT: 2035 ALT3

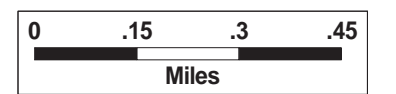
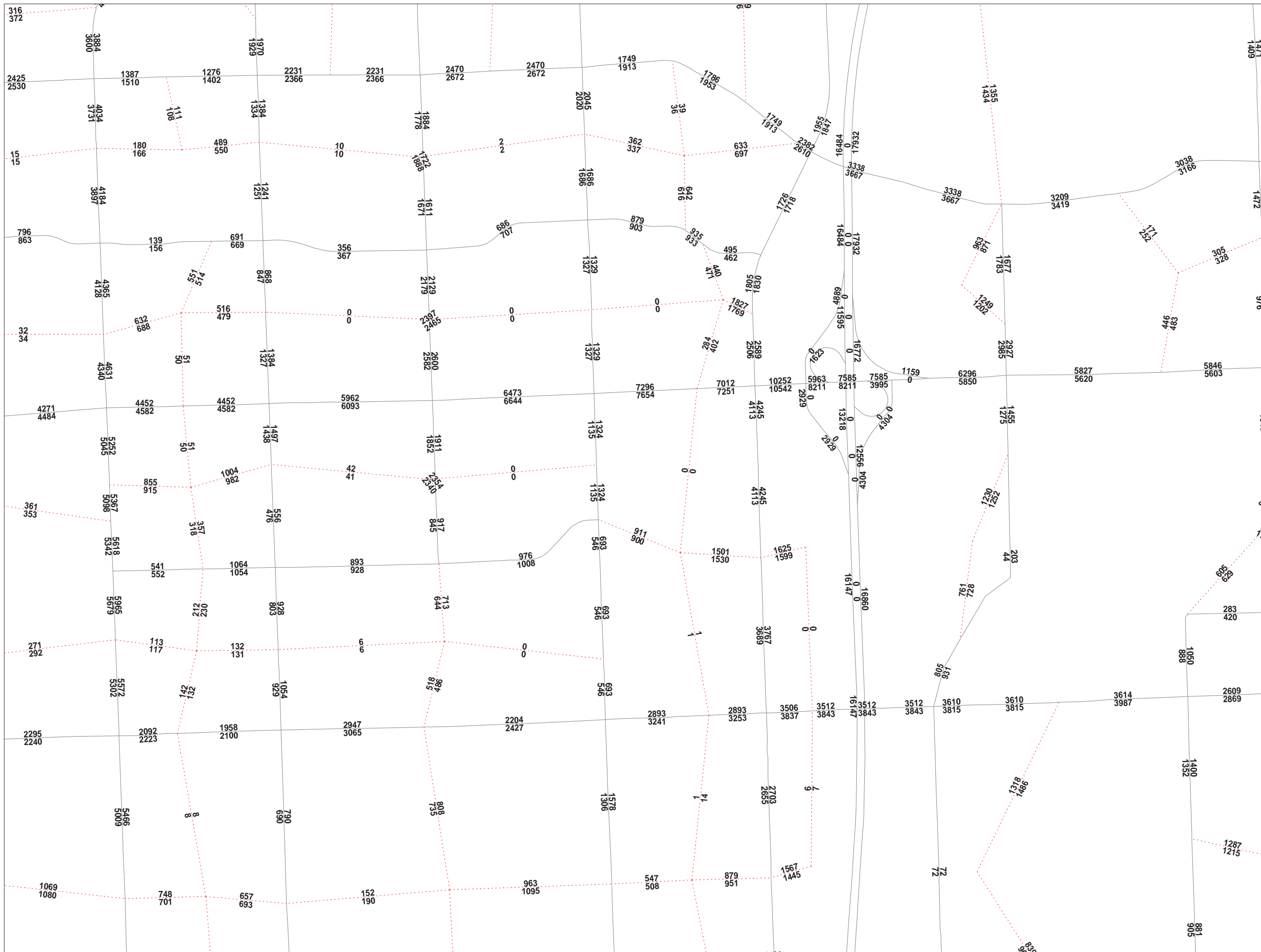
PERIOD: AM



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I-275 @ Ford

ALT: 2035 ALT3
PERIOD: MD

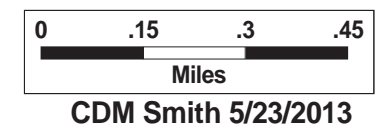
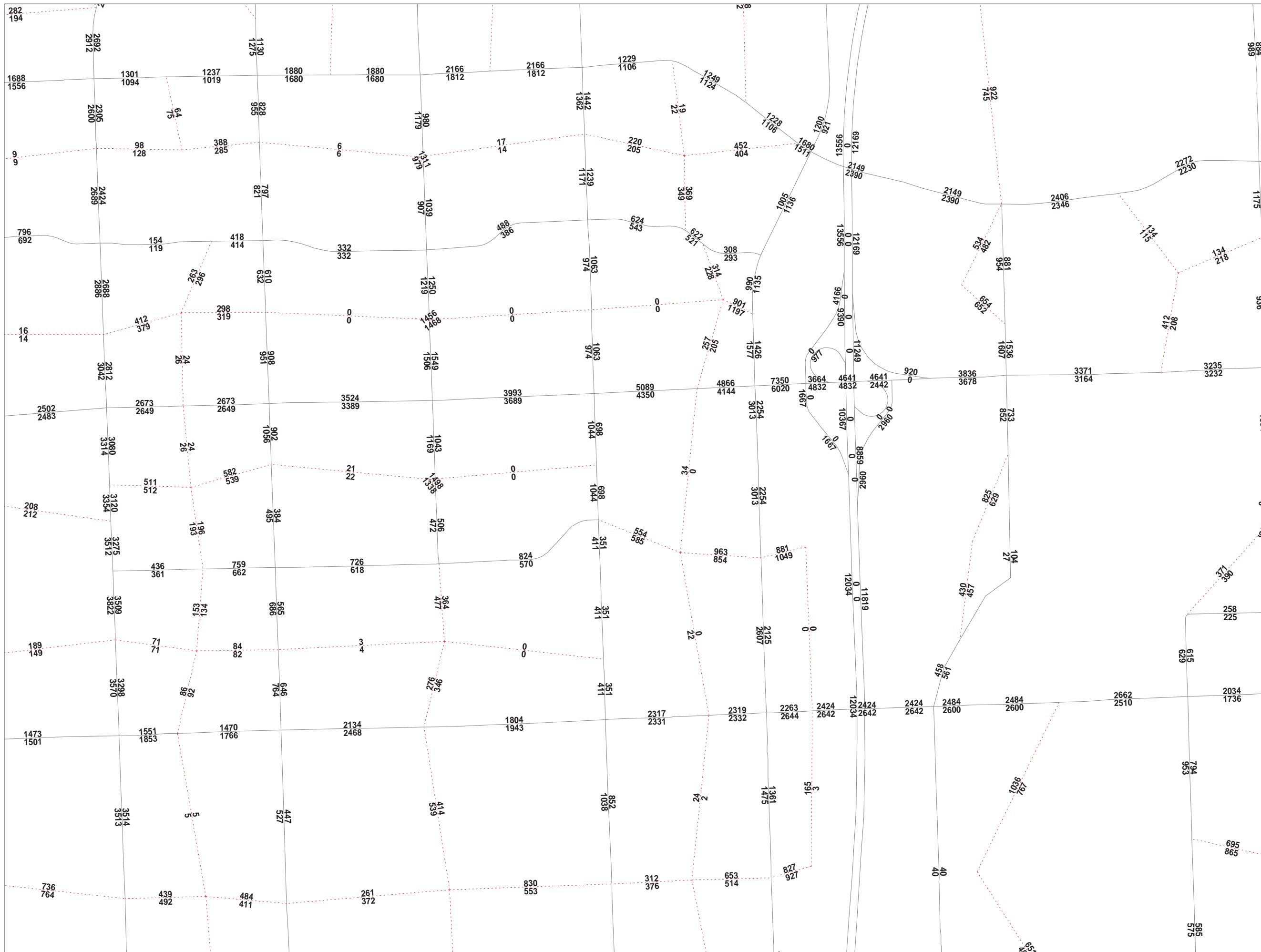


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I-275 @ Ford

ALT: 2035 ALT3

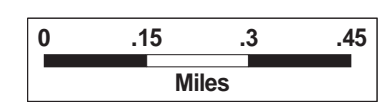
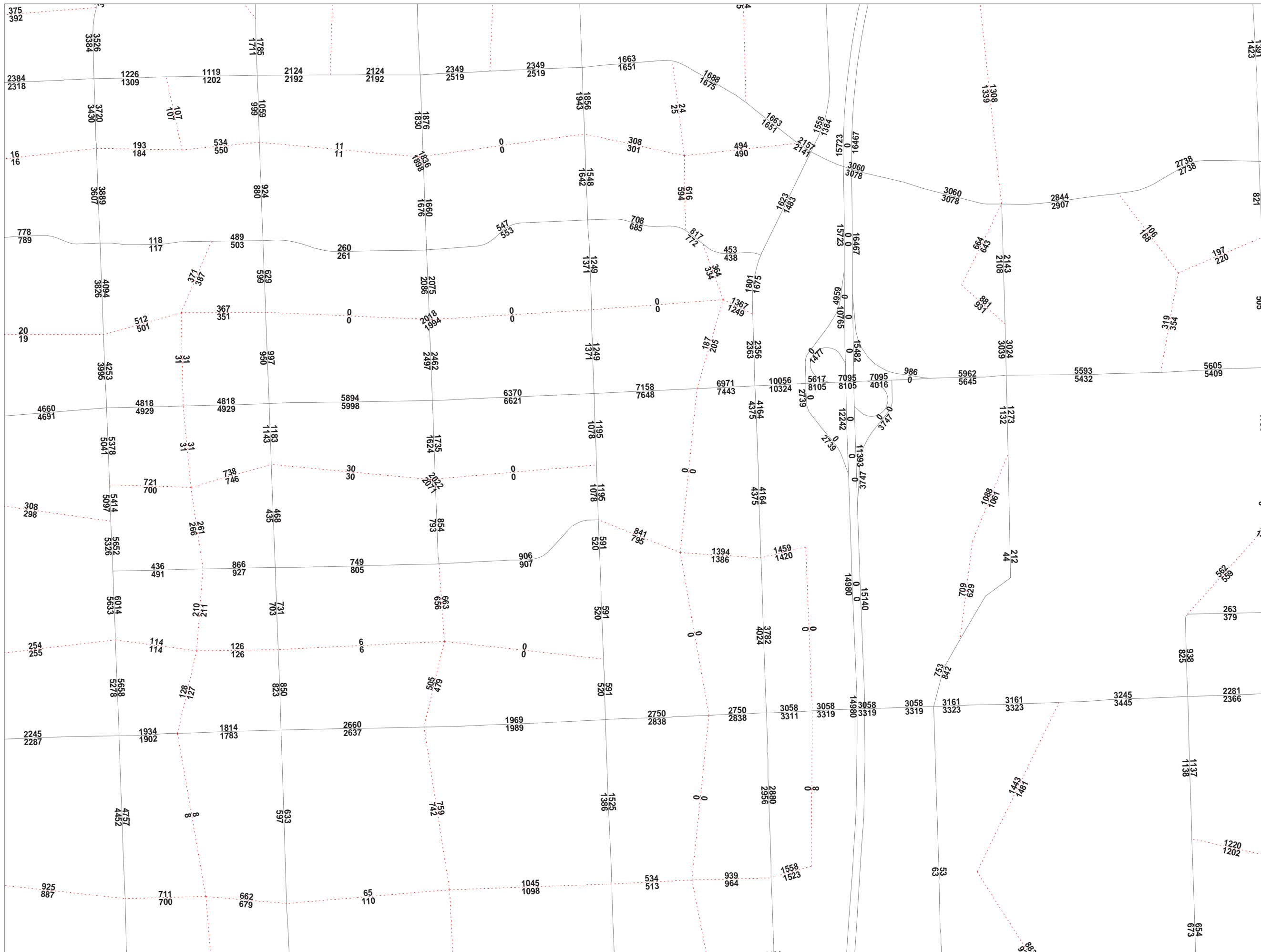
PERIOD: PM



I-275 @ Ford

ALT: 2035 ALT3

PERIOD: OP



CDM Smith 5/23/2013