CUY-71-18.29

SAFETY STUDY

I-90/I-490 TO SR176 (JENNINGS FREEWAY)

PID 107356

ODOT DISTRICT 12

2016 URBAN FWY RANKING #25, #47, #84, #141, #227, #307, #314

2017 URBAN FWY RANKING #1, #4, #8, #24, #36, #122, #298

MARCH 13, 2019

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EXECUTIVE SUMMARY

The purpose of this study is to evaluate the existing safety performance and to identify potential countermeasures to reduce traffic crashes of the following segments shown on Figure 1:

- **EB I-90** from the diverging ramp to 44th Street (SLM 13.20) to the diverging ramp gore to SB I-71/SR 176 (SLM 14.60)
- **WB I-490** from the west end of bridge over the Cuyahoga River (SLM 1.00) to the ramp diverge to SB I-71/ SR 176 (SLM 0.00)
- **SR 176** from begin of SR 176 (SLM 13.83) to the merge of 3-ramp lanes from I-71, I-90, and I-490 (SLM 13.20)
- **SB I-71** from south end of bridge over Starkweather Avenue (SLM 19.12) to ramp diverge to 25th Street (SLM 17.90)

Due to concerns about construction activities affecting the safety performance within the study area, the study was structured to limit the affects cause by maintenance of traffic activities as noted:

- Traffic data was collected in December 2017 which occurred more than a year after the west alternate route plan (WARP) was removed (October 2016).
- Crash data from 2015-2017 was analyzed for the study area south of the I-90/ I-490 corridor. The safety impacts related to Innerbelt MOT plans were less south of I-90/ I-490 than on other segments of the study area (i.e., EB I-90).
- Crash data from 2016-2018 was analyzed for the study area on EB I-90. The safety impacts related to Innerbelt MOT plans are less than any other dataset available for analysis purposes. All 3 years included time frames where crashes were not affected by MOT activities within the study area. Analysis would have needed to extend back to 2011 which represents the last time construction activities were not in effect within the study area.

Several existing conditions contribute to the safety performance of the study area. The following countermeasures are proposed to mitigate the safety performance issues.

1. **Mitigate 3-Lane Weave across SB I-71.** The single lane ramp from the C-D roadway to SB I-71 is about 1,800 feet long before merging with the 3-lane section of SB I-71. The ramp merge (right side of SB I-71) occurs within the functional area of a left side exit ramp (diverge) to SB SR176. Traffic will merge onto SB I-71 with the purpose of using the SB SR176 exit ramp on the left side of I-71. This maneuver requires a 3-lane weave across I-71 over a distance of 800 to 1,800 feet. **A total of 25 crashes also were attributed to a 3-lane weave across I-71.**

   The countermeasures include extending concrete barrier and longitudinal rumble strips along the entrance ramp from the C-D roadway to SB I-71. Construction costs are equal to $1,276,300 (**Appendix F**). See **Figure 14** for a conceptual plan of the proposed countermeasures.

2. **Convert C-D roadway to a 3-Lane Section**. The existing 2-lane, collector-distributor (C-D) roadway formed by the WB I-490 ramp (2-lanes) operates over capacity due to the ramp merging from EB I-90. A 2014 technical memo and capacity analysis using 2017 volumes (**Appendix D**) determined the segment operates at a v/c ratio (PM peak hour) of 1.08 and 1.16 (**Appendix G**), respectively.

   The countermeasure is comprised of converting the 2-lane C-D roadway to a 3-lane section. Weaving is simplified by increasing the weaving distance and eliminating the merge of EB I-90. A 3-lane section with a center option lane (to SB I-71 or to SB 176 ramp) will improve levels of service from F to D. Construction costs are equal to $1,864,300 (**Appendix F**). See **Figure 15** for a conceptual plan of the proposed improvements.

3. **2-Lane Ramp to SB SR176 over I-71/ Valentine Avenue Ramp**. Safety countermeasures to mitigate the 3-lane weave across I-71 will increase traffic volumes on the ramp to SB SR176 via the C-D roadway. Ramp volumes from the C-D road to SB SR176 exceed 2,000 pcphpl (**Figure 9**) which is representative of the ideal capacity for a single lane ramp having free flow speeds of 40 MPH. The existing horizontal curve has a design speed of 40 MPH. Eliminating the 3-lane weave across I-71 could potentially divert an additional 510 vehicles in the PM peak hour to the SR176 ramp thus requiring a 2-lane ramp over I-71.

   Converting the SR176 ramp to 2-lanes requires the single lane ramp from W. 14th Street/Valentine Avenue to become a merge prior to the horizontal curve over I-71. Reconstruction of the Valentine Avenue ramp will require retaining wall reconstruction to address the 16 ft elevation difference between W 14th Street and the SR176 ramp. The Valentine Street ramp operates at LOS C as a merge condition with 2-lanes on the SB SR176 ramp over I-71.

   Queues that form on EB I-90 are attributed to capacity and weaving constraints on the C-D roadway south of the I-90/ I-490 interchange and of the capacity constraints of the 2-lane ramp to SB SR176 over I-71. **A total of 238 crashes have occurred within a 3-year period (2016-2018) of which 68% are rear end crashes.** Constructions costs are equal to $1,774,400 (**Appendix F**). See **Figure 17** for a conceptual plan of the proposed countermeasures.

Mitigating crashes on EB I-90 is dependent on having a 2-lane ramp to SB SR176 over I-71 and the Valentine Avenue ramp conversion to a merge condition. The 2-lane ramp to SB SR176 over I-71 adds (Item #3, above) over 3,500 feet of additional storage on the C-D roadway. Converting the C-D roadway to a 3-lane section adds another 1,000 feet of storage on the C-D roadway. These 2 countermeasures reduce the frequency and length of queues from forming on EB I-90 at the I-490 interchange.

ECAT output having a Benefit/Cost ratio of 0.70 and a draft funding application having a score of 51 is included in **Appendix H.**

INTRODUCTION

The purpose of this study is to evaluate the existing safety performance and to identify potential countermeasures to reduce traffic crashes at the I-90/I-490/I-71/SR 176 system interchange as outlined below. An expanded study area is shown in **Figure 1**.

- **EB I-90** from the diverging ramp to 44th Street (SLM 13.20) to the diverging ramp gore to SB I-71/SR 176 (SLM 14.60)
- **WB I-490** from the west end of bridge over the Cuyahoga River (SLM 1.00) to the ramp diverge to SB I-71/ SR 176 (SLM 0.00)
- **SR 176** from begin of SR 176 (SLM 13.83) to the merge of 3-ramp lanes from I-71, I-90, and I-490 (SLM 13.20)
- **SB I-71** from south end of bridge over Starkweather Avenue (SLM 19.12) to ramp diverge to 25th Street (SLM 17.90)

The study area includes the south end of the Cleveland Innerbelt project limits (http://www.dot.state.oh.us/projects/ClevelandUrbanCoreProjects/Innerbelt/Pages/default.aspx). Whereas this study focuses on short to medium term countermeasures to improve safety, the Cleveland Innerbelt project identifies major upgrades to capacity of the I-71, I-77, and I-90 corridors. Improvements as part of the Innerbelt family of projects include adding lanes to the Innerbelt Bridge, as well as reconstruction of the Central Interchange.

Traffic operations have been affected by construction activities associated with the Innerbelt projects, in particular, Construction Contract Groups (CCG) 1 and 2 since 2011. Maintenance of traffic (MOT) plans have diverted traffic from I-71 north of I-90/I-490. Two different time periods were evaluated to compare the safety performance associated with the pre-WARP condition with the most recent WARP plan:

- Pre-WARP conditions (2008-2010). Travel patterns during this time period were expected to be similar to existing conditions (2016) – no specific MOT plan was in place prior to 2010. The west alternate route plan (WARP) was implemented in the summer of 2011.
- Recent WARP conditions (2015-2017). The west alternate route plan (WARP) which has been implemented at various times over the last several years. The west alternate route plan (WARP) was removed in October 2016 after all new construction was completed on the Innerbelt bridge. Despite the WARP being in effect during this timeframe, the safety data was compared to historical crash data prior to Innerbelt construction activities in the region.

AASHTOWare's Safety Analyst (SA) software was used by ODOT to prioritize safety locations. The software system prioritizes urban freeways that have higher-than-predicted crash frequencies and crash severity. Note that the methodology used to prioritize safety locations using Safety Analyst (SA) also has evolved since 2010.

Safety analysis utilized a two-step approach in an effort to compare the effects of changing roadway conditions and MOT impacts on safety performance. The interstate network within the study area has been under continuous construction since 2011.

FIGURE 1A: STUDY AREA (EB I-90/ WB I-490)

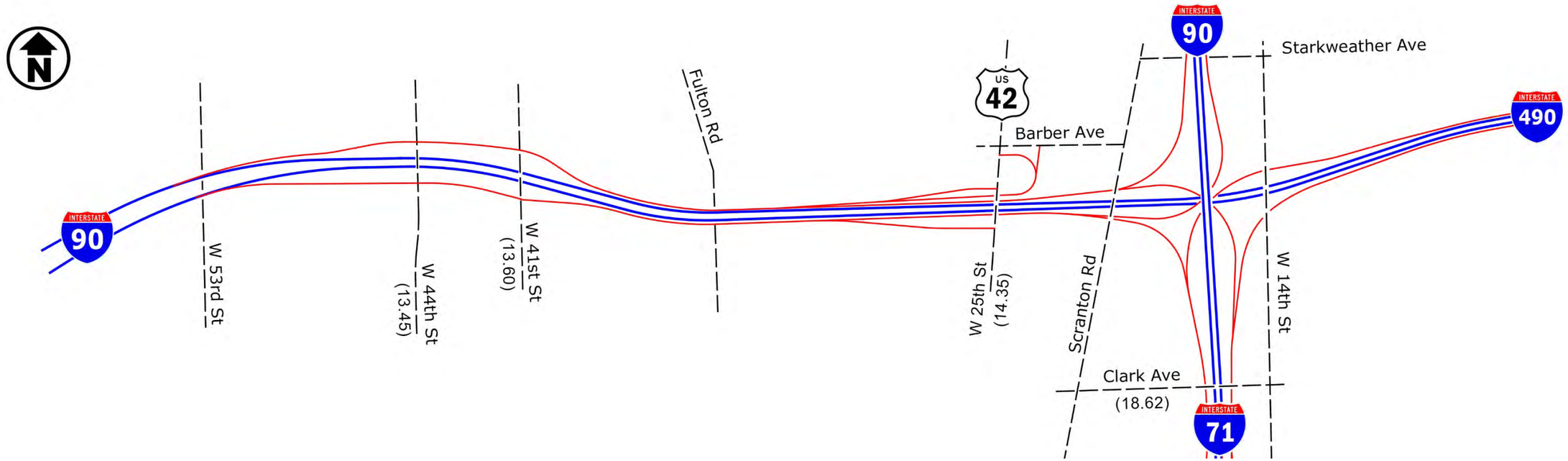
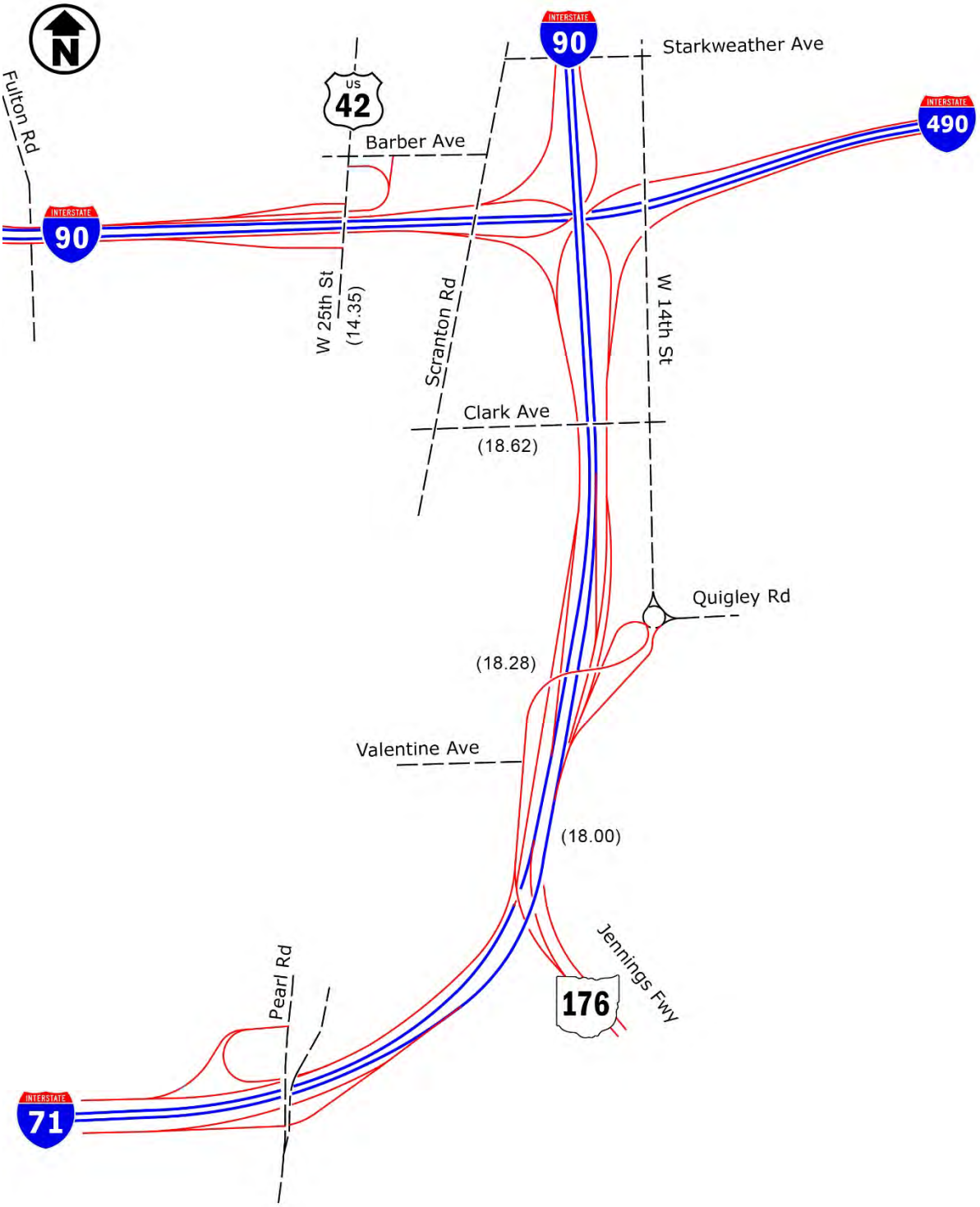


FIGURE 1B: STUDY AREA (SB I-71/ SB SR176)



Regardless of the methodology to prioritize segments and changes to traffic patterns associated with Innerbelt construction, the segment of I-90 west of I-71 has regularly appeared on the Urban Freeway priority safety list dating back to 2010. The Safety Analyst (SA) ranking of each segment on I-90 within the study area for both study periods is summarized in **Table A**.

TABLE A: SA RANKING BY SEGMENT ON I-90

2008-2010 Rank	2015-2017 Rank	Straight line mileage		Location Reference (I-90)	
		begin	end		
54	**298**	13.41	13.51	W. 44th Street (13.45)	
87		13.51	13.61	W. 41st Street (13.60)	
	514	13.58	13.68	study area length 0.20 mile	
47		13.61	13.71		
	873	13.68	13.78		
	415	13.78	13.88	study area length 0.10 mile	
	24	13.92	14.02	study area length 0.16 mile	
	8	13.98	14.08		
	36	14.08	14.18		
254	**122**	14.21	14.31		
	1	14.25	14.35	W. 25th Street (14.35)	study length 0.20 mile
7		14.28	14.38	gore of exit ramp to I-71 (14.38)	
	4	14.35	14.45	gore of exit ramp to I-71 (14.38)	
				gore of ramp split to NB and SB I-71	
221		14.57	14.67		
230		14.67	14.77		

Note that some segments overlap while gaps occur between other segments. The safety performance issues on EB I-90 has shifted from a point about 0.75 miles west of the exit ramp to SB I-71 to a point about 0.25 miles west of the exit ramp to SB I-71. The benefits of reducing queue lengths on EB I-90 have been realized as the Innerbelt projects were completed in 2016.

An interchange justification study (IJS) dated June 2009 was completed for Construction Contract Group 1 (CCG1) of the Innerbelt project. **Appendix A** contains an excerpt of the IJS.

The only Innerbelt related improvement located within the current safety study area is the addition of a decel ramp on southbound I-71 for the left side exit ramp to southbound SR 176 (CCG7A, PID 98063). Preliminary design has started for this improvement. **Appendix B** contains an excerpt of a feasibility study dated October 2017 for the SB I-71 exit ramp to SB SR 176 (CUY-71/176-17.83/12.76).

Other segments within the study area of the safety project were not addressed in the original IJS of the Innerbelt study. In particular, congestion on the C-D road from the EB I-90/ WB I-490 ramps to SB I-71/ SR 176 was considered to be an existing condition not affected by the Innerbelt improvements. **Therefore, safety countermeasures resulting from this study are independent of the Innerbelt family of projects**

EXISTING CONDITIONS

Interstate 90 (I-90) also known as the Northwest Freeway is classified as an urban interstate that connects suburbs on the west side of Cleveland to downtown. The posted speed limit within the study area is 60 miles per hour. East of the 41st Street interchange, the I-90 roadway section is 5-lanes wide (0.5 miles from the I-71/I-490/I-90 junction).

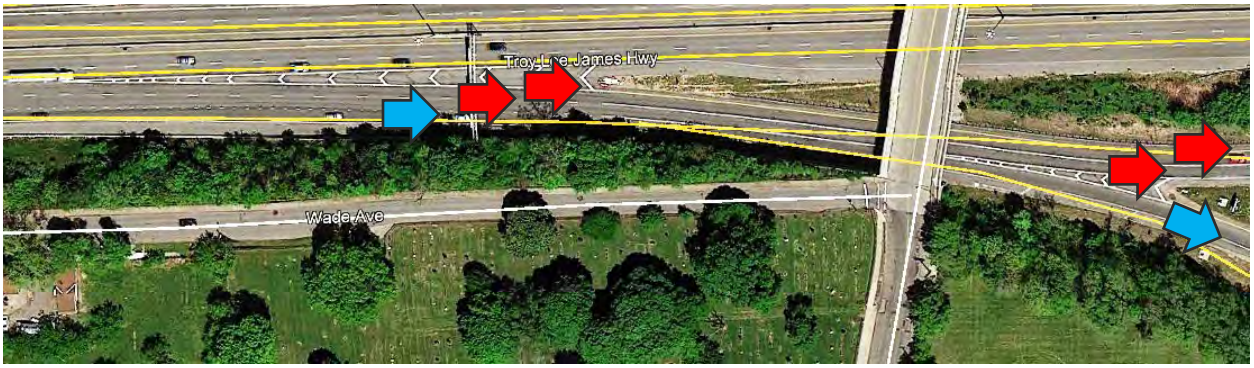
The eastbound I-90 lanes approaching the I-71/I-490/I-90 junction are assigned to the following destinations:

- Lane 1 (right lane): SB I-71/ SR 176 ramp. The 2017 annual average daily traffic on this ramp is 21,486 vehicles.
- Lane 2 and 3: EB I-90 (destination is the north leg of the system interchange).
- Lane 4 and 5: EB I-490

The EB I-90 exit ramp to SB I-71/ SR76 was reconstructed starting in 2015 to increase capacity for traffic destine to I-90 and to I-71/ SR176. The existing auxiliary lane (5th lane) east of the 41st Street interchange was extended to the SB I-71/ SR176 ramp creating a 3-lane exit ramp from EB I-90. A 2-lane ramp at this location was identified as operating at a LOS F (AM peak) in the original 2009 IJS study (**Appendix A**). **Figure 2** shows the improved segment on EB I-90 with the auxiliary lane extension shown as a blue arrow.

No improvements to the exit ramp, however, were identified to mitigate congestion as part of the CCG1 Innerbelt study. The 2015 exit ramp improvements on EB I-90 mitigate congestion caused by the original 2-lane exit ramp shown in the Innerbelt CCG1 study.

FIGURE 2: EB I-90 EXIT RAMP (3-LANES)

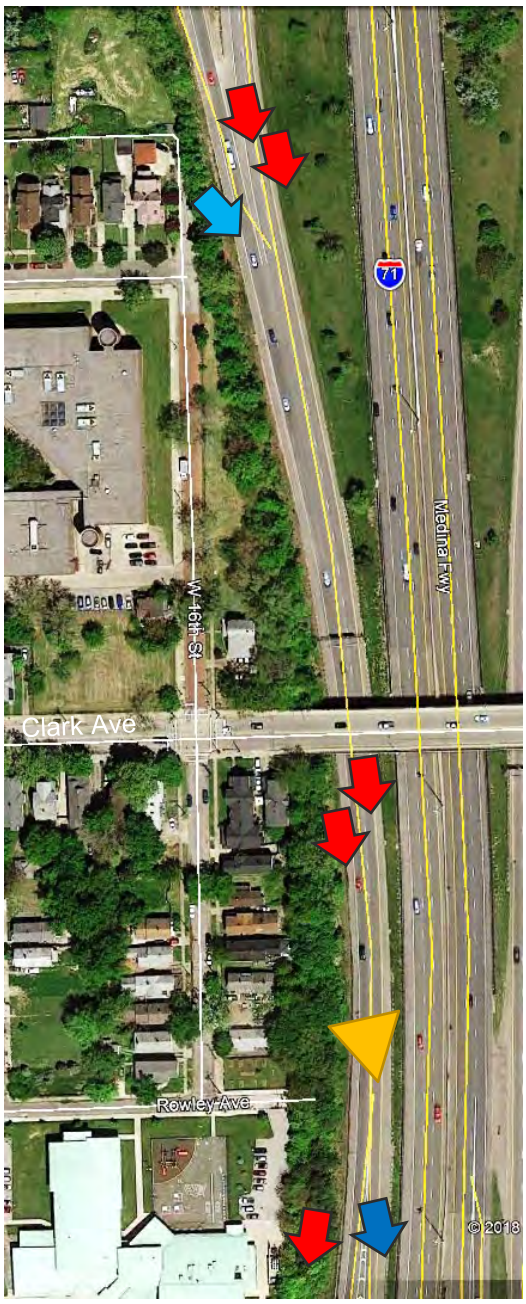


A 2-lane, collector-distributor (C-D) roadway is formed by the WB I-490 ramp (2-lanes). The single lane, directional ramp from EB I-90 (blue arrow, **Figure 2**) merges with the WB I-490 ramp.

Analysis was completed November 2014 on the C-D roadway for traffic originating from EB I-90/ WB I-490 and destine to SB I-71/ SB SR176. **The analysis concluded that the existing 2-lane C-D roadway operates over capacity (LOS F, V/C ≥ 1.08). Traffic volumes during the PM peak hour within this 2-lane segment was 3,471 vehicles (2014 volumes).** Note that the analysis was completed when traffic was being redirected as part of the WARP maintenance of traffic plan. An excerpt of the 2014 study is contained in **Appendix C**.

Figure 3 shows the segment of the C-D roadway that is comprised of 2-lanes (red arrows). Note that the length of the weave on the existing 2-lane C-D roadway is about 600 feet measured from the end of the EB I-90 ramp merge to the split (ramp to SB I-71/ramp to SB SR176).

FIGURE 3: SB C-D ROADWAY (2-LANES)



Traffic originating from EB I-90 often travel across the painted median at the south end of the C-D roadway for at least 3 reasons:

1. Traffic destine to I-71 are not able to navigate the single lane weave within the 600 ft distance. **Photo 1** shows vehicles in the right lane merging with traffic destine to SB I-71.
2. Another contributing factor is related to queue jumping. **Photo 1** shows queues forming on the ramp destine to SB SR176. Traffic will merge onto SB I-71 with the purpose of using the SB SR176 exit ramp on the left side of I-71. This maneuver requires a 3-lane weave across I-71 over a distance of 800 to 1,800 feet.
3. The last contributing factor is related to the position of overhead guide signs for traffic destine to SB SR176. **Figure 3** shows the location on the C-D roadway (yellow triangle) where drivers are able to view overhead guide signs for SB SR176 as a left side exit (via the SB I-71 ramp) or as a right-side ramp (via the C-D roadway). **Photo 2** provides a perspective of drivers on the C-D roadway (yellow triangle). Motorists may be confused (or encouraged) to use the I-71 ramp to access SB SR176 when approaching the gore on the C-D roadway.

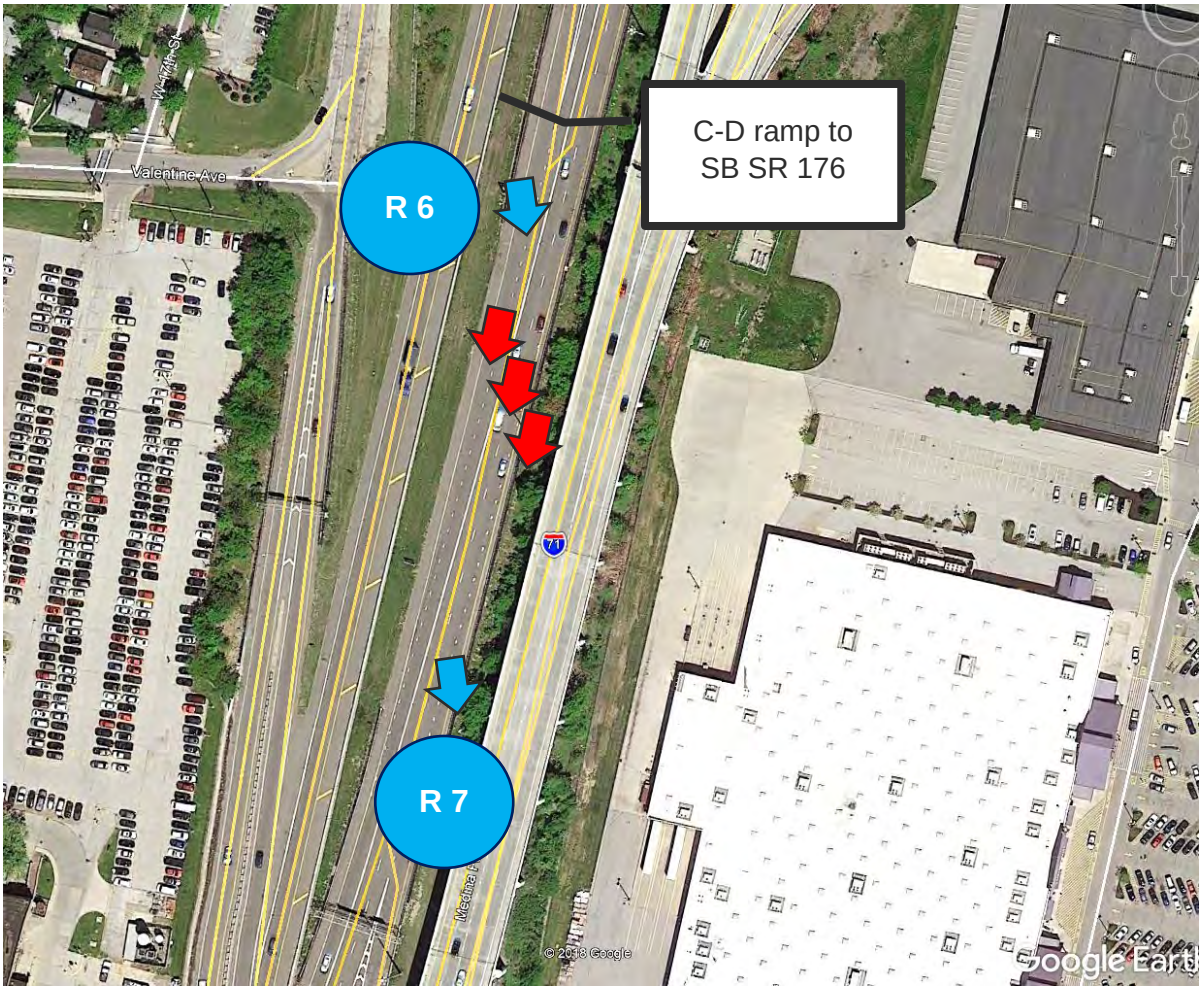
Photo 1: C-D Road Merge on SB I-71 ramp

Photo 2: C-D Road Guide signs for SB SR176

Interstate 71 (I-71) also known as the Medina Freeway is classified as an urban interstate that connects suburbs and the airport on the southwest side of Cleveland to downtown. The posted speed limit within the study area is 60 miles per hour. I-71 is a 3-lane section within this segment.

The single lane ramp from the C-D roadway to SB I-71 is about 1,800 feet long before merging with the 3-lane section of mainline I-71. The ramp merge (right side, blue arrow) occurs just north of the SR176 overpass. In addition to a right-side merge in advance of the retaining walls for the SR-176 bridge, a left side exit ramp (diverge) to SB SR176 also occurs within the functional area of the merge. **Figure 4** shows the alignment of the right-side entrance ramp (single lane, top blue arrow) and left-side exit ramp (single lane, bottom blue arrow) within the 3-lane section of I-71.

FIGURE 4: SB I-71 (3-LANES) AT SR176 EXIT RAMP

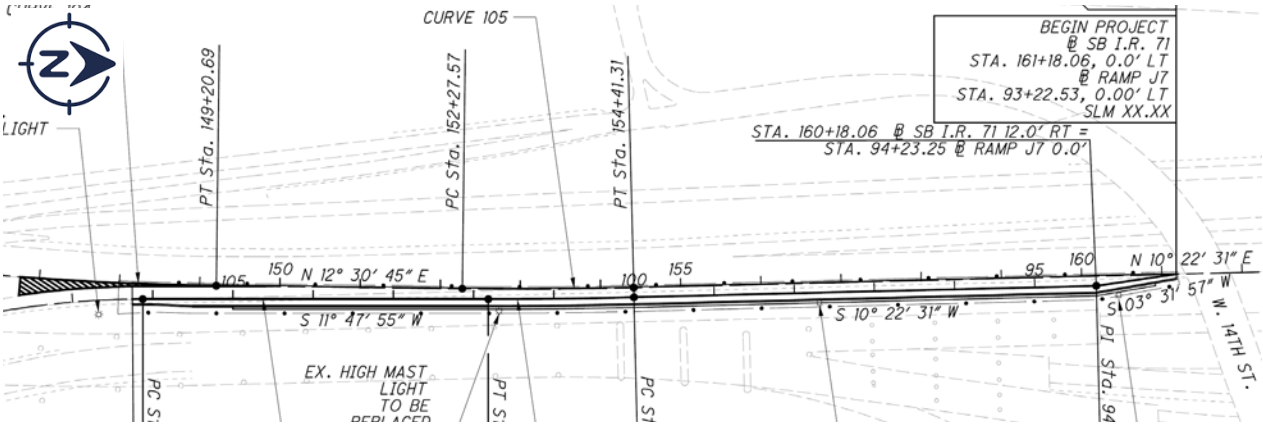


BASE CASE

The traffic study for the Innerbelt CCG1 project (**Appendix A**) shows a LOS F for the entrance ramp (R-6) from the C-D roadway to SB I-71 (PM peak period). No improvements were proposed in the BUIILD condition to mitigate the existing and future congestion on the ramp. Traffic volumes on the entrance ramp to SB I-71 was estimated in the 2009 Innerbelt study to be 1,950 vehicles in the PM peak hour for the design year 2035.

The traffic study for the 2009 Innerbelt CCG1 project (**Appendix A**) shows a LOS F for the exit ramp (R-7) from SB I-71 to SB SR176 (PM peak period). Improvements were proposed in the BUIILD condition to mitigate the existing and future congestion on I-71 within the functional area of the ramp. The CCG7A improvement consists of adding a deceleration lane on I-71 for the left-side ramp to SR 176. The decel ramp extends to the W. 14th Street bridge – a total distance of 1,300 feet – to achieve a LOS C in the design year 2035. **Figure 5** shows a concept plan of the ramp improvement to SB SR176. More detailed information can be found in **Appendix B**.

FIGURE 5: SB SR176 EXIT RAMP IMPROVEMENT ON I-71



The methodology for the capacity analysis to achieve a LOS C assumes traffic from the C-D road is not included as part of the mainline volumes. However, the mainline I-71 traffic volumes may include traffic from the C-D roadway for 2 reasons:

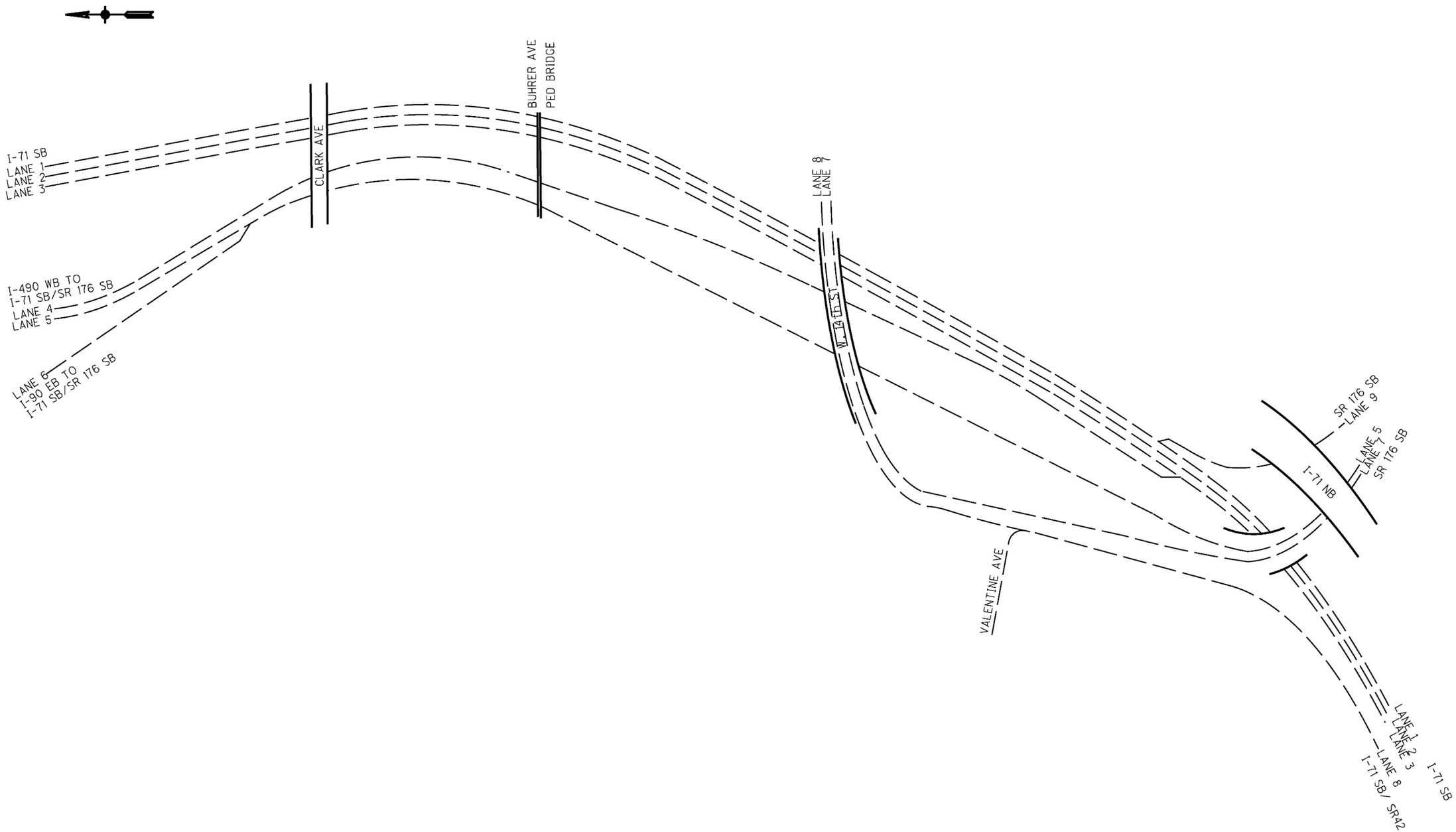
- The left side exit ramp to SR176 and the right-side entrance ramp from the C-D roadway effectively overlap -- no barrier is adjacent to the C-D ramp to reduce queue jumping.
- The influence area of a ramp typically extends 1,500 feet upstream. Therefore, the entrance ramp (R-6) is located within the influence area of the SB SR176 exit ramp (R-7) thus adversely affect freeway operations. The entrance ramp (R-6) from the C-D road was not factored into the analysis of the future BUILD condition.

Capacity analysis of the left-side exit ramp (R-7) should include volumes from the C-D road entrance ramp (R-6) to more accurately model the BUILD condition unless the R-6 ramp is separated from mainline I-71 within the length of the SB SR176 exit ramp (R-7).

> **Refinements to the conceptual design of the CCG7A improvements on SB I-71 in the area of the exit ramp to SB SR176 (R-7) and/or to the entrance ramp from the C-D road (R-6) are proposed to match the operational analysis in Appendix A.**

Additional capacity analysis for the CCG7A project is not proposed if the revised conceptual plan achieves the operational benefits contained in the 2009 Innerbelt IJS (**Appendix A**) – the ramps on SB I-71 operate independently of each other by discouraging 3-lane weaves across SB I-71. A straight-line diagram of the existing lane configuration on SB I-71 is shown on **Figure 6**.

Figure 6: Straight Line Diagram (Existing Conditions)



TRAFFIC VOLUME DATA

The certified traffic volumes developed for the Innerbelt family of projects represent a future, full build condition. Only Innerbelt phases CCG1 and CCG2 have been fully implemented at the time of this study. Therefore, the current operational condition for the entire Innerbelt program area does not match NO BUILD or the BUILD conditions from the certified traffic plates (2015/2035).

Independent of the Innerbelt projects, a technical review was performed as part of this safety study to assess current traffic conditions. Traffic data was collected in 2017 which is during a period when the Westbound Alternate Route Plan (WARP) was not in effect. Various data sources were utilized as part of the traffic volume evaluation as outlined in greater detail in **Appendix D**.

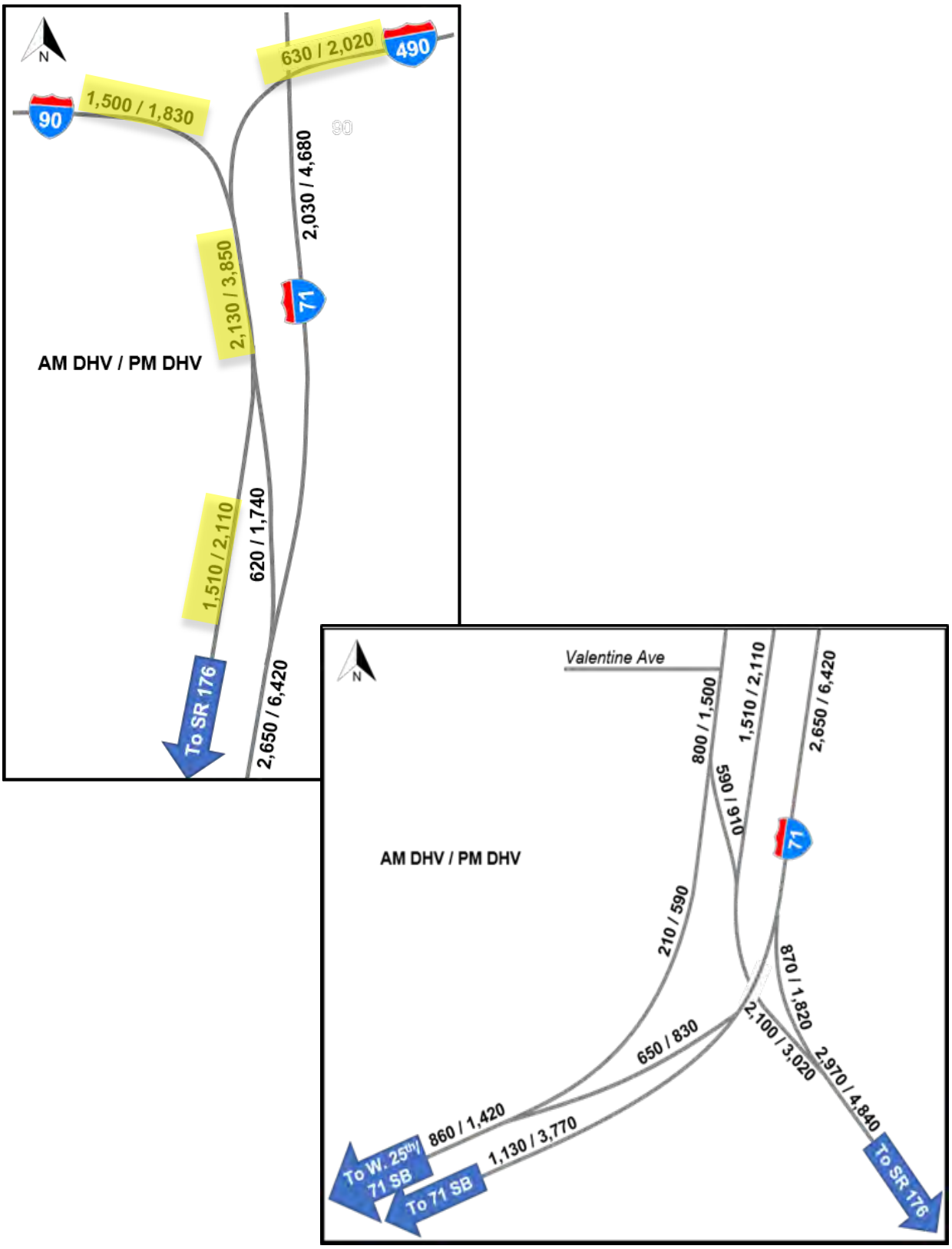
The technical review determined that the design hour for the study area was the PM peak hour as shown in **Figure 7**. The results indicate a general shift in the growth from the west (via I-71) to the southeast (via SR176) which is unrelated to Innerbelt construction. Highlighted numbers represent values that are higher than used for traffic analyses conducted in November 2014 (**Appendix C**). Note that the November 2014 analysis was limited to the collector-distributor (C-D) roadway thus volumes on I-71 or on SR176 were not provided (thus not highlighted).

Other points of interest when comparing the 2017 volumes to the November 2014 analysis include the following:

- The ideal capacity of a single lane ramp (2,000 pcphpl), such as the ramp from the C-D roadway to SB SR176, assumes free flow speeds (FFS) of >30-40 mi/hr (HCM Exhibit 13-10). Due to the complex geometry and ramp movements present (merge, 600 ft weave, diverge), the capacity may be lower. **Figure 7** indicate that volumes destine to SB SR176 (2,110 veh in PM peak) likely exceed capacity of a single lane ramp. This may contribute to the frequency of vehicles queue jumping (**Photo 2**) by using the I-71 entrance ramp to weave across 3-lanes on I-71 and access the SB SR176 left-side exit ramp.
- The capacity analysis from the Nov 2014 study concluded that the existing 2-lane, C-D roadway operates over capacity (LOS F, V/C ≥ 1.08). Traffic volumes during the PM peak hour within this 2-lane segment was 3,471 vehicles (2014 volumes). The V/C ratio increased to 1.213 when the volumes increased to 3,755 vehicles within the 2-lane segment (2013 volumes). **2017 volumes are estimated to be 3,850 vehicles in the design hour within the 2-lane segment suggesting the current conditions operate over-capacity (V/C > 1.20).**

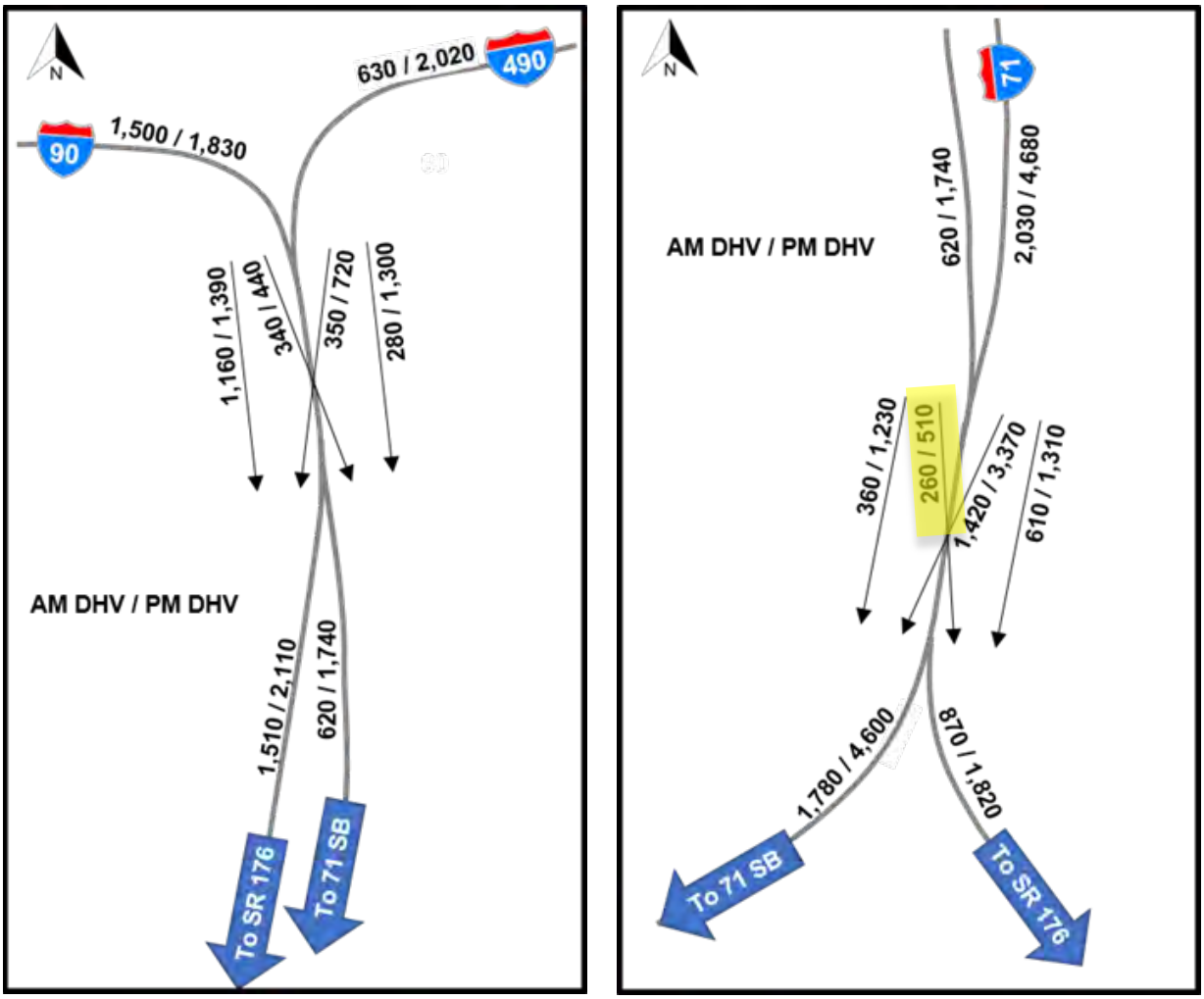
The 2015 ramp improvements (aux lane extended east of W. 41st Street interchange) of the EB I-90 exit ramp to SB I-71/ SB SR176 mitigated capacity constraints thus reduced the length of queues on EB I-90. However, rolling or stopped queues continue to form on EB I-90 due to capacity constraints/ congestion attributed to weaving of the C-D roadway and ramps.

FIGURE 7: 2017 DESIGN HOUR VOLUMES



Weaving volumes were estimated using Streetlight data and results were averaged over the year (2017) for the average day (Monday – Sunday). The final weaving volumes shown in **Figure 8** were determined by considering the origin-destination patterns from Streetlight along with the design hour volumes in **Figure 7**.

FIGURE 8: 2017 DESIGN HOUR VOLUMES (WEAVE ACROSS I-71))

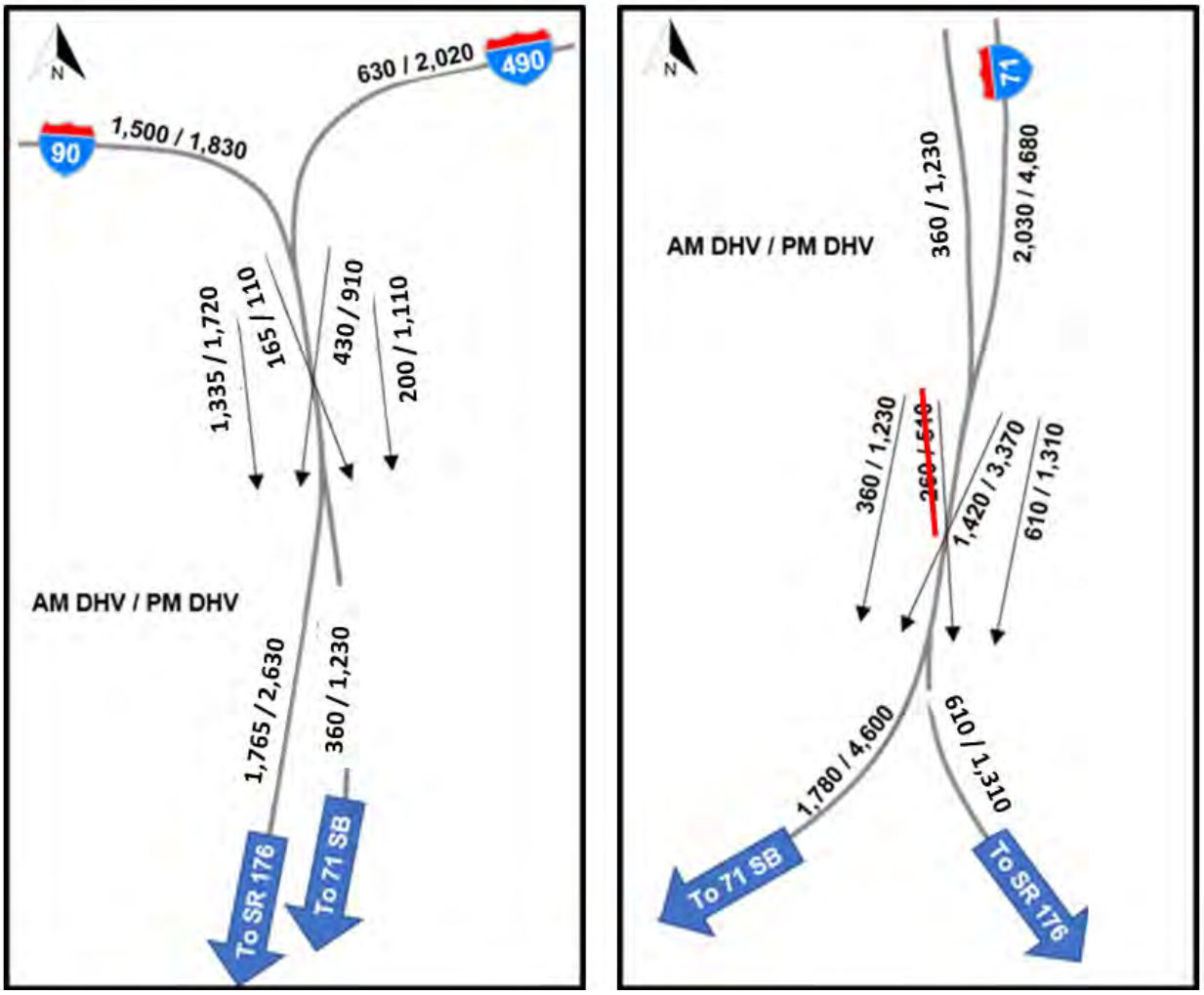


Of particular interest is the traffic originating from EB I-90/ WB I-490 and destine to SB SR176 via the SB I-71 ramp (highlighted number). A total of 510 vehicles is estimated to make the 3-lane weave across SB I-71 to access SB SR176. A double white line was added to SB I-71 to discourage the multi-lane weave. Pavement markings are the only traffic control device that discourages weaving from the C-D road to SR176 for a distance of 1,800 feet.

Countermeasures to discourage or prevent the 3-lane weave across SB I-71 may be considered to improve safety. Separating the influence areas of adjacent ramps on I-71 would also be more consistent with the assumptions used for capacity analyses contained in **Appendix A**.

Figure 9 shows revised volumes if the 3-lane weave is mitigated. The revised numbers use the origin-destination proportions summarized in the technical memo (**Appendix D**).

FIGURE 9: 2017 DESIGN HOUR VOLUMES (PROHIBIT 3-LANE WEAVE)



CRASH ANALYSIS

Crash analysis was completed for different horizon years: 2008-2010, 2015-2017 (SB I-71) and 2016-2018 (EB I-90). The time periods were proposed to account for the existing condition where construction activities have been changing since 2011. The safety performance between the two time periods were intended to help evaluate the need to identify future countermeasures. The time periods for the safety data and the corresponding phase of Innerbelt construction activities are important to understand the changing conditions within the study area.

2008-2010 CRASH ANALYSIS

Crash data was obtained from ODOT District 12 for the study area shown in **Figure 1** and summarized below:

- EB I-90 from the diverging ramp to 44th Street (SLM 13.20) to the diverging ramp gore to SB I-71/SR 176 (SLM 14.60)
- WB I-490 from the west end of bridge over the Cuyahoga River (SLM 1.00) to the ramp diverge to SB I-71/ SR 176 (SLM 0.00)
- SR 176 from begin of SR 176 (SLM 13.83) to the merge of 3-ramp lanes from I-71, I-90, and I-490 (SLM 13.20)
- SB I-71 from south end of bridge over Starkweather Avenue (SLM 19.12) to ramp diverge to 25th Street (SLM 17.90).

The crash data included three years of data from 2008 to 2010. The OH-1 crash report for each documented crash was reviewed to locate and code crashes accurately within the study limits. Noteworthy crash statistics for the 3-year period between 2008 and 2010 are summarized below. Freeway statistics were used for comparison purposes. Statewide averages for crashes on the state system, freeway locations are shown in parentheses based on data for years 2010 through 2014.

Total crashes: 475 total crashes (353 of the total crashes occurred on I-90)

- Rear end crashes: 270 crashes or 56.8 percent (29.9 percent)
- Sideswipe passing: 124 crashes or 26.1 percent (18.6 percent)
- Wet pavement: 139 crashes or 29.3 percent (24.3 percent)

Tabular crash data and crash diagrams are provided in **Appendix E**. Two primary conditions have changed making the pre-Innerbelt safety data no longer valid for developing effective countermeasures:

1. The ramp from EB I-90 destine to downtown Cleveland and to I-71/SR176 was a 2-lane ramp that operated over capacity. The majority of crashes occurred on EB I-90 between the W. 41st Street interchange (SLM 13.60) and the W. 44th Street interchange (SLM 13.45). The exit ramp to I-71 was widened to 3-lanes by 2016 which mitigates a major contributing factor of safety performance issues dating back to 2008 on EB I-90 – see **Table 1.**
2. The review of 2017 traffic volumes discussed in the Traffic Volume Data section determined that traffic patterns have shifted to increase trips to/from I-90 west of the study area to SR176 south of the study area. These changes to traffic patterns are not considered to be affected by the Innerbelt construction activities from 2011 to 2016.

The original safety scope of work was to use 2014-2016 data to compare crash patterns. The 2014-2016 safety data was not evaluated due to the WARP being in place until October 2016.

The EB I-90 ramp improvements eliminated a capacity constraint that metered traffic in 2010 (pre-Innerbelt condition having a shared lane for traffic destine to I-71/ SR176) and from 2011 to 2016 (single lane ramp to I-71/ SR176). The safety performance on I-90 prior to Innerbelt reconstruction (2008-2010) is well documented in **Appendix E** – a total of 353 crashes of which 69% were rear-end crashes. Additional analysis of the I-90 segment was not performed due to the short time frame between the completion of the CCG1 project and the start of the bridge rehab of SR176 over I-71 (June 2018).

2015-2017 CRASH ANALYSIS

The 3-year timeframe for safety analysis of post-Innerbelt conditions includes 2017 crash data – the only year when active construction has not occurred within the study area since 2010:

- EB I-90 ramp to SB I-71/ SB SR176 completed August 2016. The EB I-90 ramp improvements eliminated a capacity constraint that metered traffic in 2010 (pre-Innerbelt condition having a shared lane for traffic destine to I-71/ SR176), 2011 to 2016 (single lane ramp to I-71/ SR176), and 2017 (3-lane ramp with one lane to I-71/ SR176)
- WARP for CCG1 construction removed October 2016. Traffic patterns were expected to evolve until the end of 2016 due to the duration of the previous MOT plan.
- Bridge deck rehabilitation of SB SR176 over SB I-71 started June 2018. Part width bridge reconstruction reduced to a single through lane during construction.

A revised study area also was proposed to focus on a segment from I-90/ I-490 junction to the 25th Street interchange on I-71 and to Jennings Road interchange on SR176 (southbound direction only).

The effect of Innerbelt construction activities on safety performance within this smaller study area is expected to be less than on I-90 or I-490. **Figure 10** shows the revised study area using 2015-2017 crash data.

FIGURE 10: STUDY AREA OF 2015-2017 SAFETY DATA

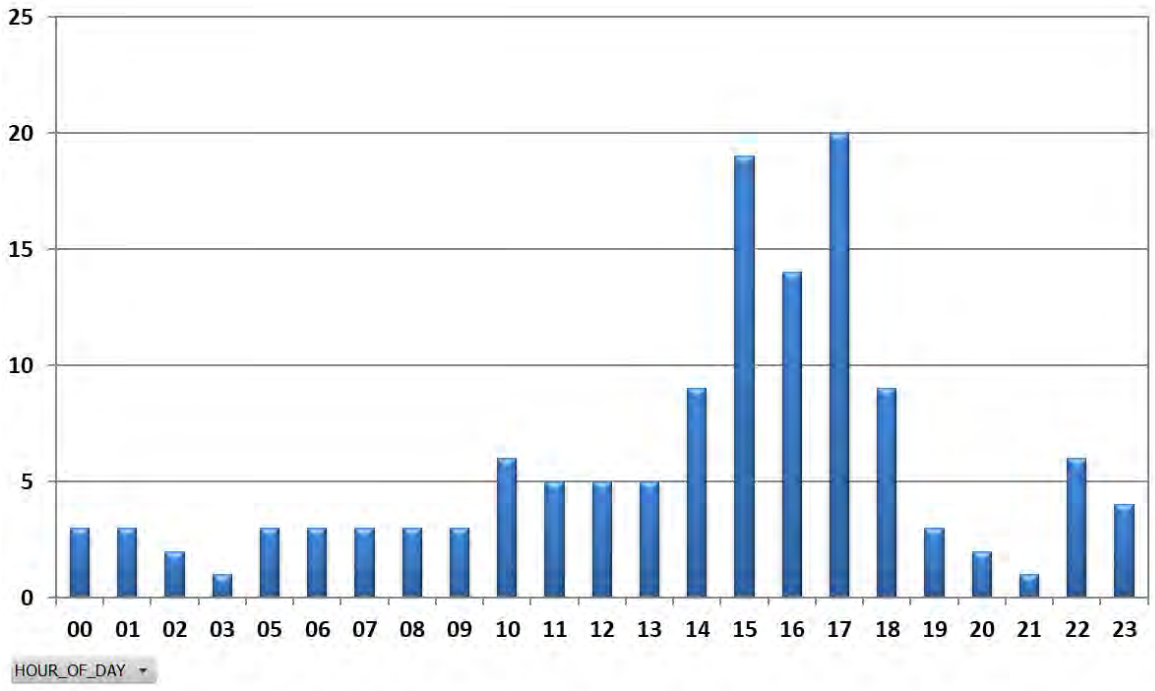
A total of 132 crashes occurred within the study area between 2015 and 2017. Statewide averages for crashes on the state system, freeway locations are shown in parentheses based on data for years 2010 through 2014.

- Rear end crashes: 58 crashes or 43.9 percent (29.9 percent)
- Sideswipe passing: 40 crashes or 30.3 percent (18.6 percent)
- Wet pavement: 139 crashes or 29.3 percent (24.3 percent)

Fixed object crashes (28 crashes or 21.2 percent) are below the statewide average of 26.1%.

The crash pattern by time of day shows the majority of crashes (54 percent) occur during the afternoon timeframe (2:00 - 7:00 PM). **Figure 11** shows the distribution of crashes over a 24-hour period. Congestion during the PM peak period is a contributing factor to the crash types listed above. The 2015-2017 crash patterns by time of day (PM period) differs from the pre-Innerbelt construction projects (2008-2010) which was predominately an AM peak period issue.

FIGURE11: FREQUENCY OF CRASHES BY HOUR

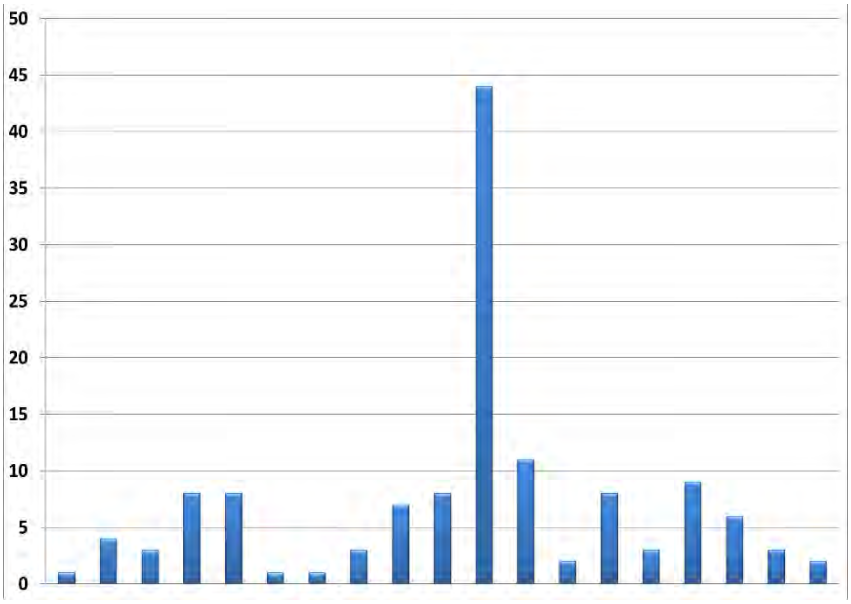


The ability to assign upstream crashes to the operational constraints specific the study area was limited. Therefore, the crash data does not include segments from I-90 and I-490 that are upstream of the study area. The safety performance on I-90 that are attributed to operations of the existing 2-lane, C-D roadway is not able to be clearly documented with the current dataset.

A defined crash pattern does exist on I-71 within the area of the entrance ramp from the C-D roadway and the exit ramp to SB SR176. **Figure 12** shows a spike of 44 crashes that occur within a 500 ft segment on SB I-71 – the segment is measured from the gore of the left-hand exit ramp and extending north. This area includes the ramp diverge to SB SR176 and the ramp merge from the C-D roadway.

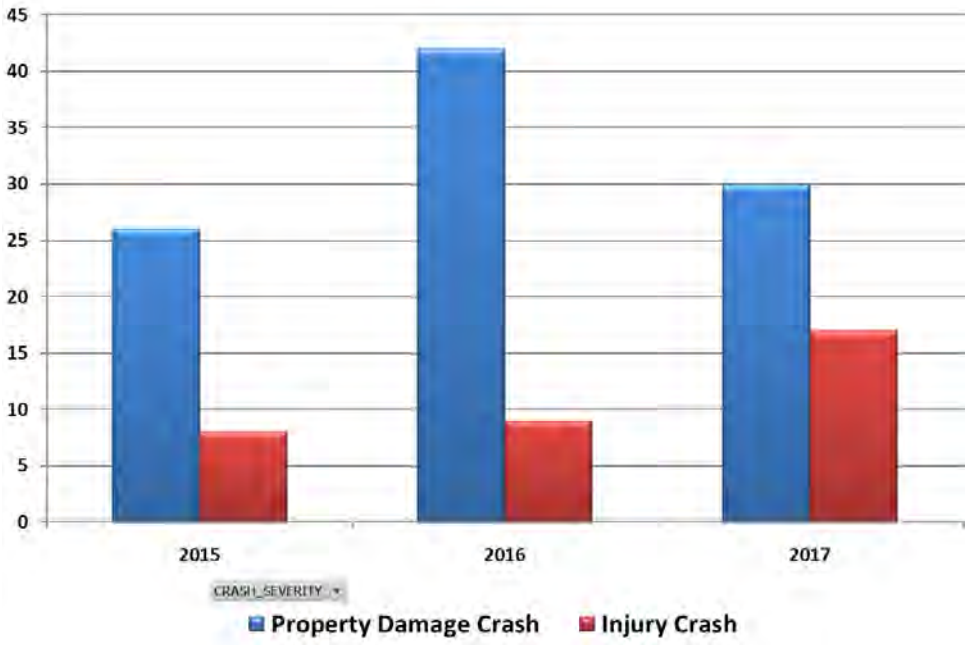
A total of 25 crashes also were attributed to a 3-lane weave across I-71. Vehicles on the C-D roadway will jump the queue if destine to SB SR176 and cross 3-lanes on I-71 to access the left side exit ramp to SB SR176. Public comments received as part of a public involvement effort for the CCG7A project in 2019 indicated driver frustration with motorists attempting the 3-lane weave maneuver.

FIGURE 12: CRASH FREQUENCY I-71 (500 FT SEGMENTS)



Since October 2016, a 3-lane ramp with one lane to I-71/ SR176 enables higher traffic volumes to access the roadway network south of I-90/ I-490. The percentage of injuries has increased in 2017 as shown in **Figure 13**. Injury crashes comprised 55% of the total crashes in 2017. This is the first 'post Innerbelt construction' year. Mitigating the bottleneck on the EB I-90 ramp may contribute to the higher injury trends (i.e., higher volumes and higher speeds).

FIGURE 13: FREQUENCY OF CRASHES BY YEAR AND SEVERITY



Appendix E contains crash data in tabular format and crash diagrams.

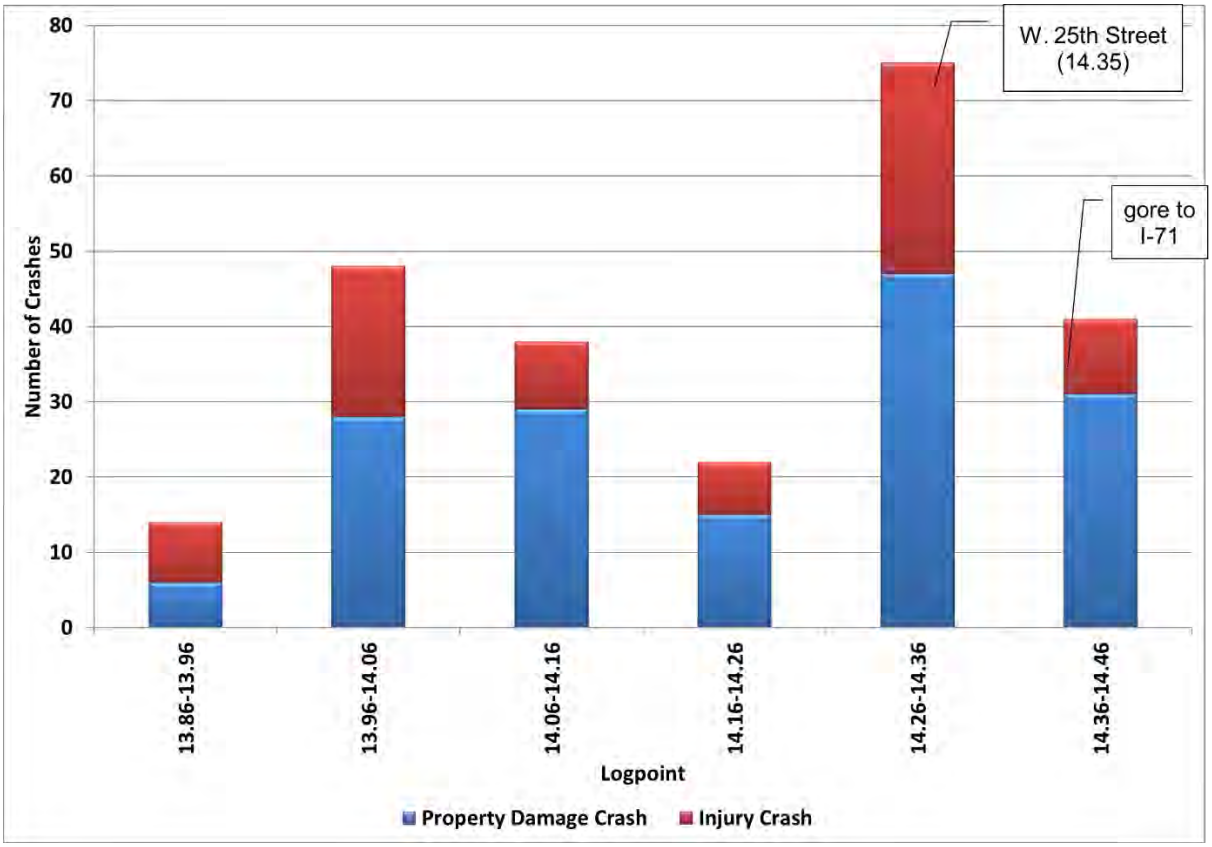
2016-2018 CRASH ANALYSIS

Crash analysis of EB I-90 used 3 years of data from 2016-2018 for 3 reasons:

- Bridge deck rehabilitation of SB SR176 over SB I-71 started June 2018 which provides a partial year of crash data not affected by MOT plans within the study area.
- The west alternate route plan (WARP) for CCG1 construction was removed October 2016 which provides a partial year of crash data not affected by Innerbelt MOT plans.
- 2017 crash data is the only year when active construction has not occurred within the study area since 2010.

The study area focused on a segment on EB I-90 from the gore of the exit ramp to I-71 (SLM 14.38) to SLM 13.86 (east of the W. 41st Street interchange). **Figure 14** shows the location frequency of crashes by severity. The highest frequency of crashes occurs within 500 feet of the ramp gore to I-90/I-71. The frequency of these crashes on EB I-90 is attributed to queues that extend from the C-D roadway.

FIGURE 14: LOCATION FREQUENCY BY SEVERITY



COUNTERMEASURES

The CCG7A project (PID 98063) is a committed project that adds a left hand decel lane to better accommodate vehicles speed reduction in advance of the SB SR176 ramp from SB I-71. This project was identified as part of the original Innerbelt IJS study from June 2009. The improvement will address ramp capacity constraints and mitigate 9 fixed object crashes attributed to high approach speeds and horizontal ramp alignment. While no fatalities occurred within the study timeline (2015-2017), a fatality and serious injury did occur in 2018 when a pickup truck struck the ramp gore at SB SR176/ SB I-71.

Countermeasures are identified that improve safety performance by focusing on the crash types having the greatest potential for mitigation. Additional countermeasures may be suggested to minimize potential safety issues that may not be directly attributable to historical crash patterns.

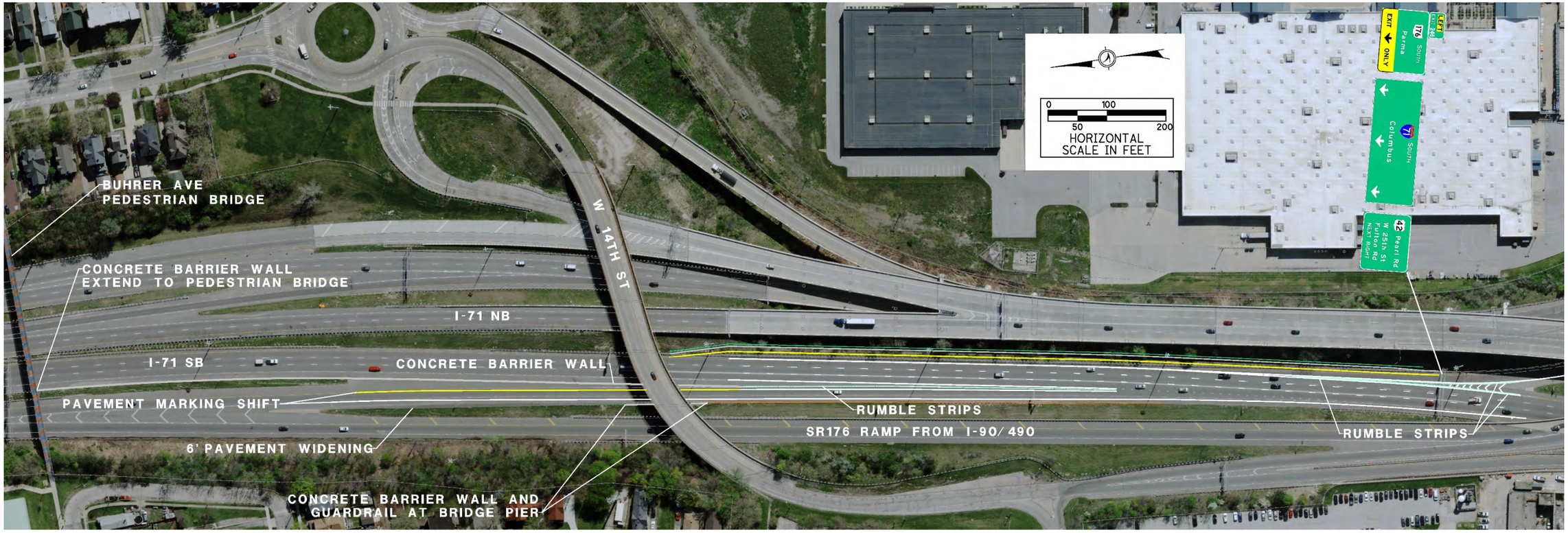
SHORT TERM COUNTERMEASURE – SB I-71

The highest frequency of crashes occurred on a 500 ft segment of I-71 which includes the influence area of the SB SR176 ramp diverge and of the C-D ramp merge. The technical review of 2017 traffic volumes indicated up to 510 vehicles destine to SB SR176 use the ramp to SB I-71 and weave across 3-lanes. This weave is feasible due to the lack of a barrier between the entrance ramp from the C-D road to the SB SR176 ramp.

Vehicles weaving from the C-D roadway to the SB SR176 exit ramp contributes to the safety performance of this segment – 25 crashes are attributed to the 3-lane weave. The following countermeasures are shown on **Figure 15** to discourage the 3-lane weave:

1. Extend a concrete barrier between I-71 and the C-D ramp from the Buhrer Avenue pedestrian bridge to a point 100 feet south of the W. 14th Street bridge (1,200 feet total length). Minimum shoulder widths may be reduced to maximize the length of the concrete barrier. Extending the concrete barrier in the southbound direction is more desirable than widening of the SB SR176 ramp to extend a barrier north -- attenuators would be needed to protect the blunt end of a barrier if extended north.
2. Extend longitudinal rumble strip between the C-D ramp and I-71 from the end of the concrete barrier to the painted merge of the C-D ramp (650 feet). The longitudinal rumble strip is located where a barrier cannot be extended due to min shoulder width requirements.
3. Extend longitudinal rumble strip between the SB SR176 diverge ramp and I-71 from the ramp gore (400 feet). Offset exit ramp to accommodate rumble strip.
4. Add concrete barrier to protect the west piers at W. 14th Street adjacent to the C-D entrance ramp – shifting the ramp on existing pavement is desirable to maximize the width between the C-D ramp and mainline I-71.
5. Maintaining double white lines on I-71 to discourage multi-lane weaves
6. Add regulatory sign prohibiting exit to SB SR176 from the C-D ramp to SB I-71 (see example sign – right).

FIGURE 15: CONCEPTUAL PLAN (CD RAMP TO SB I-71)



Construction costs for countermeasures to discourage the 3-lane weave from the C-D ramp to the SB SR176 exit ramp is estimated to be $1.0 million. The cost estimate does not include costs to extend the left side exit ramp to SB SR 176. The cost estimate is limited to the ramp, concrete barrier, and signing improvements to the CD road ramp. See **Appendix F** for a breakdown of costs for this short-term countermeasure.

SHORT TERM COUNTERMEASURE – C-D ROADWAY

The 2-lane C-D roadway south of I-90/ I-490 was determined to operate over-capacity contributing to queues extending onto ramps from EB I-90 and from WB I-490. A technical memo from 2014 and capacity analysis using the technical review of volumes (2018) determined the segment operates at a v/c ratio in the PM peak hour of 1.08 and 1.16, respectively.

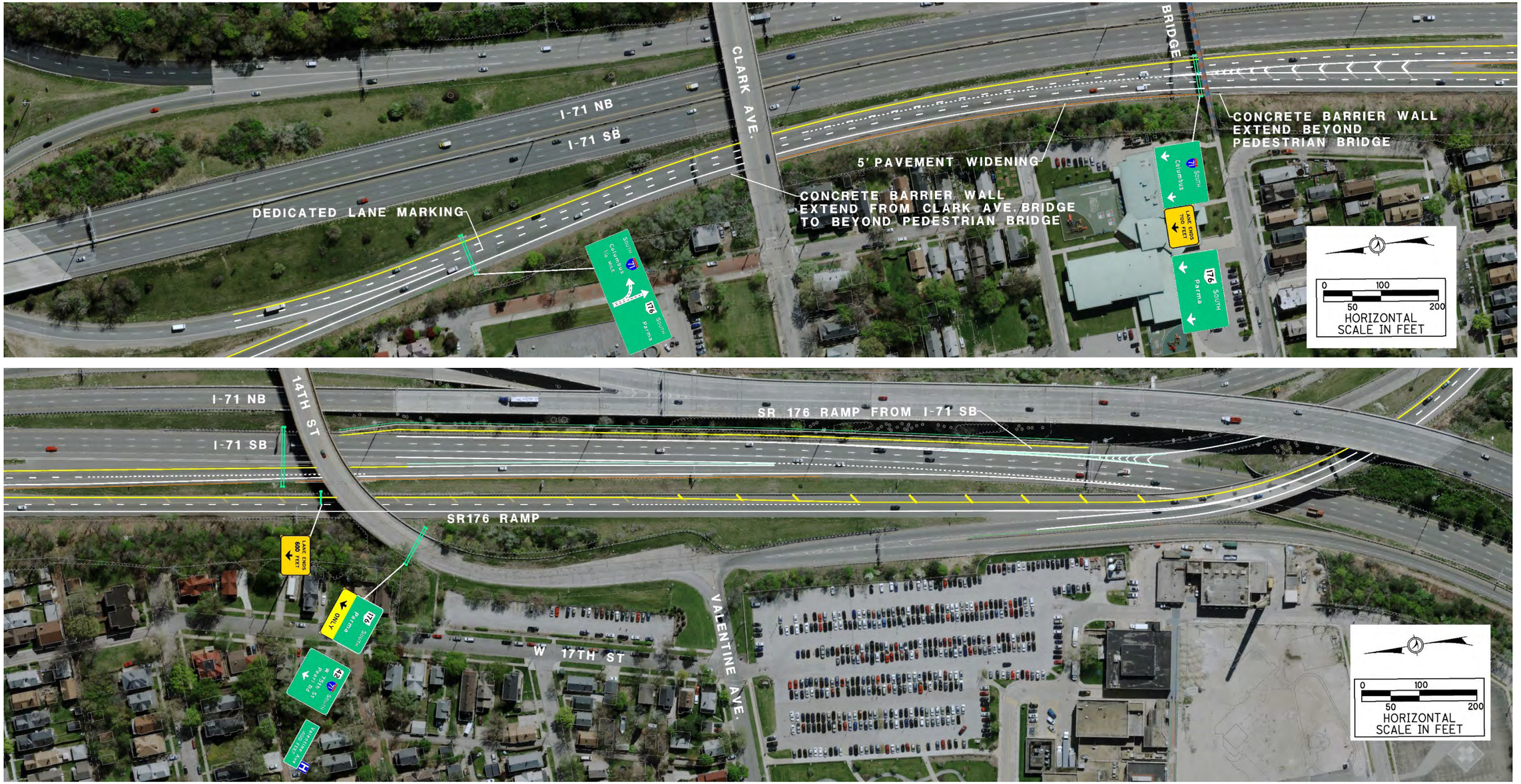
Revising the configuration of the C-D roadway having a 3-lane section is proposed as a short-term countermeasure. A 3-lane section was the basis of the original construction plans for the C-D roadway in 1965. Therefore, converting the C-D roadway to a 3-lane section can be done without impacting existing bridge piers. The 3-lane countermeasure is comprised of the following:

- The C-D roadway increases the weaving distance from 600 feet to 1,250 feet. Guide signs can be placed 0.25 miles in advance of the ramp to SB I-71. Adequate space was not available for advance signing for the existing condition.
- The major movements from EB I-90 (to SR176) and from WB I-490 (to SB I-71) do not require a lane change with a 3-lane segment. Converting the merge condition for the EB I-90 movement to a dedicated lane will reduce congestion along this segment of the CD roadway and on EB I-90 during the PM peak period. See **Appendix G**.
- Previous alternatives have considered a 3-lane C-D road section (**Appendix C**). However, an option lane is proposed for the center lane of the 3-lane section to reduce the workload of drivers by distributing the decision points over a longer distance. A driver from EB I-90 destine to SB I-71 in the proposed condition is required to weave a single lane within a distance of 1,250 feet. A lane drop follows the weave segment. The sequential decision points over a distance of ½ mile improves safety when compared to other options such as a 2-lane weave within a distance of 1,250 feet.
- The traffic volumes required to weave a single lane then merge with ramp traffic destine to SB I-71 is the lowest volume weaving movement. **Figure 9** estimates that 165 vehicles in the AM peak would need to make this 2-step maneuver over a ½ mile distance.
- Minimal pavement widening required. The proposed section consists of an inside shoulder width of 4 feet, 3-12 ft lanes, and an outside shoulder width of 10 feet. Minor pavement widening is required to maximize the weaving distance on the C-D roadway.
- A noise wall 300 ft north of the Buhrer Street pedestrian bridge is proposed between the C-D roadway and mainline I-71 (350 ft length, 10 ft height) to reduce visibility of overhead guide signs on I-71 as shown on **Photo 2**. The advance sign (1/2 mile legend) on I-71 for the SB SR176 exit is located 2,500 feet north of the ramp – relocating the advance sign to reduce visibility of the signs from the CD road is not recommended due to spacing and sight obstructions (overhead bridges) upstream and downstream of the current location.

  Noise wall analysis/construction also may be required if the number of lanes on the C-D roadway is increased from 2 to 3 lanes although the original design was based on a 3-lane section on the CD roadway.

Capacity analysis of the proposed 3-lane segment uses the technical review of traffic volumes memo dated 2018. A 3-lane segment with a center option lane (to SB I-71 or to SB 176 ramp) will improve levels of service from F to D. **Figure 16** is a conceptual plan of improvements to the C-D roadway from the EB I-90/ WB I-490 junction to the lane merge on the ramp to SB I-71.

FIGURE 16: CONCEPTUAL PLAN (C-D ROAD)

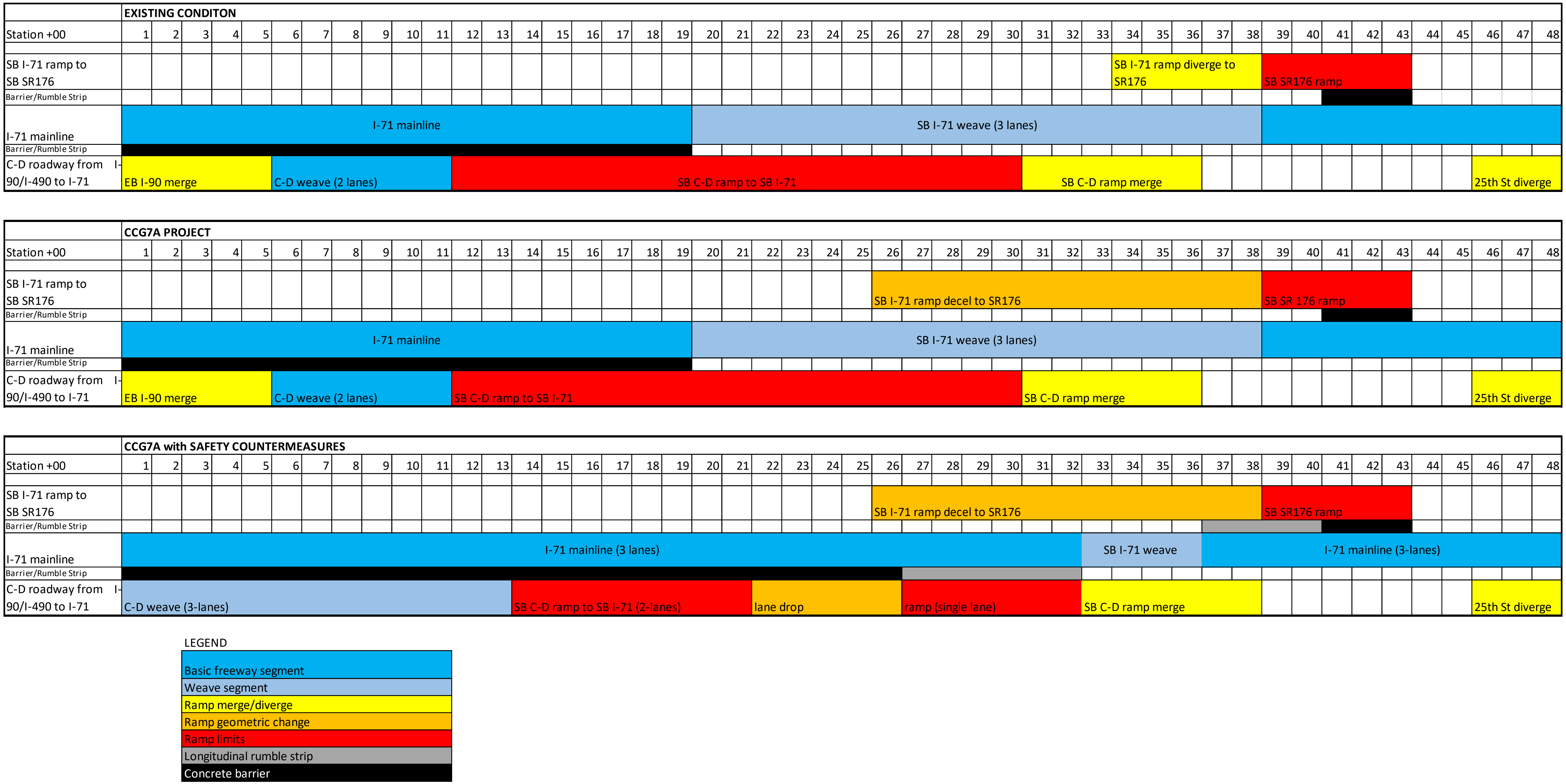


Construction costs for countermeasures to increase capacity of the C-D ramp and to reduce weaving is estimated to be $1.7 million. The proposed revisions to the C-D roadway mitigate diverted traffic attributed to safety improvements that discourage the 3-lane weave across I-71. See **Appendix F** for a breakdown of costs for this short-term countermeasure.

Figure 17 is a block diagram of the short-term countermeasures along SB I-71. Each row represents a travel path (C-D roadway, I-71 corridor, exit/entrance ramps). Each column represents 100 feet. The block diagram is created for 3 conditions: Existing Conditions, the CCG7A project, and the Proposed (Short Term) Countermeasures. A comparison of the 3 scenarios shows the comparable location of ramps, the use of ramps, and the extension of barriers.

For example, extending a combination of concrete barrier and longitudinal rumble strips reduces the available gap for potential weaving from 1,800 feet (Existing Condition) to 400 feet (CCG7A + Safety Countermeasures).

FIGURE 17: BLOCK DIAGRAM OF ALTERNATIVES



VALENTINE AVE/ 14TH STREET RAMP IMPROVEMENTS

Improvements are proposed to the ramp from Valentine Avenue/14th Street to SB SR 176. The ramp improvements mitigate capacity constraints associated with a single lane ramp for traffic destine to SB SR176.

2-lane ramp to SB SR176

The safety countermeasures to mitigate the 3-lane weave across I-71 will increase traffic volumes on the ramp to SB SR176 via the C-D roadway. The revised 2017 ramp volumes (**Figure 9**) from the C-D road to SB SR176 exceed 2,000 pcphpl which is representative of the ideal capacity for a single lane ramp having free flow speeds of 40 MPH. The existing horizontal curve has a design speed of 40 MPH. Eliminating the 3-lane weave across I-71 could potentially divert an additional 510 vehicles in the PM peak hour to the SR176 ramp thus requiring a 2-lane ramp.

The existing single lane ramp to SB SR176 is increased to 2-lanes to accommodate the potential traffic diverted to SB SR176 and to mitigate crashes on EB I-90.

Convert ramp from Valentine Avenue/W. 14th Street to SR176 from an add lane to a merge.

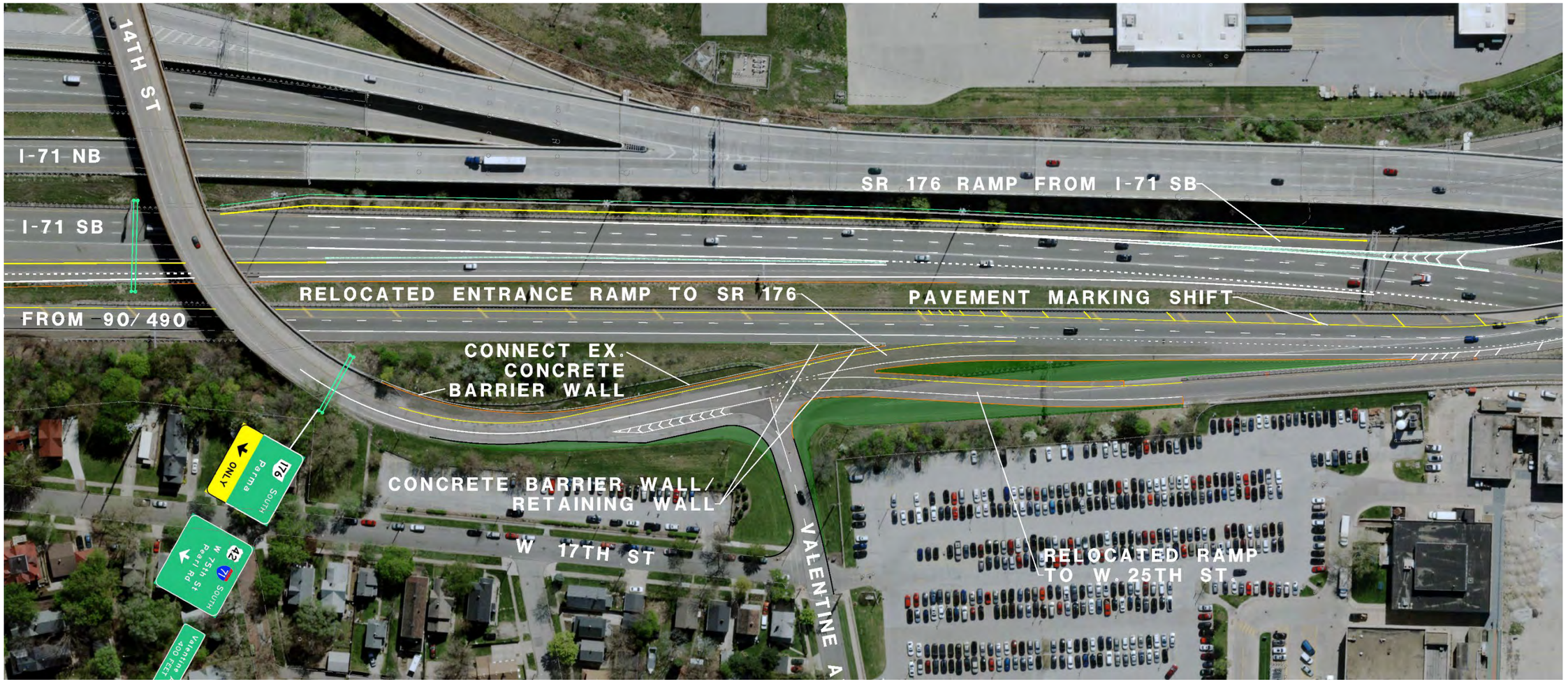
Converting the SR176 ramp to 2-lanes requires the single lane ramp from W. 14th Street/Valentine Avenue to become a merge prior to the horizontal curve over I-71. Reconstruction of the Valentine Avenue ramp will require retaining wall reconstruction to accommodate the 16 ft elevation difference between W 14th Street and the SR176 ramp. Design elements of this improvement include the following:

1. Retain direct access from Valentine Avenue to SB I-71 and to SB SR 176. The design assumes the Valentine/W. 14th Street intersection is lowered to reduce the elevation difference between Valentine and the C-D roadway.
2. Retain direct access from Valentine Avenue to SB I-71 and the Pearl Road/ W. 25th Street interchange. Changes to the horizontal alignment of W. 14th Street is proposed to accommodate changes to the W. 14th Street pavement elevation, accommodate grading to the existing embankment on the west side of W. 14th Street, and to reduce operating speeds on W. 14th Street.
3. Retain direct access from W. 14th Street to SB I-71 and to SB SR 176.

Figure 18 is a conceptual plan of improvements on the ramp to SB SR176. The proposed alignment of the SR176 ramp over I-71 is adequate for a stopping sight distance for 45 MPH. Existing warning signs on the approach to the horizontal curve over I-71 have an advisory speed plaque of 40 MPH.

Capacity analysis in **Appendix G** shows the Valentine Street ramp operates at LOS C as a merge condition with 2-lanes on the SB SR176 ramp over I-71. The grades on the entrance ramp from W. 14th Street to the C-D roadway are expected to be in the 5% range in an effort to maximize the length of the pacing area on the ramp.

FIGURE 18: CONCEPTUAL PLAN (VALENTINE AVE RAMP TO SB SR176)



LONG TERM COUNTERMEASURES

The scope of the safety study focused on short- and medium-term countermeasures. These countermeasures refined the lane configuration of existing ramps and proposed minor geometric changes to improve safety performance within the study area. As part of the process to develop and evaluate alternatives, several options were considered that modified the left side exit ramp from SB I-71 to SB SR176.

Alternatives that changed to the configuration of the left side exit ramp on SB I-71 were considered to mitigate the safety issues associated with the 3-lane weave from the CD roadway to the SB SR176 exit ramp. The scope of these changes to the roadway network were considered to exceed the intent of the safety program for several reasons:

- Extensive public involvement would be needed to address the diversion of traffic on the local roadway network (i.e., Valentine Avenue/ 14th Street).
- Alternative analysis using planning level volumes would be required of the roadway network beyond the study area to confirm that safety improvements do not create other safety performance or traffic operations issues at adjacent interchanges (i.e., W.25th Street at SB I-71, Jennings Rd at SB SR176, CD road capacity, etc).
- Lower cost, shorter term countermeasures are effective to mitigate the safety issues.

Three long term alternatives in addition to the short-term countermeasures were evaluated using the following qualitative criteria. A rating system was applied to the criteria as a means of evaluating the various options. The scoring ranged from a -5 which represents a poor or least desirable condition to a +5 which represents the best or most desirable condition. The relative scoring was to enable an order of magnitude evaluation of the alternatives.

- Safety – Mitigate left side exit ramp from SB I-71 to SB SR176
- Safety – Mitigate 3-lane weave across SB I-71 from CD road to SB SR176 left side exit ramp
- Safety – Improve weave on CD roadway
- Wayfinding
- Capacity – CD roadway
- Capacity – SB I-71
- Cost

Note that detailed analyses or construction cost estimates were not completed due to the feasibility of lower cost alternatives.

1. **Option #1: Drop Lane/ Add Lane on SB I-71.** The ramp volumes destine to SB SR176 are estimated to be 1,310 in the 2017 design hour (PM peak) as shown in **Figure 9**. The left lane on SB I-71 could be converted to a drop lane destine to SB SR176. The drop lane would be offset within 800 feet of the SB SR176 exit ramp gore (left side of SB I-71) to accommodate longitudinal rumble strips between the through lane and the exit ramp.

Figure 19 shows a conceptual plan of the proposed improvements. Other design elements or operational issues shown on the conceptual plan include the following:

- The entrance ramp from the CD roadway to SB I-71 is an add-lane since volumes in the design hour are estimated to be 1,230 vehicles in the 2017 design hour (PM peak) as shown in **Figure 9**. Longitudinal rumble strips extend an additional 500 feet to discourage the 3-lane weave.
- Overhead guide signs are modified to show the left lane is an Exit Only (yellow panel).
- The weave on SB I-71 between the entrance ramp from the CD roadway and the W. 25th Street exit ramp is a critical operational issue. The traffic volumes from Figure 9 combined with existing traffic data at adjacent ramps from the ODOT MS2 database result in a capacity constraint. The study area should be expanded to include planning level traffic at the adjacent intersections.
- Planning level volumes should also be developed to confirm the weave volumes on the SB I-71 corridor.

2. **Option #2: Relocate SB SR176 as Right-Side Exit Ramp (south of Clark Avenue).** This alternative was developed by ODOT Central Office for consideration as a long-term countermeasure. The primary purpose of the countermeasure is to relocate the existing left side exit ramp and as a right-side ramp south of the Clark Avenue bridge. This countermeasure (**Figure 20**) is expected to reduce the workload of the driver by providing a more conventional right-side exit ramp from SB I-71.

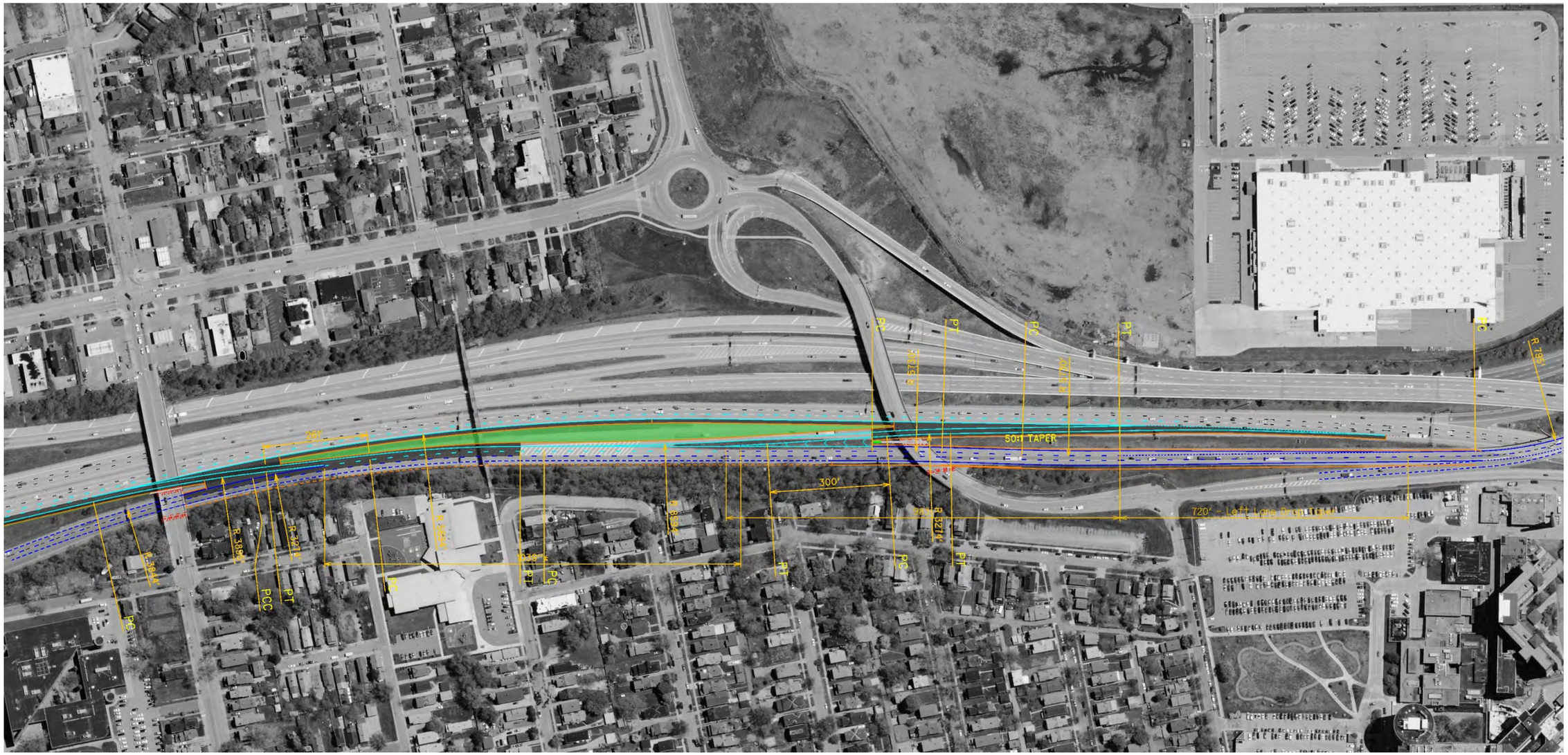
   Design elements of this alternative include the following:

   - A 2-lane weave is required of EB I-90 traffic destine to SB I-71.
   - The number of lanes is increased on the CD roadway from 2-lanes to 3-lanes for Option #1 resulting in a LOS D. The volumes on the CD roadway, however, are increased by 1,310 vehicles in the PM peak hour as shown in **Figure 9**. The level of service on the CD roadway will be worse for Option #2 than for Option #1 due to the increased volumes and multi-lane weave.
   - The C-D roadway north of the new ramp is shown as 2-lanes. A 2-lane CD roadway is expected to operate over capacity based on previous analyses of design hour volumes (**Appendix G**).
   - The volumes on SB SR176 ramp over I-71 is expected to be equal to 2,940 vehicles in the 2017 design hour. Converting the SB SR176 ramp to a right-side exit on SB I-71 will require 2 secondary improvements: increasing the SB SR176 ramp to a 2-lane ramp and changing the Valentine Avenue ramp from a merge condition from an add-lane.

   Construction costs are expected to be higher than Option #1 due to the new SB I-71 exit ramp construction and the removal of the existing SB SR176 left side exit ramp.

FIGURE 19: OPTION #1 CONCEPTUAL PLAN (ADD LANE/DROP LANE ON SB I-71)

FIGURE 20: OPTION #2 CONCEPTUAL PLAN (RIGHT SIDE RAMP SOUTH OF CLARK AVE)



3. **Option #3: Relocate SB SR176 as Right-Side Exit Ramp (north of Clark Avenue)**. This alternative was developed by ODOT Central Office for consideration as a long-term countermeasure. The primary purpose of the countermeasure is to relocate the existing left side exit ramp as a right-side ramp on SB I-71 north of the Clark Avenue bridge.

   Design elements of this alternative include the following:

   - This countermeasure is expected to reduce the workload of the driver by providing a more conventional right-side exit ramp from SB I-71.
   - Wayfinding is more challenging with this alternative due to the complex signing required for the US Route 42/ W. 25 Street/ Pearl Road/ Fulton Road/ SB I-71 destinations.
   - Volumes on the new right-side exit ramp are expected to exceed 2,000 vehicles during the PM peak hour (**Figure 7**). The traffic volumes from the left side exit to SB SR176 (1,310 vehicles after removal of the 510 weaving vehicles) would be combined with the right-side exit volumes to W. 25th Street (830 vehicles).
   - Option #3 is expected to be more expensive than Option #2. The CD roadway would need to be widened to 4 lanes which would impact the Clark Avenue bridge piers.
   - Multi-lane weaves would be required in two directions over a distance of 2,100 feet.

See **Figure 21** for a conceptual plan of Option #3. **Table B** summarizes the qualitative evaluation of each alternative.

The committed CCG7A project in addition to the short-term alternatives are the preferred countermeasures to improve safety performance within the study area. The proposed countermeasures mitigate safety issues attributed to a 3-lane weave across SB I-71 and mitigates two congestion points on the C-D roadway:

1. Convert the existing 2-lane C-D roadway south of the EB I-90/ WB I-490 ramps to a 3 lane section to mitigate a capacity issue and to reduce weaving
2. Convert the SB SR175 ramp over I-71 to having 2 through lanes from the 90/490 interchange. Two through lanes on the SB SR176 requires converting the Valentine Avenue/W. 14th Street ramp to a merge instead of an add lane.

A future study of the SR176 corridor should extend south to the Harvard Avenue/ Denison Avenue interchange. Weaving on SR176 from the SB I-71 ramp to the Steelyard Drive/ Jennings Road ramp also should be evaluated to address downstream safety and capacity concerns.

FIGURE 21: OPTION #3 CONCEPTUAL PLAN (RIGHT SIDE RAMP NORTH OF CLARK AVE)

Table B: Summary of Alternative Analysis

	Alternatives				
Design Element	**No Build**	**CCG7A + Short Term Safety**	**LT Option #1: Drop lane/ add lane on SB I-71 (2 Thru Lanes) + Short Term Safety**	**LT Option #2: Relocate SB SR176 ramp to right side exit (south of Clark Ave)**	**LT Option #3: Relocate SB SR176 ramp to right side exit (north of Clark Ave)**
Safety -- Mitigate left side exit ramp from SB I-71 to SB SR176	**-5** No deceleration on ramp, left side exit on SB I-71	**3** Deceleration added to ramp to enable lower approach speeds from aux lane	**1** Deceleration provided from drop lane; left side exit remains	**5** Left side exit ramp replaced with right side exit ramp south of Clark Avenue	**5** Left side exit ramp replaced with right side exit ramp north of Clark Avenue
Safety -- Mitigate 3-lane weave across SB I-71 from CD road to SB SR176 left side exit ramp	**-5** 19 crashes attributed to 3-lane weave across SB I-71. Secondary safety impacts atrributed to congestion.	**3** 3-lane weave mitigated with extension of concrete barrier, longitudinal rumble strips. Effective weave distance remaining = 400 ft.	**4** 3-lane weave mitigated with extension of concrete barrier, longitudinal rumble strips. Effective weave distance remaining = 0 feet.	**5** 3-lane weave mitigated with removal of left side exit ramp on SB I-71	**5** 3-lane weave mitigated with removal of left side exit ramp on SB I-71
Safety -- Improve weave on CD roadway	**0** Single lane weave required of EB I-90 traffic destine to SB I-71. Weave distance = 600 feet	**5** Safety project increases weave distance = 1,250 feet. Single lane weave required of EB I-90 traffic destine to SB I-71	**5** Safety project increases weave distance = 1,250 feet. Single lane weave required of EB I-90 traffic destine to SB I-71	**0** Two lane weave required of EB I-90 traffic destine to SB I-71. Additonal traffic volume destine to SB SR176. Weave distance = 1,000 feet.	**0** Two lane weave required of EB I-90 traffic destine to SB I-71 (only if WB I-490 ramp reduced to 1 lane). Weave also required of SB I-71 traffic destine to SB SR176. Weave distance = 2,100 ft.
Wayfinding	**-1** Guide signs for SB SR176 may confuse motorists on CD roadway (Photo 2)	**1** Safety project to reduce visibility of gudie signs for SB SR176 exit from the CD roadway	**1** Safety project to reduce visibility of gudie signs for SB SR176 exit from the CD roadway	**3** Guide sign for right side exit reduces driver workload/ increases safety (SB SR176)	**1** Guide sign legend exceeds 3 lines which increases driver workload/ reduces safety (SB SR176/ US42 Pearl Rd and W 25th Street/ Fulton Road)
Capacity -- CD Roadway	**-5** Preliminary analysis shows 2-lane CD roadway operates over capacity	**4** Safety project adds 3rd lane to CD road without increased volumes north of Clark Ave. Weave distance = 1,250 feet. Reconstruct Valentine Ave ramp possible due to diverted traffic over I-71	**4** Safety project adds 3rd lane to CD road without increased volumes north of Clark Avenue. Weave distance = 1,250 feet. Reconstruct Valentine Ave ramp possible due to diverted traffic over I-71	**-5** Preliminary analysis shows 2-lane CD roadway operates over capacity (north of Clark Avenue). Reconstruct Valentine Ave ramp required due to rerouted SB SR176 traffic over I-71	**3** Four lanes may be required on CD roadway to accommodate SB SR176 and US42 ramp volumes. Reconstruct Valentine Ave ramp required due to rerouted traffic destine to SB SR176 over I-71
Capacity -- SB I-71	**-2** Capacity analysis from Innerbelt IJS assumed ramps on SB I-71 functioned as independent ramps.	**1** Safety project mitigates 3-lane weave which is more consistent with Innerbelt IJS assumptions	**-2** Through lanes on SB I-71 reduced to 2 lanes; CD road ramp to SB I-71 weaves with W. 25th St/US42 traffic (1,000 ft)	**5** 3 lanes maintained on SB I-71 and left side exit ramp removed thus reducing congestion on mainline	**-1** 2 through lanes maintained on SB I-71; compliance with routing US42 traffic through the CD roadway unknown
Cost	**5** No construction costs	**3** Construction cost estimate of $6.5 million. Funding secured and project committed.	**3** Reduce cost of retaining wall for decel lane on left side exit ramp. Reallocate funds to other safety countermeasures such as Valentine Ave ramp	**-1** Right side exit ramp, 3rd lane on CD roadway; removal of existing left side ramp and mainline through lane; Valentine Ave ramp reconstruction	**-2** Right side exit ramp, reconstruction of Clark Avenue bridge piers to accommodate 4-lane on CD roadway; removal of existing left side ramp; Valentine Ave ramp reconstruction
COMPOSITE SCORE	**-13**	**20**	**16**	**12**	**11**

BENEFIT COST ANALYSIS

A benefit cost analysis for the proposed countermeasures was prepared using ECAT. The financial benefits of these improvements were determined by comparing the net present value of the project construction costs to the safety benefits of the recommended improvements.

No Part C CMFs were applied as a part of this analysis as the proposed countermeasures do not fit within the standard HSM toolbox of countermeasures. However, a Part D CMF was applied using crashes on SB I-71 only (without the C-D Road, EB I-90, or SB SR176 crashes). Analysis of the 86 crashes in this segment of SB I-71 show that 26 of the 86 crashes in this segment were caused directly by vehicles weaving across the 3-lane section of I-71 to access the SR-176 exit ramp. Since these crashes represent 30% of the total crash history, a 0.70 CMF was used to simulate the reduction in crashes caused by significantly reducing the ability to complete this weaving movement.

A second Part D CMT was also applied to the crashes on I-90 EB to the west of the I-490 exit gore. These crashes have strong relationship to the congestion/over capacity condition to the south on the collector-distributor road, which causes traffic to queue onto EB I-90. **Figure 18** represents improvements to the south on the I-490/ I-90 C-D road that will increase capacity and reduce the queueing on the EB I-90 section. This crash reduction was represented using the standard toolbox countermeasure for advanced queue warning systems (0.85 CMF applied to rear end crashes). This CMF was selected due to the similar result between the non-standard countermeasures in **Figure 18** (reduce queues) and the more conventional queue warning systems (alert for queues). This should represent a conservative approach since a majority of the rear end crashes may be eliminated if the queues can be shifted onto the C-D road.

Other safety benefits expected to be realized but not documented include the following:

1. Simplified weaving on the CD roadway (one lane weave, lowest of weaving volumes – 165 vehicles in AM peak hour)
2. Weaving distance on the CD roadway extended from 600 feet to 1,250 feet.

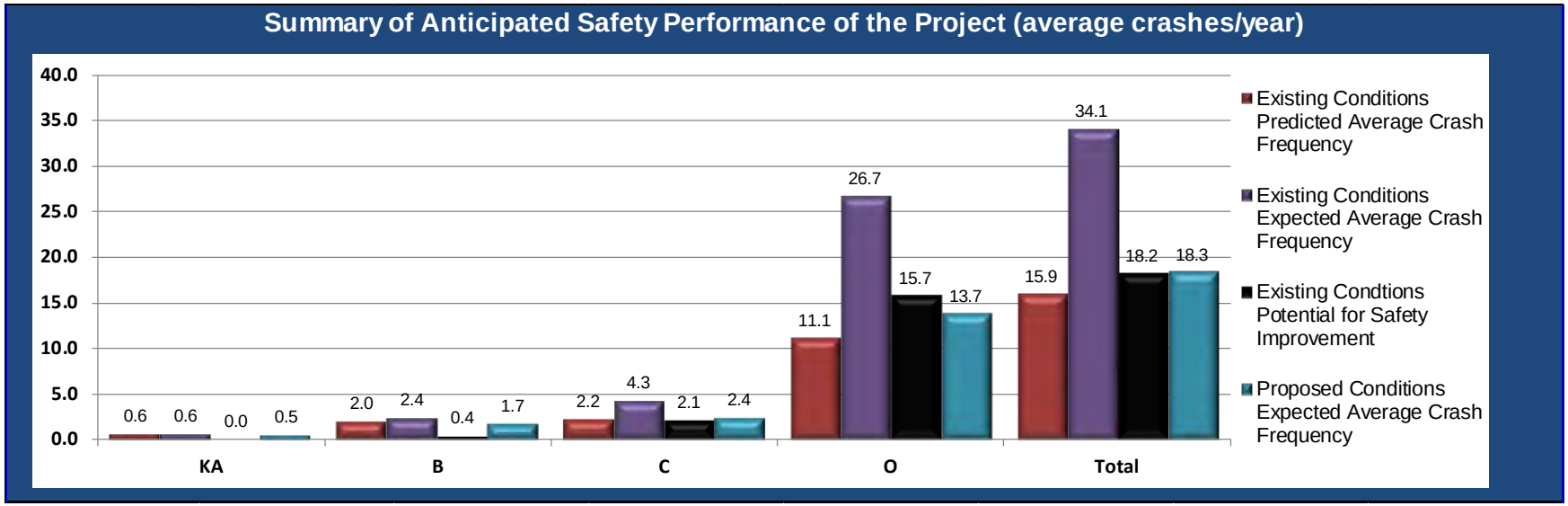
Construction costs were estimated for the proposed safety countermeasures as shown in **Figures 15, 16 and 18**. The construction costs include a 35% contingency factor in addition to an inflation factor of 7.5%. A summary of costs is shown in **Table C**.

TABLE C: COST SUMMARY

DESCRIPTION	COST
Construction cost (C-D ramp to SB I-71)	$1,276,300
Construction cost (3-lane C-D roadway section)	$1,864,300
Construction cost (convert Valentine Avenue /14th Street to merge condition)	$1,774,400
Design, Enviro, and Construction Eng Costs (30%)	$1,000,500
Property Acquisition	$0
TOTAL	**$5,915,500**

The crash reduction analysis is summarized in **Table D** and results in a benefit cost ratio of 0.70. ECAT output and a draft funding application having a score of 51 is included in **Appendix H.**

TABLE D: ECAT ANALYSIS SUMMARY



CUY-71-18.29 SAFETY STUDY

APPENDIX A: INNERBELT IJS (JUNE 2009)

CMT

CUY-90-14.90

PID 77332/85531

APPENDIX TC-03

Interchange Justification Study (IJS)

(Contract Document)

State of Ohio
Department of Transportation
Jolene M. Molitoris, Director

Innerbelt Bridge
Construction Contract Group 1 (CCG1)

Revision Date: June 29, 2009

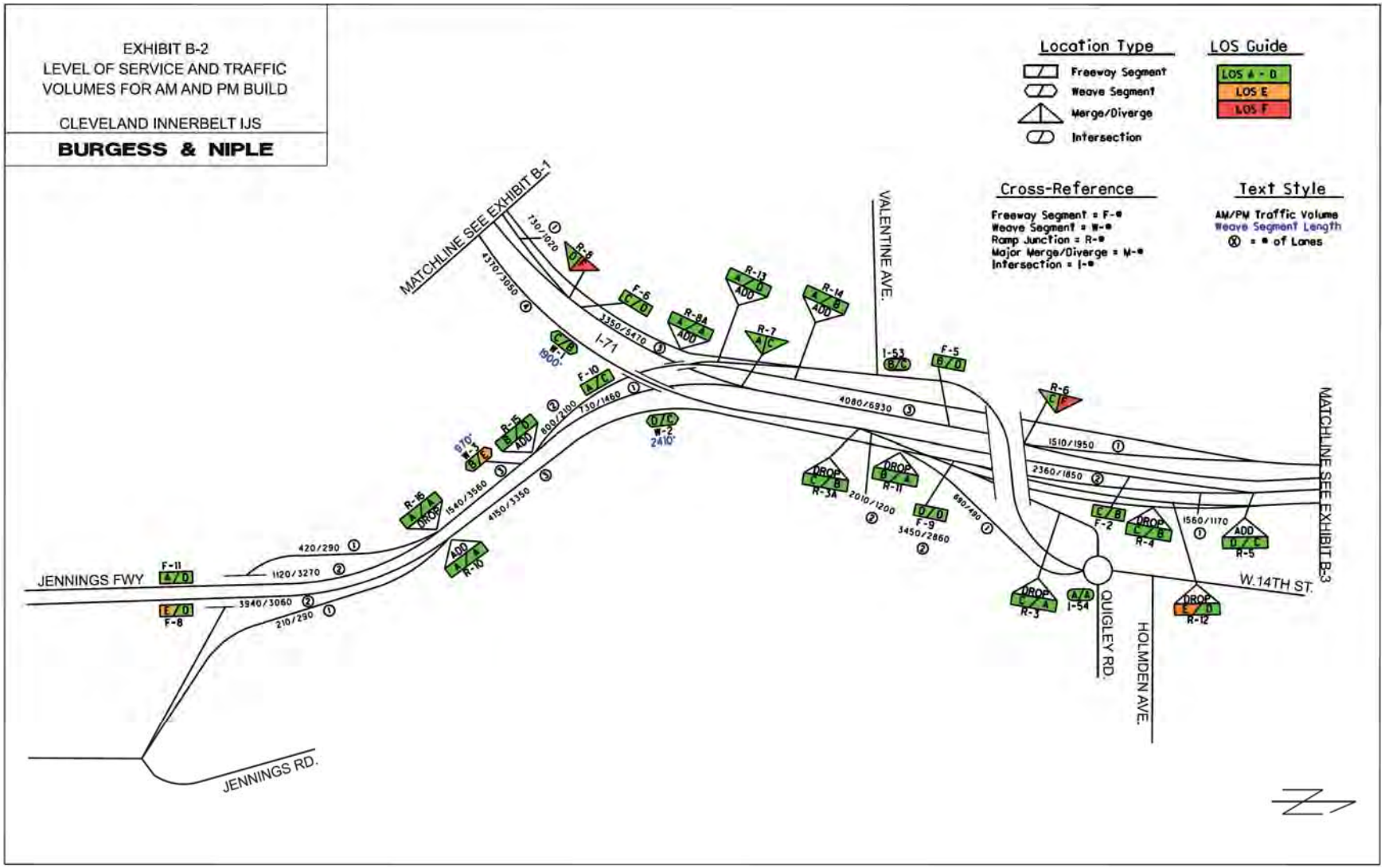


EXHIBIT B-2
LEVEL OF SERVICE AND TRAFFIC VOLUMES FOR AM AND PM BUILD
CLEVELAND INNERBELT IJS
BURGESS & NIPLE
Location Type
Freeway Segment
Weave Segment
Merge/Diverge
Intersection
LOS Guide
LOS A - D
LOS E
LOS F
Cross-Reference
Freeway Segment = F-#
Weave Segment = W-#
Ramp Junction = R-#
Major Merge/Diverge = M-#
Intersection = I-#
Text Style
AM/PM Traffic Volume
Weave Segment Length
(X) = # of Lanes
MATCHLINE SEE EXHIBIT B-1
MATCHLINE SEE EXHIBIT B-3
I-71
VALENTINE AVE.
I-53
JENNINGS FWY
JENNINGS RD.
W.14TH ST.
QUIGLEY RD.
HOLMDEN AVE.
I-54
730/1020
4370/3050
3350/5470
4080/6930
1510/1950
2360/1850
1560/1170
730/1460
800/2100
1540/3560
4150/3350
2010/1200
890/490
3450/2860
420/290
1120/3270
3940/3060
210/290
R-1
R-2
R-3
R-3A
R-4
R-5
R-6
R-7
R-8
R-8A
R-9
R-10
R-11
R-12
R-13
R-14
R-15
R-16
F-2
F-5
F-6
F-8
F-9
F-10
F-11

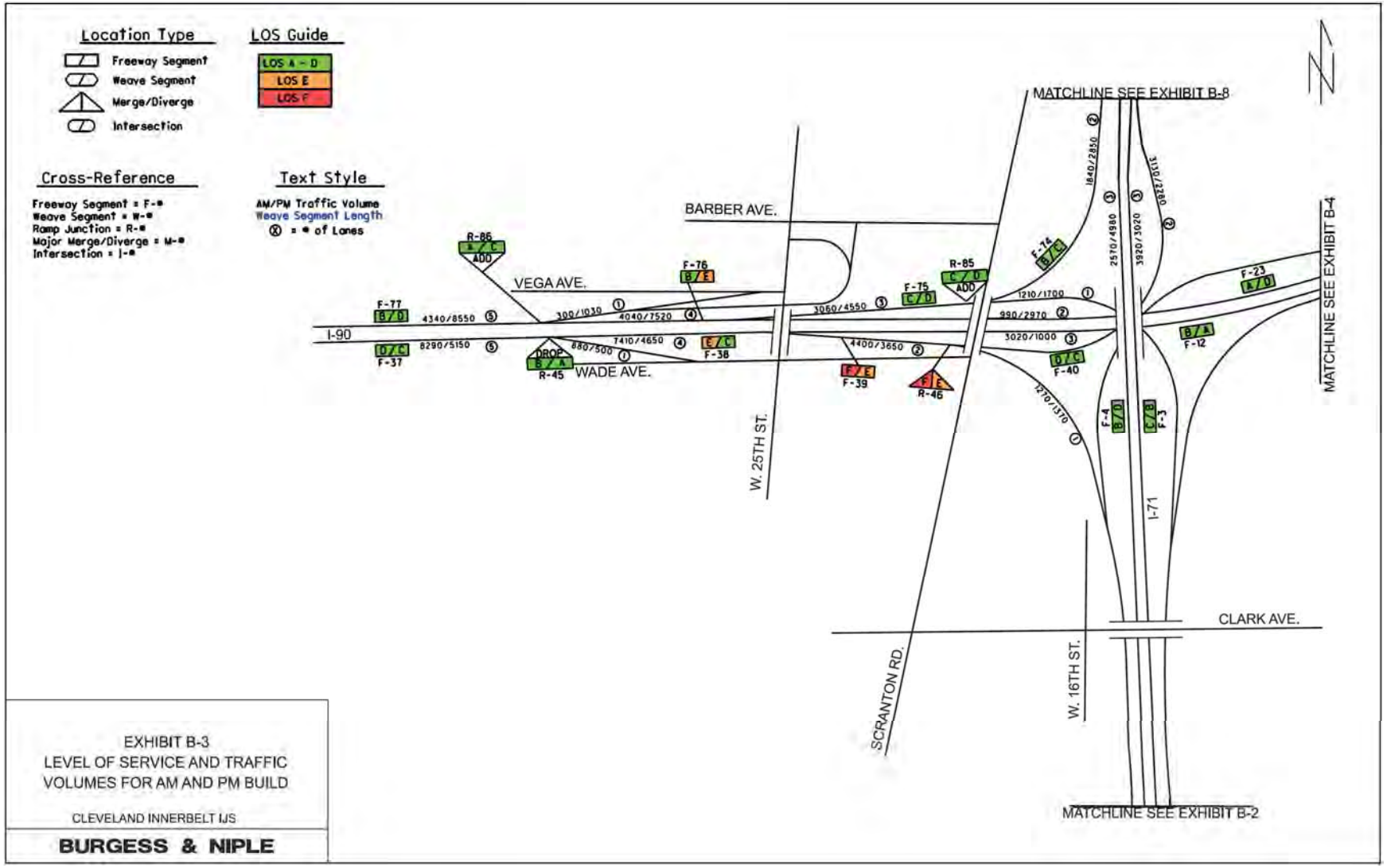


EXHIBIT B-3
LEVEL OF SERVICE AND TRAFFIC VOLUMES FOR AM AND PM BUILD

CLEVELAND INNERBELT IJS

BURGESS & NIPLE

The primary factor by which LOS for basic freeway segments (major merge/diverge) is measured is the computed density of the facility. Density is the number of vehicles occupying a given length of lane on a roadway averaged over time, usually expressed as vehicles per mile or vehicles per mile per lane. Table 9 shows the range in densities for each LOS for basic freeway segments (major merge/diverge).

Table 9: Range in Densities for Basic Freeway Segments (Major Merge/Diverge)

Level of Service	Density Range (pc/mi/ln)*
A	0-11
B	>11-18
C	>18-26
D	>26-35
E	>35-45
F	>45

* pc/mi/ln = passenger cars per mile per lane
Source: *Highway Capacity Manual, 2000*, TRB, Chapter 23.

Individual capacity analyses for each major merge/diverge segment is presented in the Appendices. No-Build analyses are in Appendix B, while Build analyses are in Appendix C. Exhibits for each facility showing DHV and LOS are presented in Exhibits NB-1 through NB-15 for the No-Build and Exhibits B-1 through B-15 for the Build. Each major merge/diverge segment has been assigned a unique identifier (e.g. M-9), which can be used to relate information presented in these exhibits to the information presented in Table 10.

LOS for major merge/diverge segments for the Design Year (2035) is presented in Table 10. The results are presented in the format X,Y,Z, where X represents the mainline segment LOS upstream from the merge/diverge, Y represents the ramp roadway LOS and Z represents the mainline segment LOS downstream from the merge/diverge. Within the table, some segments are identified as transition areas. These transition areas are segments where no improvements are being proposed in the Build condition, but have been included to analyze the transition back to existing conditions. For ease of review, non-transition segments that exhibit either LOS E or LOS F have been highlighted in yellow and red, respectively. Not all major merge/diverge segments are present in both the No-Build and Build conditions. If a segment is not present in the No-Build condition, the result is reported as BAO (Build Alternative Only). If a segment is not present in the Build condition, the result is reported as NBAO (No-Build Alternative Only).

Table 10: 2035 Major Merge/Diverge HCS Analysis

Ref	Facility	Location	LOS			
			No-Build		Build	
			AM Peak	PM Peak	AM Peak	PM Peak
M-1	EB I-490	I-77 off-ramp	C,D,B	A,A,A	B,C,B	A,A,A
M-2		I-77 on-ramp	B,A,B	A,A,A	B,A,B	A,A,A
M-3	WB I-490	I-77 off-ramp	A,A,A	A,A,B	A,A,A	A,A,B
M-4		I-77 on-ramp	A,A,A	B,C,B	A,A,A	B,C,B

Table 10: 2035 Major Merge/Diverge HCS Analysis

Ref	Facility	Location	LOS			
			No-Build		Build	
			AM Peak	PM Peak	AM Peak	PM Peak
M-5	WB I-490 (cont.)	I-71 off-ramp	A,A,A	C,B,D	A,A,A	C,B,D
M-6	EB I-90	NB I-77 on-ramp	BAO	BAO	D,B,D	C,B,C
M-7		WB SR 2 off-ramp	C,A,C	D,A,D	NBAO	NBAO
M-8		EB SR 2 on-ramp	C,B,C	D,D,D	C,A,C	E,C,D
M-9	WB I-90	WB SR 2 diverge	F,D,F	D,C,E	D,C,E	C,B,D
M-10	WB I-90 (Cont.)	EB SR 2 on-ramp	F,A,D	E,A,C	NBAO	NBAO
M-11		SB I-77 off-ramp	BAO	BAO	C,B,B	C,B,C
M-12	WB State Route 2	EB I-90 on-ramp	D,A,B	C,A,B	NBAO	NBAO

X,Y,Z: X = Mainline segment LOS upstream from merge/diverge
Y = Ramp roadway LOS
Z = Mainline segment LOS downstream from merge/diverge

X = LOS E
X = LOS F
X = Transition Area

BAO = Build Alternative Only
NBAO = No-Build Alternative Only

1.3.1.5 Interpretation of Freeway Operations Results

ODOT policy, "Requests for New or Revised Access – Interstate Highways or Other Freeways," can be found in Section 550 of ODOT's *Location and Design Manual (L&D), Volume One.* This policy outlines the requirements for preparing and processing access point requests in relation to new and existing interchanges on the interstate and other freeway systems. This policy is in accordance to Federal Code 23 U.S.C. 111 and *FHWA Policy – Additional Interchanges to the Interstate System* (Federal Register: February 11, 1998, Volume 63, Number 28).

According to ODOT's policy, the LOS of the interstate/freeway system and the interchange components that are built should generally provide a LOS C, except when the local Metropolitan Planning Organization (MPO) states that LOS D is acceptable. In Cleveland the local MPO is the Northeast Ohio Areawide Coordinating Agency. NOACA's *Congestion Management System, Manual of Practice, Second Edition,* states on page 29 that "In the NOACA region, LOS 'D' in urbanized areas will be considered acceptable." Based on this, the Build Alternative was designed to provide a minimum LOS of D.

The proposed interstate/freeway interchange or improvements cannot have a significant adverse impact on the safety and operation of the interstate/freeway facility based on an analysis of design year traffic. Significant impact is defined as lowering the LOS one or more levels from the No-Build condition, unless

the resulting build LOS meets new design criteria of LOS D allowed by NOACA. If the No-Build LOS is F, or if the Build LOS is reduced below LOS D, degradation is not assumed to occur unless the Build traffic volume is greater than 2 percent more than the No-Build traffic volume in the peak hour.

While every attempt was made to design all components of the Build alternative to LOS D or better, there are several locations where this was not possible. These locations often occurred in segments where there are no proposed changes to the facility as they are transition areas between the project and existing facilities. These transition areas are the roadway segments directly adjacent to the improved segments of the project. As long as there was no degradation of the transition segment's operation, no additional discussion is provided. Additional explanations will be provided for all locations operating at LOS E or LOS F that are not located in transition areas. This explanation will describe what is required to obtain a LOS D or better, what is proposed, what happens as a result if the deficiency is not addressed and what mitigative measures can be taken.

Based on Section 550.2 of the Ohio Department of Transportation's Location and Design Manual Volume 1 Roadway Design, "If the no-build LOS is F, or if the LOS is reduced, degradation is not assumed to occur unless the build traffic volume is greater than 2% more than the no build traffic volume in the peak hour of the design year using constrained traffic."

I-71
LOS for the I-90/I-490 on-ramp to southbound I-71 (R-6, shown on Exhibits NB-2 and B-2) is operating at LOS F during both the PM peak in the No-Build and Build conditions. The volume in both the No-Build and Build condition is 1950 vehicles. ***Because there is no change in traffic between the No-build and Build, there is no degradation.***

The CD road off-ramp (R-8, shown on Exhibits NB-2 and B-2) is operating at LOS F in the PM peak in both the No-build and Build conditions. ***This location is in a transition area and there is no degradation of this segment.***

All other locations on I-71 operate at an acceptable LOS D or better in the Build condition.

SR 176 (Jennings Freeway)
There are three roadway segments in the SR 176 portion of the corridor that do not operate at LOS D or better:

- In the northbound direction, the freeway segment south of the Jennings Road on-ramp (F-8, shown on Exhibits NB-2 and B-2) operates at LOS E during the AM peak in both the No-Build and Build conditions.
- The freeway weave between the I-71 on-ramp and the Jennings Road off-ramp (W-3, shown on Exhibits NB-2 and B-2) operates at LOS E during the PM peak in both the No-Build and Build conditions.
- In the northbound direction, the on-ramp (R-12, shown on Exhibits NB-2 and B-2) from the Jennings Freeway to I-490 operates at LOS E during the AM peak in both the No-Build and Build conditions.

These locations occur in the transition area and there is no degradation of these segments.

All other locations on SR 176 operate at an acceptable LOS D or better in the Build condition.

I-490
The I-71/Jennings Freeway on-ramp to eastbound I-490 (R-17, shown on Exhibits NB-4 and B-4) operates at LOS E during the AM peak for both the No-Build and Build conditions. ***This is a transition area and there is no degradation of this segment.***

All other locations on I-490 operate at an acceptable LOS D or better in the Build condition.

I-77
Northbound I-77, south of I-490 operates at either LOS E or F in the AM peak in both the No-Build and Build conditions. The following roadway segments are specifically associated with this condition:

- The northbound I-77 freeway segment south of the Pershing Avenue off-ramp (F-24, shown on Exhibits NB-6 and B-6) operates at LOS F in both the No-Build and Build conditions.
- The northbound I-77 and Pershing Avenue off-ramp junction (R-22, shown on Exhibits NB-6 and B-6) operates at LOS F in the No-Build and Build conditions.
- The northbound I-77 freeway segment south of the Broadway Avenue off-ramp (F-25, shown on Exhibits NB-6 and B-6) operates at LOS F in both the No-Build and Build conditions.
- The northbound I-77 and Broadway Avenue off-ramp junction (R-23, shown on Exhibits NB-6 and B-6) operates at LOS F in both the No-Build and Build conditions.
- The northbound I-77 freeway segment south of the I-490 off-ramp (F-26, shown on Exhibits NB-6 and B-6) operates at LOS E in the No-Build and at LOS F in the Build conditions. However, the increase in volume is less than 2 percent, so no degradation occurs. Thus, there is no relative change in operation between the No-Build and Build conditions for this segment.
- The northbound I-77 freeway segment south of the I-490 on-ramp (F-27, shown on Exhibits NB-5 and B-5) operates at LOS F in the No-Build and LOS E in the Build condition.

For all the segments listed above, there is no relative change in traffic volume or operation between the No-Build and Build conditions. All segments have increases in volumes of less than 2 percent and, thus, there is no degradation of the segments.

The cause of the LOS E and F ratings for these roadway segments is directly attributable to the mainline freeway being over capacity. In order to correct this capacity problem an additional mainline freeway lane would need to be added to northbound I-77 and this additional capacity would need to be extended upstream to at least I-480 (more than 5 miles) to achieve lane balance. However, a previous study, the Cleveland/Akron/Canton (CAC) Study, specifically examined widening of I-77 from I-490 south to I-480. Under Resolution Number 2002-037 the Governing Board of the Northeast Ohio Areawide Coordinating Agency stated that, "The Governing Board of the Northeast Ohio Areawide Coordinating Agency does not support any proposal to add general-purpose highway lanes on I-77 north of I-480."

As such, mainline capacity improvements south of I-490 were not considered as part of this project. However, by reconfiguring the I-490 off-ramp from a drop to a diverge configuration, the capacity of I-77 could be increased by 1 lane north of the I-490 off-ramp (see Figure 6), effectively creating an additional thru lane across I-490. In the No-Build condition, three lanes come northbound on I-77 approaching I-490. At the I-490 off-ramp, one lane drops to I-490 and two lanes continue northbound. After crossing I-490, the third lane is again developed to the right side of the alignment and, then, the I-490 on-ramp merges with the

F-4

HCS+: Basic Freeway Segments Release 5.2

Burgess & Niple, Inc.
5085 Reed Rd.
Columbus, OH 43220

Phone: (614) 459-2050 Fax:
E-mail:

Operational Analysis

Analyst:	JK
Agency or Company:	Burgess and Niple
Date Performed:	9/8/2006
Analysis Time Period:	PM
Freeway/Direction:	SB I-71
From/To:	I-90 off-ramp to I-90 on-ramp
Jurisdiction:	
Analysis Year:	2035 Build
Description:	Entry Link I-71 ML, S of I-90 off-ramp

Flow Inputs and Adjustments

Volume, V	4980	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1383	v
Trucks and buses	4	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.980	
Driver population factor, fp	1.00	
Flow rate, vp	1881	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1881	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.1	mi/h
Number of lanes, N	3	
Density, D	29.8	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

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Phone: (614) 459-2050 Fax:
E-mail:

Operational Analysis

Analyst:	JK
Agency or Company:	Burgess and Niple
Date Performed:	6/21/2006
Analysis Time Period:	AM
Freeway/Direction:	SB I-71
From/To:	WB I-90 off to EB I-90 on
Jurisdiction:	
Analysis Year:	2035 No-Build
Description:	Entry Link I-71 ML, S of WB I-90 off-ramp

Flow Inputs and Adjustments

Volume, V	2470	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	686	v
Trucks and buses	6	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.971	
Driver population factor, fp	1.00	
Flow rate, vp	942	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	942	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	14.5	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

F-5

HCS+: Basic Freeway Segments Release 5.2

Burgess & Niple, Inc.
5085 Reed Rd.
Columbus, OH 43220

Phone: (614) 459-2050 Fax:
E-mail:

Operational Analysis

Analyst:	JK
Agency or Company:	Burgess and Niple
Date Performed:	9/7/2006
Analysis Time Period:	AM
Freeway/Direction:	SB I-71
From/To:	I-90 on to Jennings off
Jurisdiction:	
Analysis Year:	2035 Build
Description:	I-71 ML, N of Jennings off-ramp

Flow Inputs and Adjustments

Volume, V	4080	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1133	v
Trucks and buses	6	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.971	
Driver population factor, fp	1.00	
Flow rate, vp	1167	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1167	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	4	
Density, D	18.0-	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

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Phone: (614) 459-2050 Fax:
E-mail:

Operational Analysis

Analyst:	JK
Agency or Company:	Burgess and Niple
Date Performed:	6/21/2006
Analysis Time Period:	AM
Freeway/Direction:	SB I-71
From/To:	I-90 on to Jennings off
Jurisdiction:	
Analysis Year:	2035 No-Build
Description:	I-71 ML, N of Jennings off-ramp

Flow Inputs and Adjustments

Volume, V	3977	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1105	v
Trucks and buses	6	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.971	
Driver population factor, fp	1.00	
Flow rate, vp	1517	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1517	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	23.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

R-6

HCS+: Ramps and Ramp Junctions Release 5.2

Burgess & Niple, Inc.
5085 Reed Rd.
Columbus, OH 43220

Phone: (614) 459-2050 Fax:
E-mail:

Merge Analysis

Analyst:	JK
Agency/Co.:	Burgess and Niple
Date performed:	11/22/06
Analysis time period:	PM
Freeway/Dir of Travel:	SB I-71
Junction:	I-90 / I-490 on-ramp
Jurisdiction:	
Analysis Year:	2035 Build
Description:	I-90 / I-490 on-ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4980	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	1950	vph
Length of first accel/decel lane	850	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4980	1950		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1383	542		v
Trucks and buses	4	10		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, f_{HV}	0.980	0.952		
Driver population factor, f_P	1.00	1.00		
Flow rate, vp	5644	2275		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.601 Using Equation 1

$v_{12} = v_F (P_{FM}) = 3394$ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	7919	7050	Yes
v_{R12}	5669	4600	Yes

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A = 43.3$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	$M_S = 1.375$	
Space mean speed in ramp influence area,	$S_R = 33.4$	mph
Space mean speed in outer lanes,	$S_O = 58.7$	mph
Space mean speed for all vehicles,	$S = 38.0$	mph

R-6

HCS+: Ramps and Ramp Junctions Release 5.2

Burgess & Niple, Inc.
5085 Reed Rd.
Columbus, OH 43220

Phone: (614) 459-2050 Fax:
E-mail:

Merge Analysis

Analyst:	JK
Agency/Co.:	Burgess and Niple
Date performed:	6/23/2006
Analysis time period:	PM
Freeway/Dir of Travel:	SB I-71
Junction:	I-90 / I-490 on-ramp
Jurisdiction:	
Analysis Year:	2035 No-Build
Description:	I-90 / I-490 on-ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4703	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	1950	vph
Length of first accel/decel lane	850	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	865	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1700	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4703	1950	865	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1306	542	240	v
Trucks and buses	4	10	4	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.980	0.952	0.980	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5330	2275	980	pcph

Estimation of V12 Merge Areas

L_{EQ} = 4886.56 (Equation 25-2 or 25-3)

P_{FM} = 0.700 Using Equation 3

$v_{12} = v_F (P_{FM})$ = 3732 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	7605	7050	Yes
v_{R12}	6007	4600	Yes

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 46.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 1.829	
Space mean speed in ramp influence area,	S_R = 22.9	mph
Space mean speed in outer lanes,	S_O = 61.0	mph
Space mean speed for all vehicles,	S = 26.4	mph

HCS+: Ramps and Ramp Junctions Release 5.2

Burgess & Niple, Inc.
5085 Reed Rd.
Columbus, OH 43220

Phone: (614) 459-2050 Fax:
E-mail:

Diverge Analysis

Analyst:	JK
Agency/Co.:	Burgess and Niple
Date performed:	9/8/2006
Analysis time period:	PM
Freeway/Dir of Travel:	SB I-71
Junction:	Jennings off-ramp
Jurisdiction:	
Analysis Year:	2035 Build
Description:	Jenning off-ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4980	vph

Off Ramp Data

Side of freeway	Left	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1460	vph
Length of first accel/decel lane	1800	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4980		1460			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1383		406			v
Trucks and buses	4		4			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%	%	
Length	0.00	mi	0.00	mi	mi	
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.980		0.980			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	5644		1655			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.543 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD} = 3820$ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5644	7050	No
v_{12}	3820	4400	No
$v_{FO} = v_F - v_R$	3989	7050	No
v_R	1655	2100	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D = 22.5$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	$D_S = 0.447$	
Space mean speed in ramp influence area,	$S_R = 54.7$	mph
Space mean speed in outer lanes,	$S_O = 68.8$	mph
Space mean speed for all vehicles,	$S = 58.2$	mph

HCS+: Ramps and Ramp Junctions Release 5.2

R-7

Burgess & Niple, Inc.
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Columbus, OH 43220

Phone: (614) 459-2050 Fax:
E-mail:

Diverge Analysis

Analyst:	JK
Agency/Co.:	Burgess and Niple
Date performed:	6/23/2006
Analysis time period:	PM
Freeway/Dir of Travel:	SB I-71
Junction:	Jennings off-ramp
Jurisdiction:	
Analysis Year:	2035 No-Build
Description:	Jenning off-ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	6653	vph

Off Ramp Data

Side of freeway	Left	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1435	vph
Length of first accel/decel lane	800	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	6653		1435			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1848		399			v
Trucks and buses	4		4			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.980	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	7540	1626	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.497 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4564 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	7540	7050	Yes
v_{12}	4564	4400	Yes
$v_{FO} = v_F - v_R$	5914	7050	No
v_R	1626	2100	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 38.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	D_S = 0.444	
Space mean speed in ramp influence area,	S_R = 54.8	mph
Space mean speed in outer lanes,	S_O = 64.5	mph
Space mean speed for all vehicles,	S = 58.0	mph

R-14

HCS+: Basic Freeway Segments Release 5.2

Burgess & Niple, Inc.
5085 Reed Rd.
Columbus, OH 43220

Phone: (614) 459-2050 Fax:
E-mail:

Operational Analysis

Analyst:	JK
Agency or Company:	Burgess & Niple
Date Performed:	6/29/2006
Analysis Time Period:	AM
Freeway/Direction:	SB Jennings Freeway
From/To:	Valentine/I90/I490 merge
Jurisdiction:	
Analysis Year:	2035 Build
Description:	Valentine/I90/I490: I-90/I-490 (double)

Flow Inputs and Adjustments

Volume, V	680	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	189	v
Trucks and buses	6	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.971	
Driver population factor, fp	1.00	
Flow rate, vp	389	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	55.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	4.5	mi/h
Free-flow speed, FFS	55.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	389	pc/h/ln
Free-flow speed, FFS	55.0	mi/h
Average passenger-car speed, S	55.0	mi/h
Number of lanes, N	2	
Density, D	7.1	pc/mi/ln
Level of service, LOS	A	

Overall results are not computed when free-flow speed is less than 55 mph.

R-14

HCS+: Basic Freeway Segments Release 5.2

Burgess & Niple, Inc.
5085 Reed Rd.
Columbus, OH 43220

Phone: (614) 459-2050 Fax:
E-mail:

Operational Analysis

Analyst:	JK
Agency or Company:	Burgess & Niple
Date Performed:	9/6/2006
Analysis Time Period:	PM
Freeway/Direction:	SB Jennings Freeway
From/To:	Valentine/I90/I490 merge
Jurisdiction:	
Analysis Year:	2035 Build
Description:	Valentine/I90/I490: I-90/I-490 (double)

Flow Inputs and Adjustments

Volume, V	1640	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	456	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	934	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	55.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	4.5	mi/h
Free-flow speed, FFS	55.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	934	pc/h/ln
Free-flow speed, FFS	55.0	mi/h
Average passenger-car speed, S	55.0	mi/h
Number of lanes, N	2	
Density, D	17.0	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

R-14

HCS+: Basic Freeway Segments Release 5.2

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Columbus, OH 43220

Phone: (614) 459-2050 Fax:
E-mail:

Operational Analysis

Analyst:	JK
Agency or Company:	Burgess & Niple
Date Performed:	6/29/2006
Analysis Time Period:	PM
Freeway/Direction:	SB Jennings Freeway
From/To:	Valentine/I90/I490 merge
Jurisdiction:	
Analysis Year:	2035 No-Build
Description:	Jct. Valentine/I90/I490: I-90/I-490 (double)

Flow Inputs and Adjustments

Volume, V	1948	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	541	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1109	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	55.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	4.5	mi/h
Free-flow speed, FFS	55.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1109	pc/h/ln
Free-flow speed, FFS	55.0	mi/h
Average passenger-car speed, S	55.0	mi/h
Number of lanes, N	2	
Density, D	20.2	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

R-15

HCS+: Basic Freeway Segments Release 5.2

Burgess & Niple, Inc.
5085 Reed Rd.
Columbus, OH 43220

Phone: (614) 459-2050 Fax:
E-mail:

Operational Analysis

Analyst:	JK
Agency or Company:	Burgess & Niple
Date Performed:	6/29/2006
Analysis Time Period:	AM
Freeway/Direction:	SB Jennings Freeway
From/To:	I-71 on-ramp
Jurisdiction:	
Analysis Year:	2035 No-Build
Description:	I-71 on-ramp: ramp roadway (double)

Flow Inputs and Adjustments

Volume, V	1454	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	404	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	828	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	55.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	4.5	mi/h
Free-flow speed, FFS	55.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	828	pc/h/ln
Free-flow speed, FFS	55.0	mi/h
Average passenger-car speed, S	55.0	mi/h
Number of lanes, N	2	
Density, D	15.1	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

WEST 25TH STREET

I.R. 71 SOUTHBOUND
I.R. 71 NORTHBOUND

TO S.R. 176
SOUTHBOUND

FROM W. 14TH STREET

FROM I.R. 90 / I.R. 490

I.R. 71 SOUTHBOUND
I.R. 71 NORTHBOUND

CLARK AVENUE

WEST 14TH STREET

NOTE: QUIGLEY ROAD EXTENSION AND ROUNDABOUT NOT TO SCALE

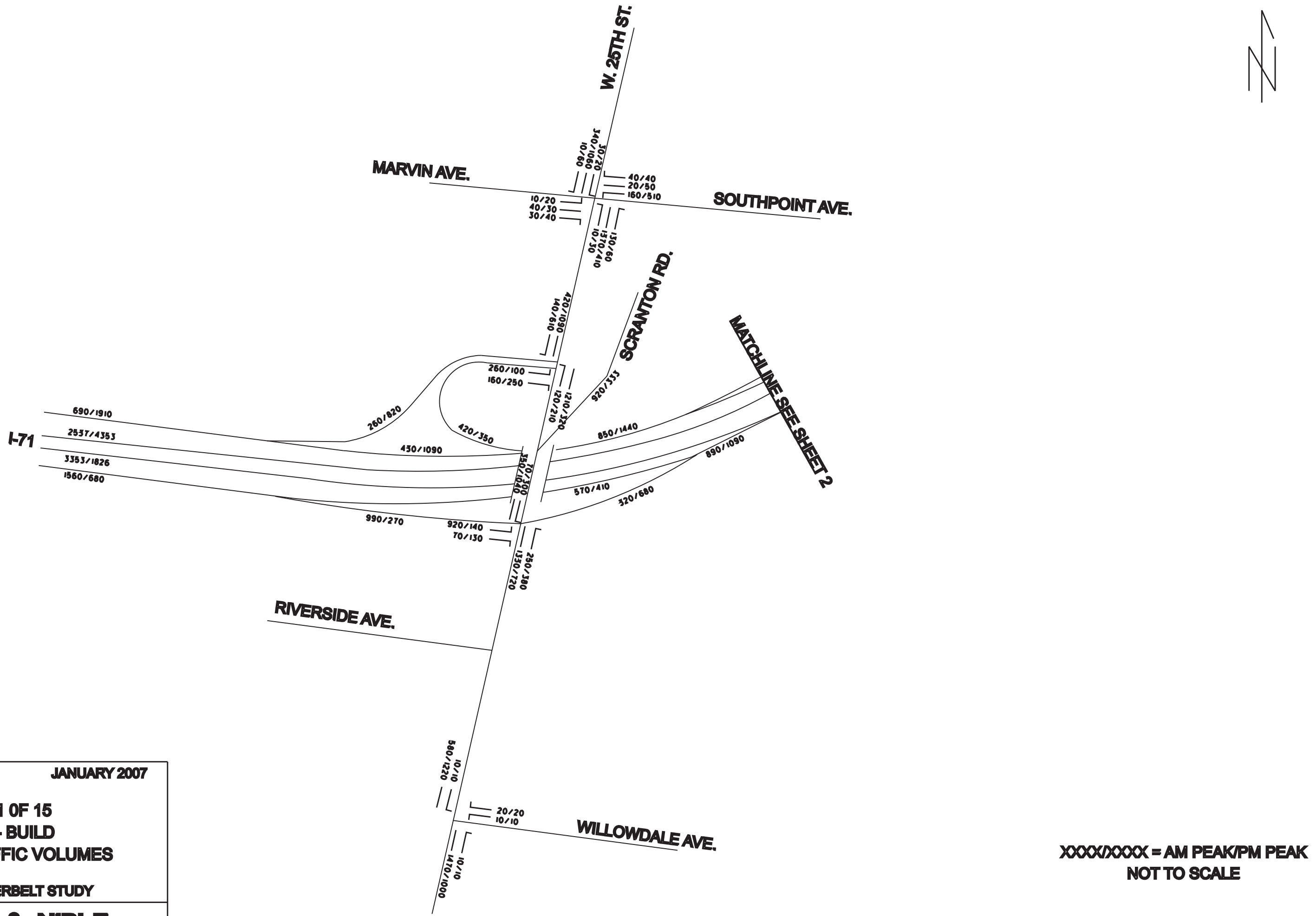
CLEVELAND INNERBELT PLAN
OHIO DEPARTMENT OF TRANSPORTATION

N

FIGURE 5
SOUTHERN INNERBELT PREFERRED ALTERNATIVE

0' 200'
100'

AUGUST 31, 2008
DRAFT



CLEVELAND, OHIO JANUARY 2007

FIGURE 1 0F 15
2035 NO - BUILD
CERTIFIED TRAFFIC VOLUMES

CLEVELAND INNERBELT STUDY

BURGESS & NIPLE

XXXX/XXXX = AM PEAK/PM PEAK
NOT TO SCALE

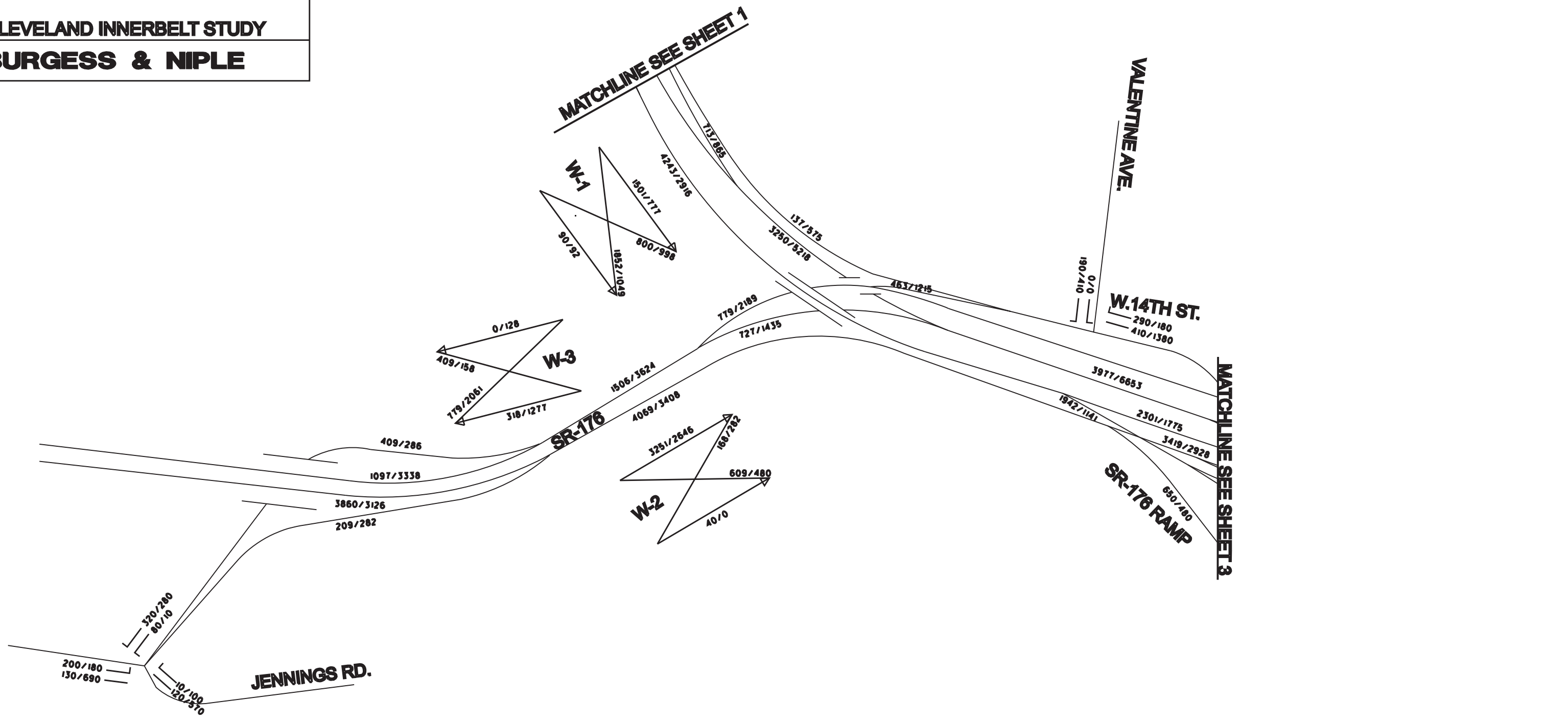
CLEVELAND, OHIO JANUARY 2007

FIGURE 2 0F 15
2035 NO - BUILD
CERTIFIED TRAFFIC VOLUMES

CLEVELAND INNERBELT STUDY

BURGESS & NIPLE

XXXX/XXXX = AM PEAK/PM PEAK
NOT TO SCALE



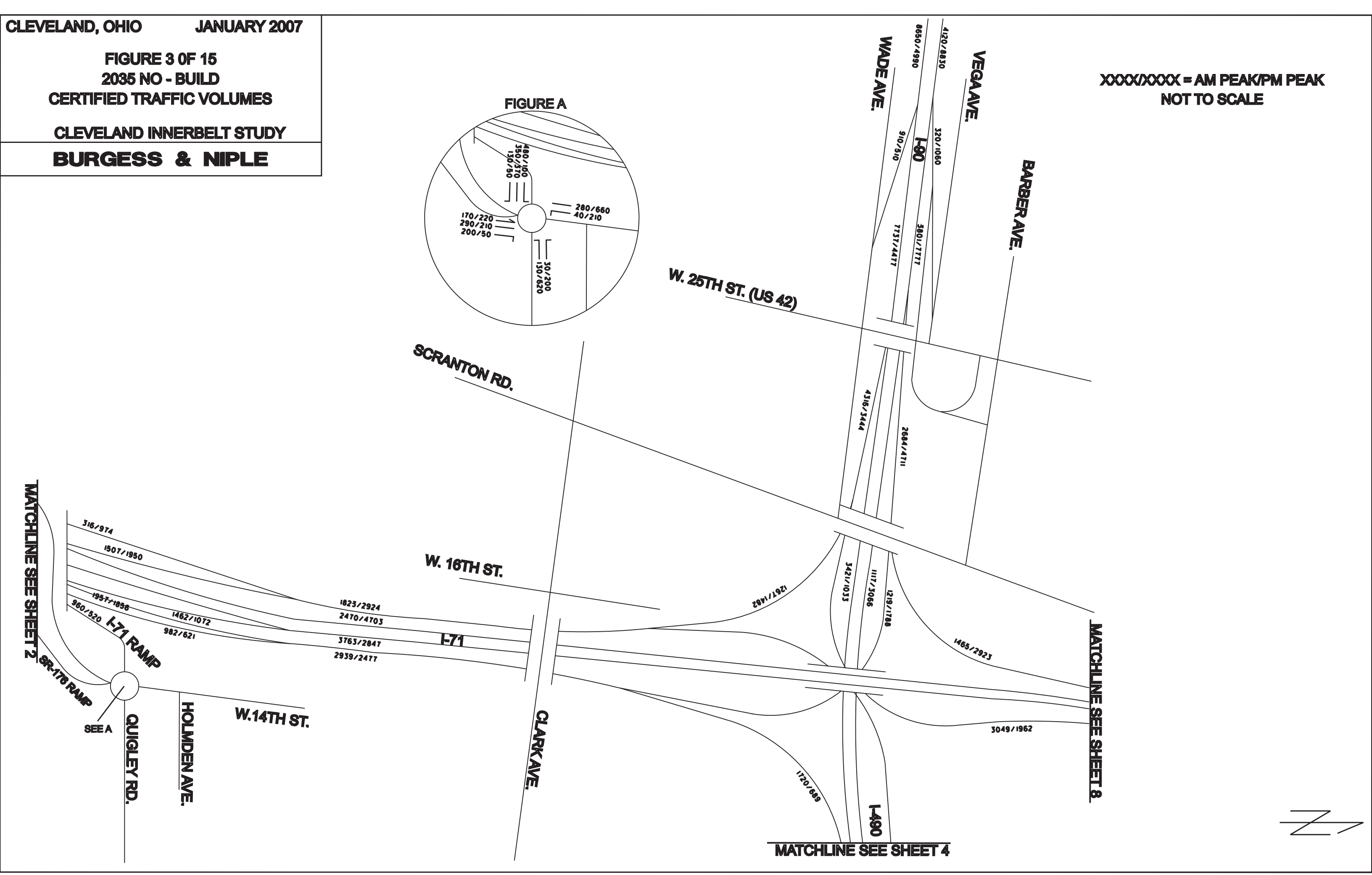
CLEVELAND, OHIO JANUARY 2007

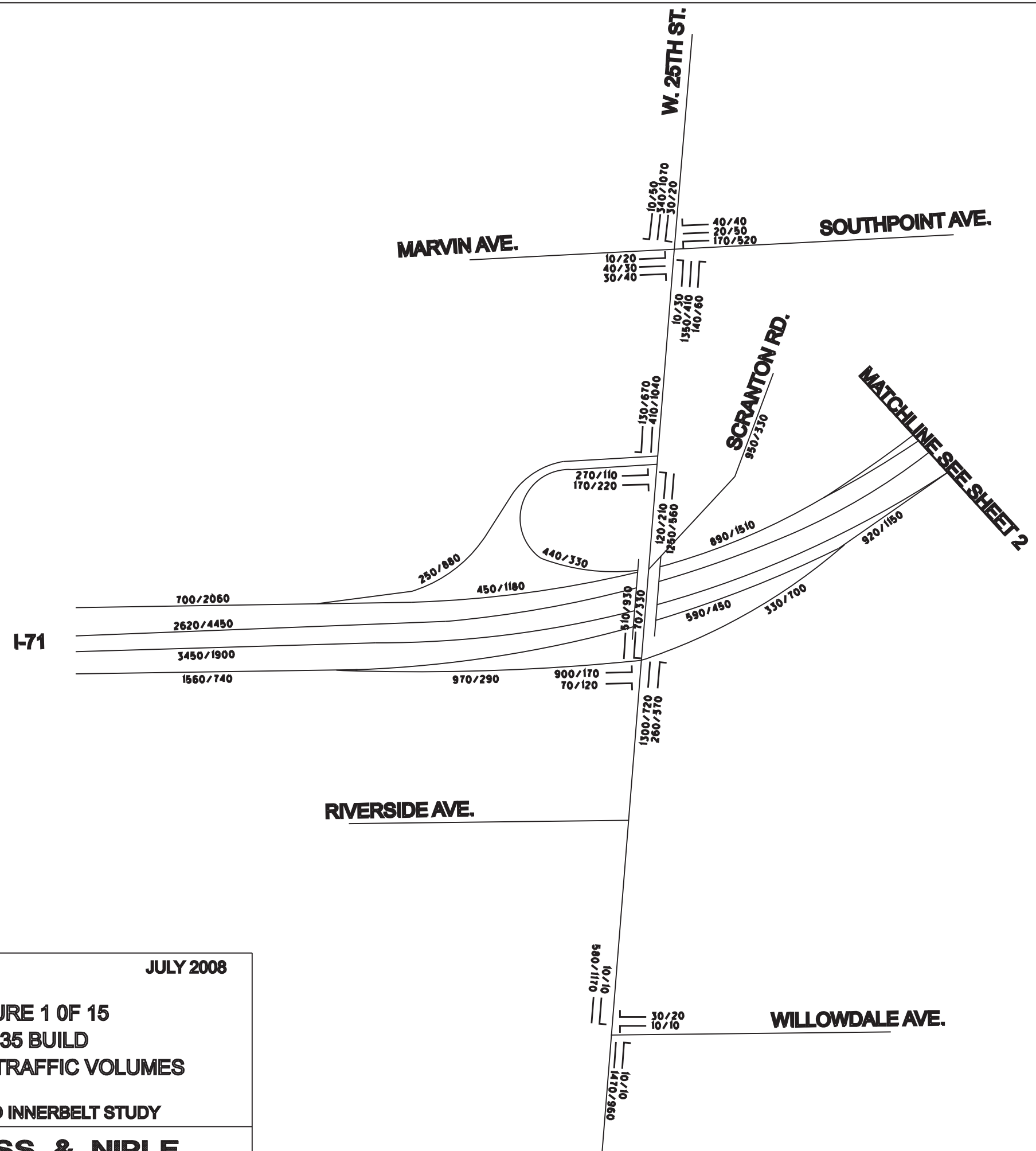
FIGURE 3 0F 15
2035 NO - BUILD
CERTIFIED TRAFFIC VOLUMES

CLEVELAND INNERBELT STUDY

BURGESS & NIPLE

XXXX/XXXX = AM PEAK/PM PEAK
NOT TO SCALE





CLEVELAND, OHIO JULY 2008

FIGURE 1 0F 15
2035 BUILD
CERTIFIED TRAFFIC VOLUMES

CLEVELAND INNERBELT STUDY

BURGESS & NIPLE

XXXX/XXXX = AM PEAK/PM PEAK
NOT TO SCALE

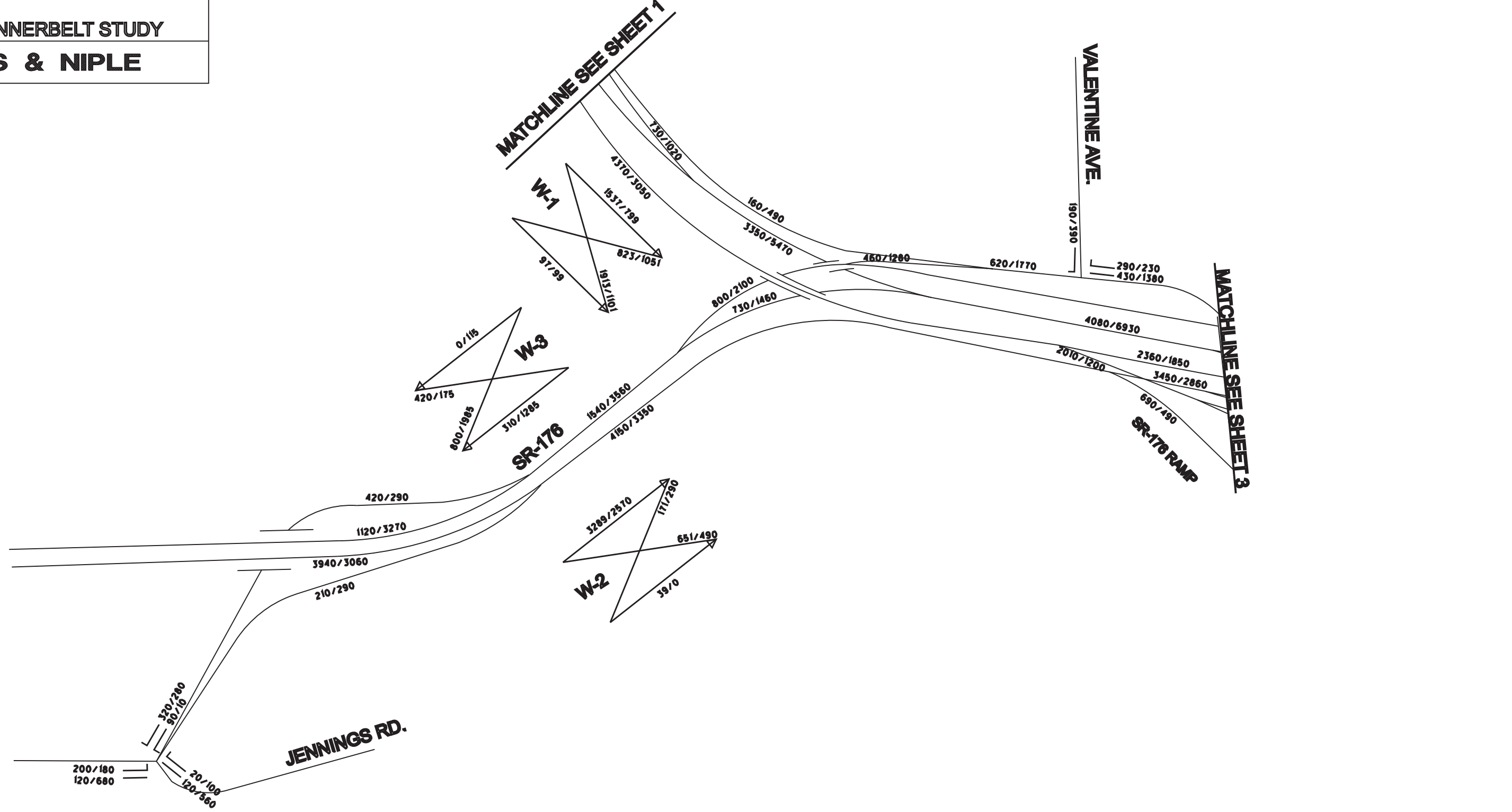
CLEVELAND, OHIO JULY 2008

FIGURE 2 0F 15
2035 BUILD
CERTIFIED TRAFFIC VOLUMES

CLEVELAND INNERBELT STUDY

BURGESS & NIPLE

XXXX/XXXX = AM PEAK/PM PEAK
NOT TO SCALE



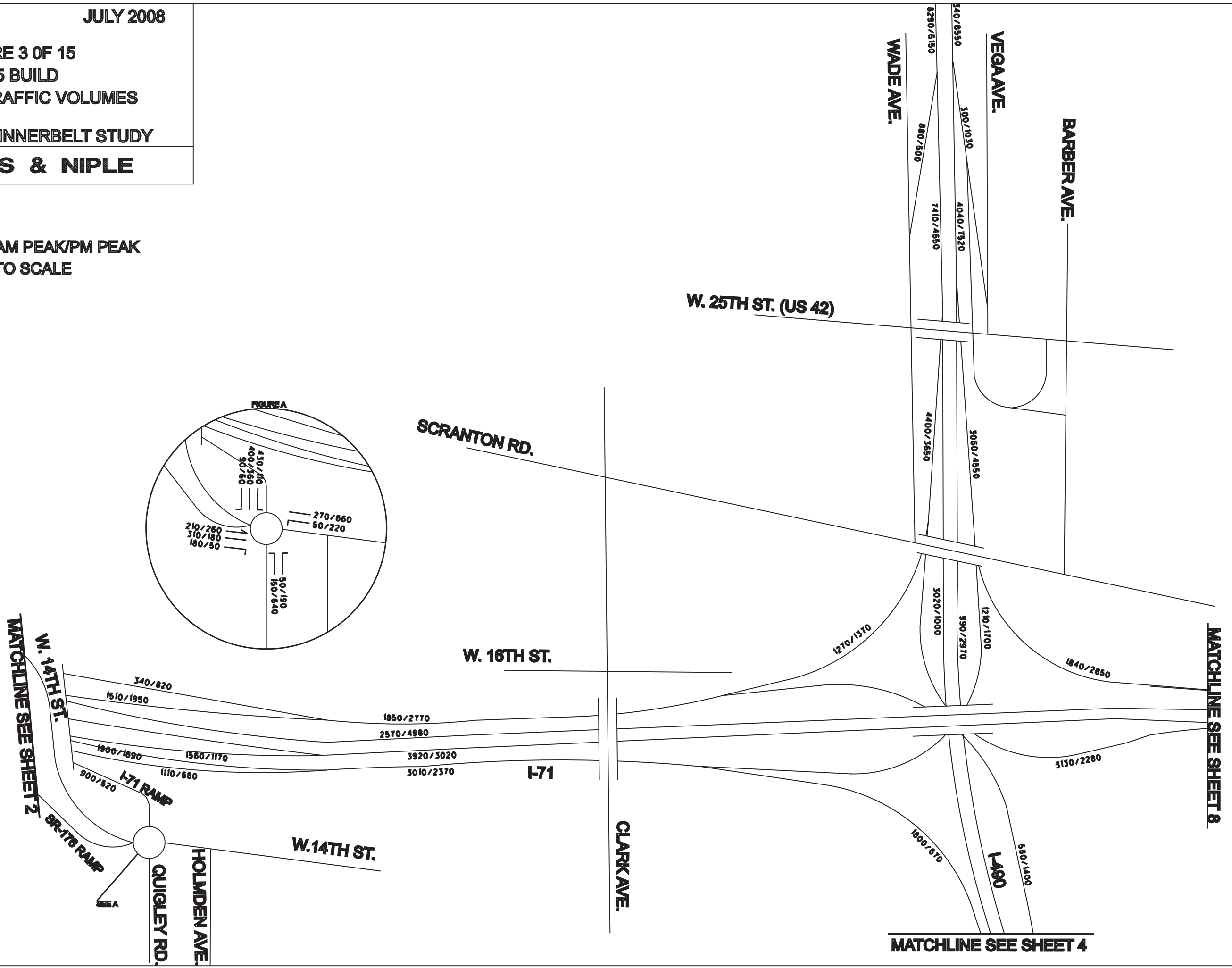
CLEVELAND, OHIO JULY 2008

FIGURE 3 0F 15
2035 BUILD
CERTIFIED TRAFFIC VOLUMES

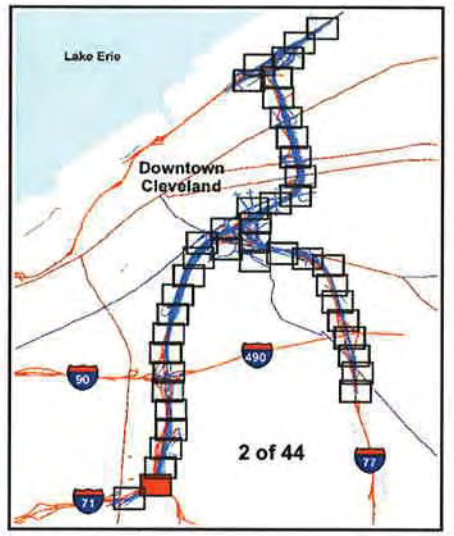
CLEVELAND INNERBELT STUDY

BURGESS & NIPLE

XXXX/XXXX = AM PEAK/PM PEAK
NOT TO SCALE



Cleveland Innerbelt Project
CUY-I-71/I-90
PID No. 77510



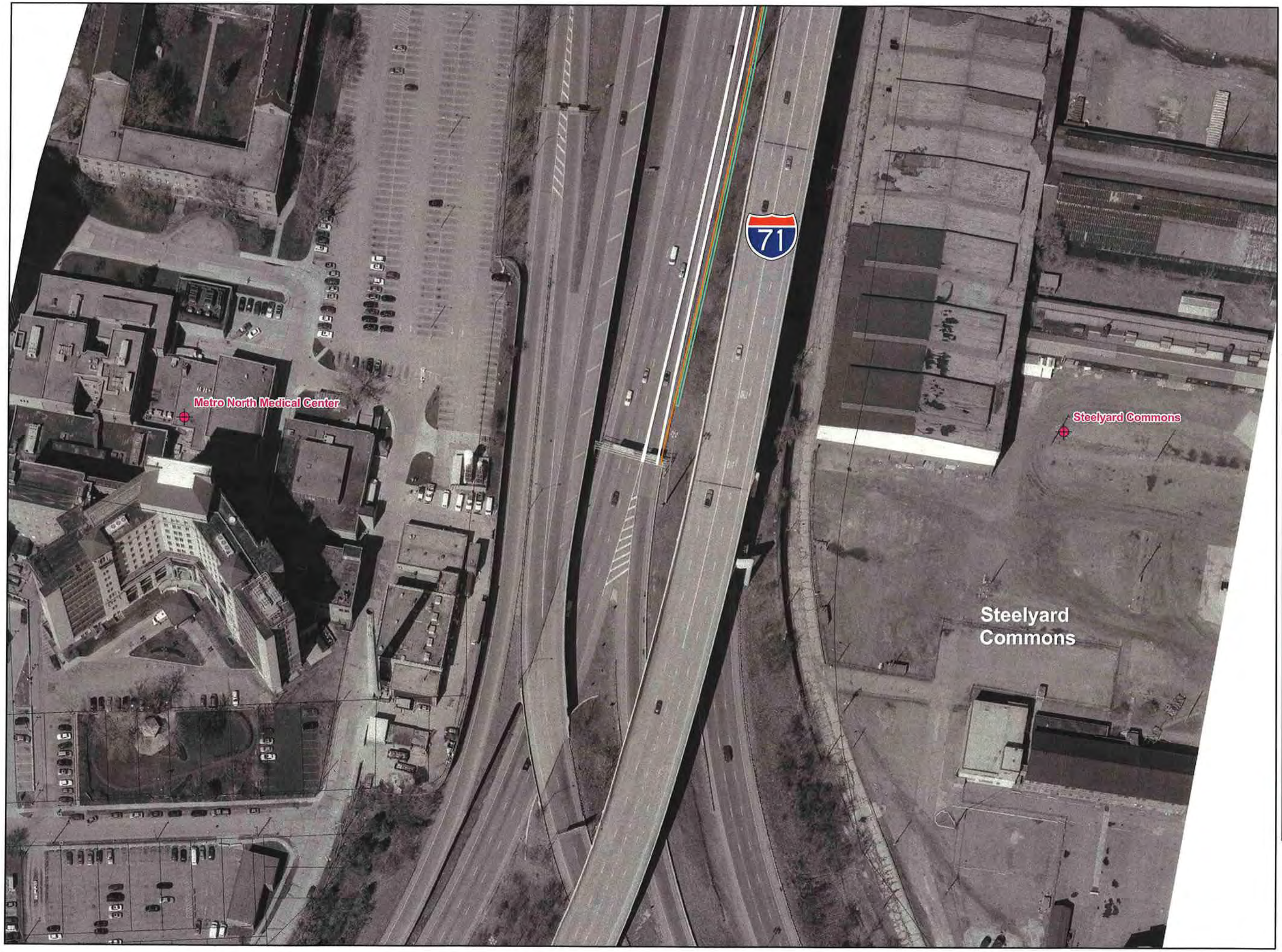
Legend

- Construction Limits
- Edge of Pavement
- Shoulder
- Retaining Wall
- Bridge
- Curb
- Driveway
- Sidewalk
- Concrete Barrier
- Median Barrier
- Community Facilities
- Historic Properties
- Building Takes
- Parcels
- Parks
- Contributing Features to Tremont Historic District

Feet
0 100 200
1 inch = 100 feet

Alternative A	2

Cleveland Innerbelt Project
CUY-I-71/I-90
PID No. 77510



Legend

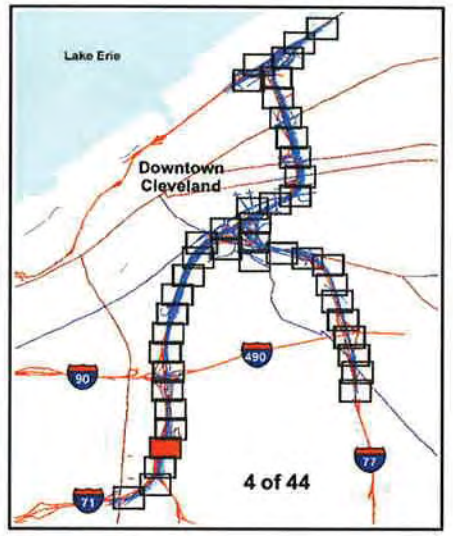
- Construction Limits
- Edge of Pavement
- Shoulder
- Retaining Wall
- Bridge
- Curb
- Driveway
- Sidewalk
- Concrete Barrier
- Median Barrier
- Community Facilities
- Historic Properties
- Building Takes
- Parcels
- Parks
- Contributing Features to Tremont Historic District

0 100 200 Feet

1 inch = 100 feet

Alternative A	3

Cleveland Innerbelt Project
CUY-I-71/I-90
PID No. 77510



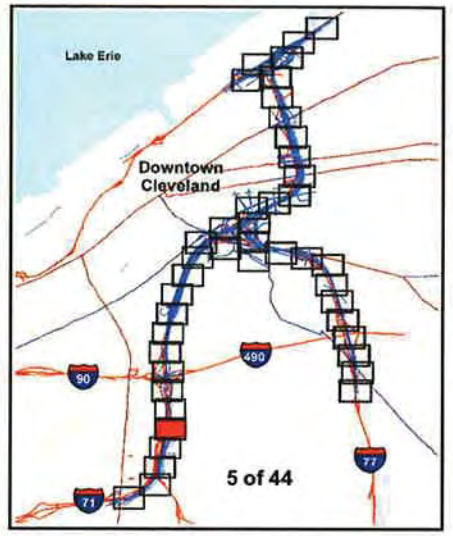
Legend

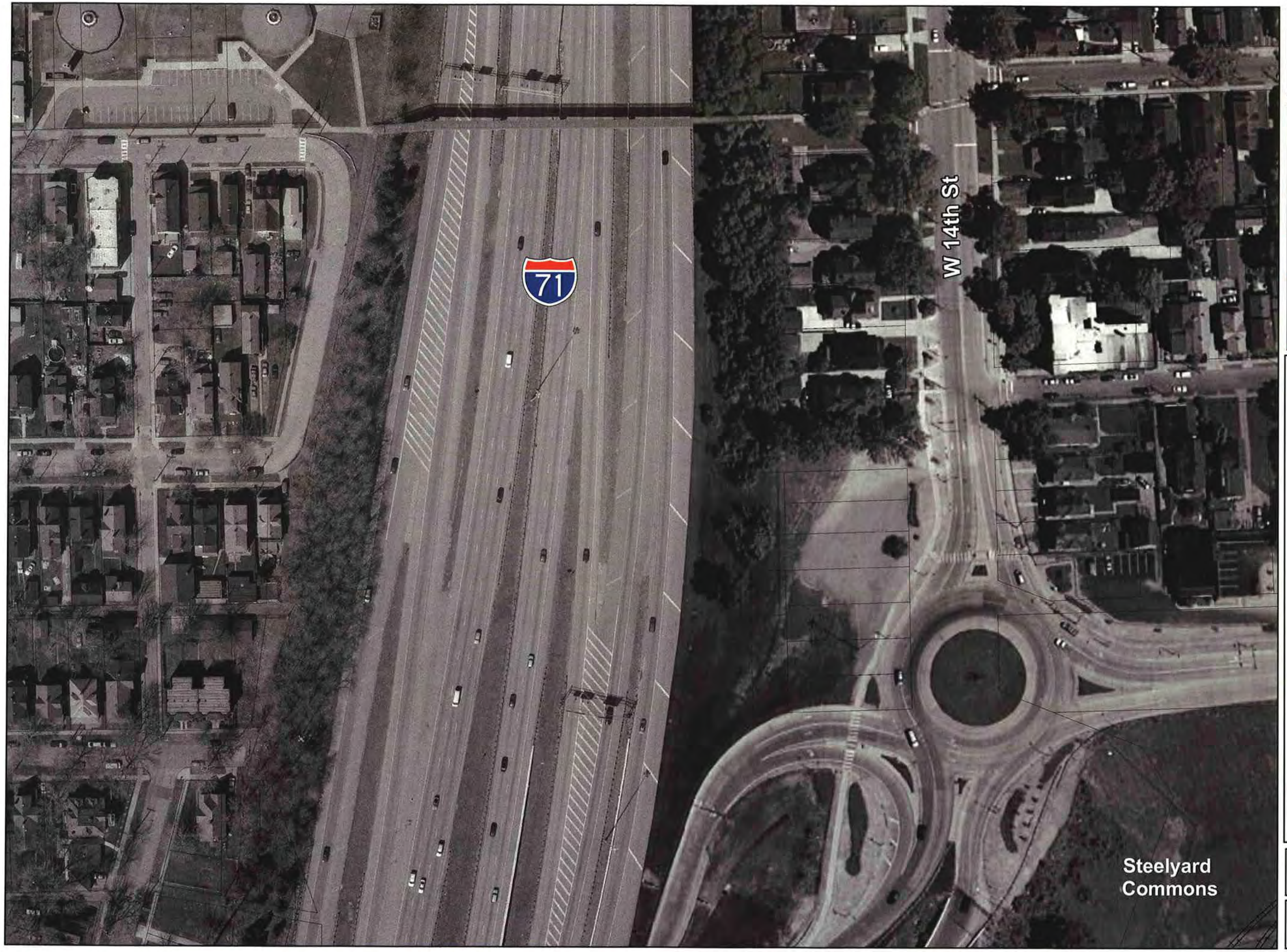
- Construction Limits
- Edge of Pavement
- Shoulder
- Retaining Wall
- Bridge
- Curb
- Driveway
- Sidewalk
- Concrete Barrier
- Median Barrier
- Community Facilities
- Historic Properties
- Building Takes
- Parcels
- Parks
- Contributing Features to Tremont Historic District

Feet
0 100 200
1 inch = 100 feet

Alternative A	4

Cleveland Innerbelt Project
CUY-I-71/I-90
PID No. 77510





Legend

- Construction Limits
- Edge of Pavement
- Shoulder
- Retaining Wall
- Bridge
- Curb
- Driveway
- Sidewalk
- Concrete Barrier
- Median Barrier
- Community Facilities
- Historic Properties
- Building Takes
- Parcels
- Parks
- Contributing Features to Tremont Historic District

0 100 200 Feet

1 inch = 100 feet

Alternative A	5

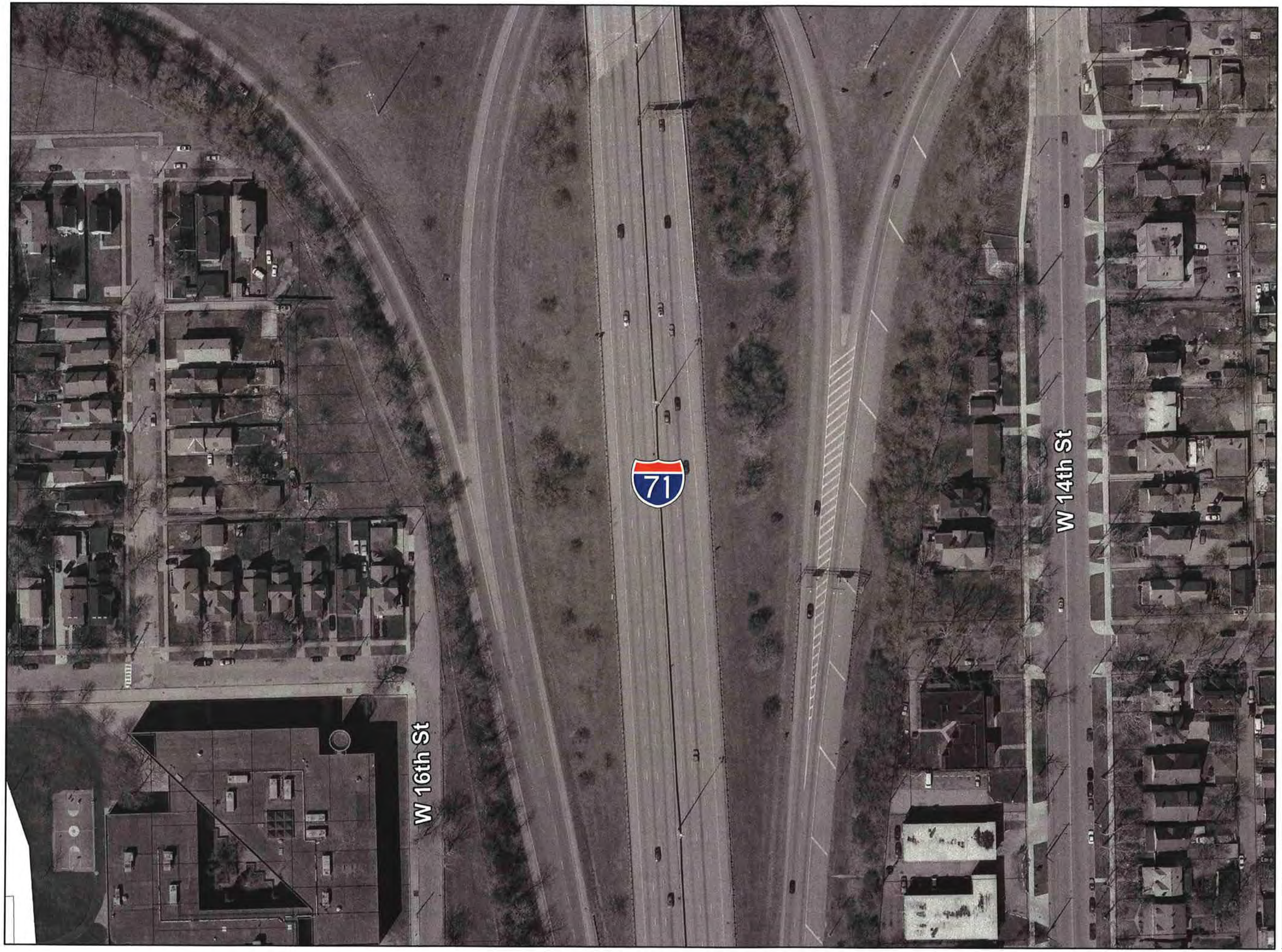
Cleveland Innerbelt Project
CUY-I-71/I-90
PID No. 77510

Legend

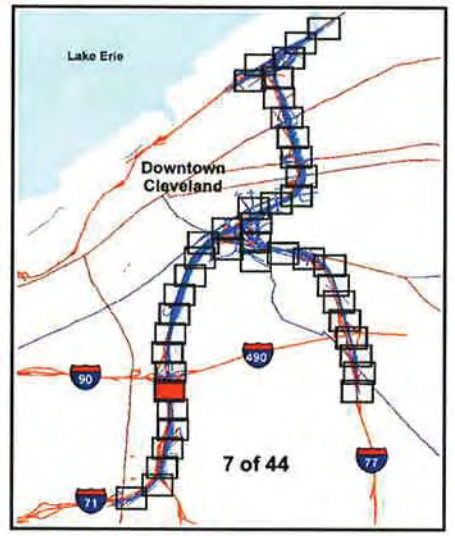
- Construction Limits
- Edge of Pavement
- Shoulder
- Retaining Wall
- Bridge
- Curb
- Driveway
- Sidewalk
- Concrete Barrier
- Median Barrier
- Community Facilities
- Historic Properties
- Building Takes
- Parcels
- Parks
- Contributing Features to Tremont Historic District

Feet
0 100 200
1 inch = 100 feet

Alternative A	6



Cleveland Innerbelt Project
CUY-I-71/I-90
PID No. 77510



Legend

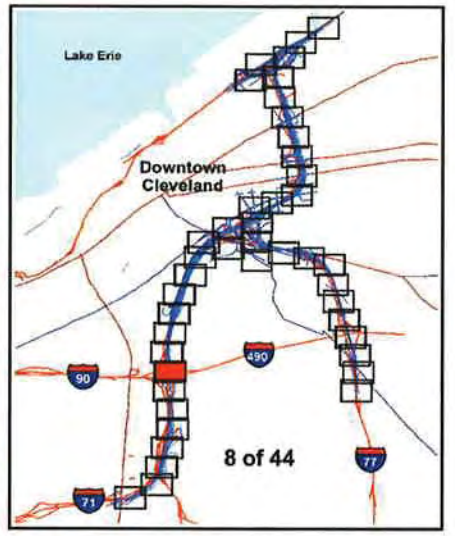
- Construction Limits
- Edge of Pavement
- Shoulder
- Retaining Wall
- Bridge
- Curb
- Driveway
- Sidewalk
- Concrete Barrier
- Median Barrier
- Community Facilities
- Historic Properties
- Building Takes
- Parcels
- Parks
- Contributing Features to Tremont Historic District

0 100 200 Feet

1 inch = 100 feet

Alternative A	7

Cleveland Innerbelt Project
CUY-I-71/I-90
PID No. 77510



Tremont Historic District

I-90 WB

I-90 EB

W 14th St

90

71

490

Legend

- Construction Limits
- Edge of Pavement
- Shoulder
- Retaining Wall
- Bridge
- Curb
- Driveway
- Sidewalk
- Concrete Barrier
- Median Barrier
- Community Facilities
- Historic Properties
- Building Takes
- Parcels
- Parks
- Contributing Features to Tremont Historic District

Feet
0 100 200
N
1 inch = 100 feet

Alternative A	8

CUY-71-18.29 SAFETY STUDY

APPENDIX B: CCG7A FEASIBILITY STUDY

CMT

OHIO DEPARTMENT OF TRANSPORTATION

CUY-71/176-17.83/12.76

PID 98063 (Cleveland Innerbelt CCG7A)

Feasibility Study

October 2017

Michael Baker INTERNATIONAL

CONTENTS

Appendices

EXECUTIVE SUMMARY

The scope of services for the CUY-71/176-17.83/12.76 CCG7A project (PID 98063) is comprised primarily of the design of a deceleration lane on Ramp J7 for the I-71 SB to the SR 176 SB movement. This project proposes only the deceleration lane work, and not to impact adjoining bridge or pavement. The intent is to procure separate construction funding, to develop a stand-alone set of construction drawings for constructing the deceleration lane. There is a potential to secure safety funding, as the interchange includes numerous on and off ramps with limited spacing, resulting in high volumes of weaving traffic and conflict points.

The project study limits were established and refined to minimize the number and magnitude of impacts on, and to avoid reconstruction of adjacent bridges and pavement. Several geometric

Figure 1-Project Area

options for the ramp geometry were explored while developing the recommended geometric configuration presented in the roadway plans. One Design Exception is necessary to avoid additional impacts. The Study identified the need for a retaining wall along the eastern edge of the proposed deceleration lane, impacting the existing high mast tower lighting.

INTRODUCTION/BACKGROUND

The Ohio Department of Transportation (ODOT) has implemented a comprehensive strategy for rebuilding and modernizing the Cleveland Innerbelt corridor. The project has been divided into Construction Contract Groups (CCG). This project is designated CCG7A, and was sub-divided from CCG7 to be designed with and constructed in advance of CCG3. The work and improvements are based upon the countermeasures developed in the Abbreviated Safety Study - April 22, 2014 (see APPENDIX RD). The work proposed by this project was reviewed through the National Environmental Policy Act (NEPA) process and documented as part of the Cleveland Innerbelt Draft Environmental Impact Statement (DEIS), Final Environmental Impact Statement (FEIS), and

Record of Decision (ROD) dated September 18, 2009, for the Cleveland Innerbelt Project, CUY-71/90-16.79/14.90, PID 77510. For this Path 2 project we anticipate the need for a Categorical Exclusion C1 document - prepared by ODOT District 12.

CCG7A includes modifications to I-71 to I-176 ramp J7, widening the pavement to introduce a decleration taper and full size lane, meeting the criteria in ODOT Location & Design Manual Vol. 1 Section 503.6.3.1 that states all deceleration should occur on the full width deceleration lane and not on the mainline.

Approximately 1,300 linear feet of retaining wall will be constructed to accommodate the installation of the deceleration ramp to I-176 SB. This will permit additional roadway capacity on the ramp, and enhance safety on both the ramp and I-71 SB by providing the required deceleration lane.

ROADWAY DESIGN

CERTIFIED TRAFFIC - IJS

See APPENDIX RD for Certified Traffic data and excerpts from the Innerbelt Interchange Justification Study, specific to this project. The results of the study's traffic analysis indicate that the proposed work result in a Level of Service (LOS) improvement. For I-71 SB (F-5), the No-Build LOS – C is in the am, F in the pm. The Build LOS – improves to B in the AM, D in the PM. The improvement on Ramp J7 (R-7) - No-Build LOS – C in the am, F in the pm. The Build LOS – improves to A in the AM, C in the PM. There is a minor improvement in the weave LOS in the PM Peak, but it remains a LOS E (W-3).

DESIGN SPEED/FUNCTIONAL CLASS

The design criteria matrix used for this project is attached in APPENDIX RD - Design Criteria Matrix.

GEOMETRY

A single Design Exception was identified in the development of the Feasibility Study. This Design Exception should be submitted to the ODOT Office of Roadway Engineering. We have also determined a geometric deficiency in the existing geometry.

The Design Exception involves **Superelevation Rate – Fig 202-10E - Ramp J7 Curve 5° 30' 00" (RT) e=0.053, existing cross slope = 0.044.** The scope of the project would need to be extended beyond the defined limits to correct this deficiency.

CUY-71/176-17.83/12.76

PID 98063 (Cleveland Innerbelt CCG7A)

Feasibility Study

October 2017

Appendices

Michael Baker
INTERNATIONAL

CUY-71/176-17.83/12.76

PID 98063 (Cleveland Innerbelt CCG7A)

Feasibility Study

October 2017

Appendix CE

OHIO DEPARTMENT OF TRANSPORTATION

Michael Baker INTERNATIONAL

CUY-71/176-17.83/12.76
PID 98063 (Cleveland Innerbelt CCG7A)
Feasibility Study Cost Estimate

Roadway		$ 295,100
Erosion Control		$ 10,200
Drainage		$ 104,700
Pavement		$ 201,900
Lighting		$ 100,000
Traffic Control		$ 4,300
Retaining Walls		$ 2,474,800
Incidentals		$ 253,000
Contingency & Inflation	30%	$ 1,033,200
TOTAL		$ 4,477,200

ITEM	From	To	Length	Width	TOTAL SF	TOTAL SY or CY	Unit $	TOTAL
	Roadway							$ 295,100.00
Clearing and Grubbing	145+91.99	161+18.06	1,526.07	48.5	74014.4			**$ -**
Pavement Removed	94+23.25	106+50.00	1,226.75	14.5	17787.88		$ 15.00	$ 29,646.46
Excavation	93+50.00	106+50.00	1,300.00		854.79	20578.278	$ 6.00	$ 123,469.67
Embankment	93+50.00	106+50.00	1,300.00		116.04	2793.556	$ 7.00	$ 19,554.89
Guardrail					100		$ 15.00	$ 1,500.00
Concrete Barrier Type D	93+50.00	106+50.00	1,300.00				$ 80.00	$ 104,000.00
Topsoil	145+91.99	161+18.06	1,526.07	10	15260.7	565.211	$ 30.00	$ 16,956.33
	Erosion Control							$ 10,200.00
Seeding and mulching	145+91.99	161+18.06	1,526.07	10	15260.7		$ 6.00	$ 10,173.80
	Drainage							$ 104,700.00
12" Conduit, Type B	94+23.25	106+50.00	1,226.75				$ 55.00	$ 67,471.25
INLET, NO. 3D					4		$ 8,500.00	$ 34,000.00
Inlet/CB Adjusted to Grade					4		$ 800.00	$ 3,200.00
	Pavement							$ 201,900.00
AGGREGATE BASE 6"	93+50.00	106+50.00	1,300.00	24	31200	577.778	$ 55.00	$ 31,777.78
ASPHALT CONCRETE BASE 10"	93+50.00	106+50.00	1,300.00	24	31200	962.963	$ 135.00	$ 130,000.00
TACK COAT, SURFACE COURSE					190.6667		$ 2.50	$ 476.67
TACK COAT, INTERMEDIATE COURSE					190.6667		$ 2.50	$ 476.67
ASPHALT SURFACE COURSE 1.5"	93+50.00	106+50.00	1,300.00	24	31200	144.444	$ 125.00	$ 18,055.56
ASPHALT INTERMEDIATE COURSE 1.75"	93+50.00	106+50.00	1,300.00	24	31200	168.519	$ 125.00	$ 21,064.81
	Lighting							$ 100,000.00
3 tower @ 30k EA + conduit10k								$ 100,000.00
	Traffic Control							$ 4,300.00
5K/mile Edge, lane, gore	145+91.99	161+18.06	1,526.07			0.867		$ 4,335.43
	Retaining Walls							$ 2,474,800.00
From Retaining Wall Justification								$ 2,135,250.00
Moment Slab								$ 339,500.00
							Subtotal	$ 3,191,000.00
	Incidentals							$ 253,000.00
MOT	3%	Construction Value						$ 95,730.00
Mobilization								$ 100,000.00
Field Office	10	Months					$ 2,500.00	$ 25,000.00
Construction Staking	1%	Construction Value						$ 31,910.00
							TOTAL	**$ 3,444,000.00**

CUY-71/176-17.83/12.76

PID 98063 (Cleveland Innerbelt CCG7A)

Feasibility Study

October 2017

Appendix RD

OHIO DEPARTMENT OF TRANSPORTATION

Michael Baker INTERNATIONAL

Michael Baker INTERNATIONAL

Designed by:	JTH	S.O. No.	142795
Checked by:	SM	Date:	3/30/2015
Reviewed by:	JMW	Date:	3/31/2015

ITEM		L & D REF SECTION	I-90 Mainline	I-71 Mainline	I-71 SB to SR-176 SB (Ramp J7)*
Highway Classification		101.2, 501.2.1	Urban Interstate	Urban Interstate	Directional Ramp
Terrain			Level	Level	
Design Speed		104.2, 503-1, 503.2	60	70	45 (MIN)
Managing Agency			ODOT	ODOT	ODOT
NHS FAP					
Current ADT - 20XX					
Design ADT - 20XX					
DHV					
Directional Distribution					
% Trucks(T24)					
TD					
Design Vehicle (LD-10)	Primary		WB-62	WB-62	WB-62
	Secondary		N/A	N/A	N/A
	Primary (Reference Link)				LD-10-1 Design Vehicle Requirements.pdf
Stopping Sight Distance		201-1E	570'	730'	360'
Horizontal Sight Distance		201-2E	Varies. Refer to Figure	Varies. Refer to Figure	Varies. Refer to Figure
Minimum passing sight distance		201-3E	1000'	1200'	700'
Intersection Sight Triangles		201-4E	N/A	N/A	N/A
Intersection Sight Distance (left/right)	Left	201-5E	N/A	N/A	N/A
	Right		N/A	N/A	N/A
Decision Sight Distance (Urban Stop) (B)		201-6E	1150'	1410'	N/A
DSD (Urban speed/path/direction change) (E)		201-6E	1280'	1445'	N/A
Max. CL deflection w/out horiz. Curve		202-1E	0º 55'	0º 45'	1º 40'
Max. Degree of Curve		202-2E	4º 15'	2º 45'	8º 00'
Max. degree of curve w/out superelevation		202-3E	0º 33'	0º 26'	5º 40'
Max. relative gradient for superelevation		202-4E	0.45	0.4	0.54
Max. superelevation rate		202-8E/202-9E/202-10E	0.06 ft/ft	0.06 ft/ft	0.06 ft/ft
Max. degree of curve w/out spiral		202-11E	3º 00'	2º 15'	N/A
Maximum Grade		203-1E, Table 503-1	3%	3%	5%
Minimum Grade		203.2.2	0.5% PRF/0.3% MIN	0.5% PRF/0.3% MIN	0.5% PRF/0.3% MIN
Critical Lengths of Grade		203-1aE	Varies. Refer to Figure	Varies. Refer to Figure	Varies. Refer to Figure
Max change in vertical alignment w/out curve		203-2E	0.30%	0.25%	0.55%
Minimum "K" value for crest vertical curve (SSD)		203-3E	151	247	61
Minimum "K" value for sag vertical curve (SSD)		203-6E	136	181	79
Maximum "K" value for all vertical curves (drainage)		AASHTO 3.4.6	167	167	167
Minimum length of vertical curve		202.3	180	210	135
Level of Service Minimum		301-1E	C or D	C or D	C or D
Lane width	minimum	301-4E / 303-1E	12'	12'	16'
	preferred		12'	12'	16'
Minimum Curbed Shoulder Width	w/o parking	301-4E	12' RT/4' Median	12' RT/4' Median	N/A
	w/ parking		N/A	N/A	N/A
	Ramps	303-1E	N/A	N/A	3' LT / 6' RT
Normal Cross Slope (Raised Median)		301-6E	0.016	0.016	0.016
Sidewalk Cross Slope (MAX)		306-2E	0.02	0.02	0.02
Criteria for new & reconst. Bridges	Horz. Clear-Lt	302-1E, 301-4E	12' + 2' to match guardrail offset	14'	4'
	Horz. Clear-Rt		12' + 2' to match guardrail offset	14'	6' + 2' to match guardrail offset
	Min Vert Clr Min	Reference the Proposed Exhbits Tab for Numbered Values PID 82380 Proposed Bridge Matrix 2014-01-31.pdf	15.5'** (9) (14)	16.5'	15.5'**
	Min Vert Clr Prf		16.0'	16.5'	16.5'
Criteria for Ex. Interstate and Other Freeway Bridge to Remain:	Horz. Clear-Lt	302-2E	3.5'	3.5'	N/A
	Horz. Clear-Rt		10'	10'	N/A
	Min Vert Clr		14.5'	14.5'	N/A
	Min Vert Clr Prf		16'	16'	N/A
Criteria for Existing Non-Freeway Bridge to Remain:	Horz. Clear-Lt	302-3E	N/A	N/A	N/A
	Horz. Clear-Rt		N/A	N/A	N/A
	Min Vert Clr		N/A	N/A	N/A
	Min Vert Clr Prf		N/A	N/A	N/A
Horz. clear. under bridge = Clear Zone Width		302-3E / 603-2E	30'	30'	N/A
Sidewalk Buffer + 2' to ROW	minimum	306-2E	N/A	N/A	N/A
	preferred		N/A	N/A	N/A
Offset from face of curb to ROW (includes buffer and walk)	minimum	306-2E	N/A	N/A	N/A
Offset from face of curb to ROW (includes walk but no buffer		307-6E	N/A	N/A	N/A
Clear Zone		600.2.2, 600-1, 302-1 (P)	See figure.	See figure.	See figure.
Terrain			Level	Level	

*** - Ramps**

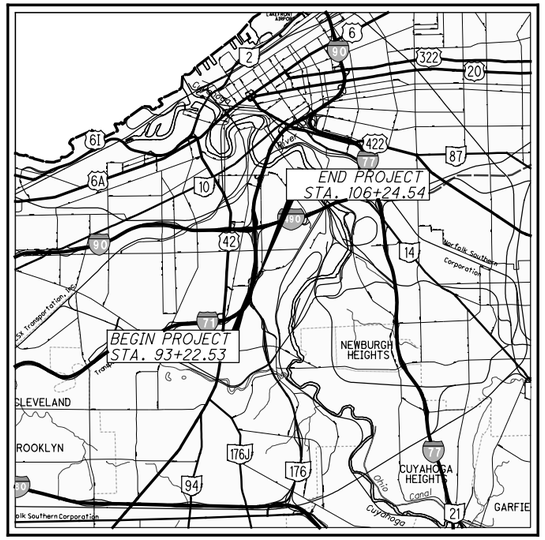
Ramp Upgrades	503.3	
Ramp Downgrades	503.3	Downgrades may exceed Table 503-1 values by 2%, but should not exceed 8%
Decision Sight Distance	201-6	
Acceleration Length on grade (3-4% grade)	503-2a, 503-2b, and 503-2c	
Minimum Deceleration Length (3-4% grade)	503-3a, 503-3b, and 503-3c	

Please note MOT requirement for offsets behind PCB/Barrier during construction. 3' for concrete and 1' for asphalt pavement.

STATE OF OHIO

DEPARTMENT OF TRANSPORTATION

CUY-77-17.83/
CUY-176-12.76
INNERBELT CONSTRUCTION
CONTRACT GROUP 7A
CITY OF CLEVELAND
CUYAHOGA COUNTY



LOCATION MAP

LATITUDE: 41°27'42" LONGITUDE: -81°41'38"

SCALE IN MILES
0 1 2 3 4

N

PORTION TO BE IMPROVED
INTERSTATE HIGHWAY
FEDERAL ROUTES
STATE ROUTES
COUNTY & TOWNSHIP ROADS
OTHER ROADS

DESIGN DESIGNATION	*I.R. 71*	*RAMP J7*
CURRENT ADT (2015)	6600	1420
DESIGN YEAR ADT (2035)	6930	1460
DESIGN HOURLY VOLUME (2035)		
DIRECTIONAL DISTRIBUTION	100	100
TRUCKS (24 HOUR B&C)		
DESIGN SPEED	60 MPH	45 MPH
LEGAL SPEED	60 MPH	N/A

DESIGN FUNCTIONAL CLASSIFICATION URBAN INTERSTATE
NHS PROJECT YES
DESIGN EXCEPTIONS SUPERELEVATION

UNDERGROUND UTILITIES
CONTACT BOTH SERVICES TWO WORKING DAYS
BEFORE YOU DIG.
OHIO Utilities Protection SERVICE
Call Before You Dig
1-800-362-2764
(Non-members must be called directly)
OIL & GAS PRODUCERS
UNDERGROUND PROTECTION SERVICE
1-800-925-0988

PLAN PREPARED BY:

Michael Baker INTERNATIONAL

1111 SUPERIOR AVENUE, SUITE 2300
CLEVELAND, OHIO 44114

ROADWAY PLANS PREPARED BY: MICHAEL BAKER INTERNATIONAL

DATE: ---

STRUCTURE PLANS PREPARED BY: MICHAEL BAKER INTERNATIONAL

DATE: ---

INDEX OF SHEETS:

STANDARD CONSTRUCTION DRAWINGS	*SUPPLEMENTAL SPECIFICATIONS*	*SPECIAL PROVISIONS*

PROJECT DESCRIPTION

SAWCUT AND WIDEN THE EXISTING I.R. 71 SOUTH BOUND LANES TO CONSTRUCT A LEFT SIDE DECELERATION LANE FOR RAMP J7 (EXIT RAMP TO S.R. 176 SOUTHBOUND) AND A PROPOSED RETAINING WALL TO SUPPORT THE LANE.

PROJECT EARTH DISTURBED AREA: *ACRES*
ESTIMATED CONTRACTOR EARTH DISTURBED AREA: *ACRES*
NOTICE OF INTENT EARTH DISTURBED AREA: *ACRES*

LIMITED ACCESS

THIS IMPROVEMENT IS ESPECIALLY DESIGNED FOR THROUGH TRAFFIC AND HAS BEEN DECLARED A LIMITED ACCESS HIGHWAY OR FREEWAY BY ACTION OF THE DIRECTOR IN ACCORDANCE WITH THE PROVISIONS OF SECTION 5511.02 OF THE OHIO REVISED CODE.

2016 SPECIFICATIONS

THE STANDARD SPECIFICATIONS OF THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, INCLUDING CHANGES AND SUPPLEMENTAL SPECIFICATIONS LISTED IN THE PROPOSAL SHALL GOVERN THIS IMPROVEMENT.

I HEREBY APPROVE THESE PLANS AND DECLARE THAT THE MAKING OF THIS IMPROVEMENT WILL NOT REQUIRE THE CLOSING TO TRAFFIC OF THE HIGHWAY AND THAT PROVISIONS FOR THE MAINTENANCE AND SAFETY OF TRAFFIC WILL BE AS SET FORTH ON THE PLANS AND ESTIMATES.

UNDER AUTHORITY OF SECTION 4511.21, DIVISION (H) OF THE OHIO REVISED CODE, THE REVISED PRIMA FACIE SPEED LIMITS AS INDICATED HEREIN ARE DETERMINED TO BE REASONABLE AND SAFE, AND ARE HEREBY ESTABLISHED FOR THE DURATION OF THIS PROJECT. THE PRIMA FACIE SPEED LIMIT OF LIMITS HEREBY ESTABLISHED SHALL BECOME EFFECTIVE WHEN APPROPRIATE SIGNS GIVING NOTICE THEREOF ARE ERECTED.

APPROVED _____
DATE _____ *DISTRICT DEPUTY DIRECTOR*

APPROVED _____
DATE _____ *DIRECTOR, DEPARTMENT OF TRANSPORTATION*

FEDERAL PROJECT NO. **E070 (501)**
PID NO. **98063**
CONSTRUCTION PROJECT NO. **CUY-71-17.83/ CUY-176-12.76**
RAILROAD INVOLVEMENT **NONE**

...\Roadway\sheets\82378GT0001.dgn 10/5/2017 7:57:31 AM SMilroy

METRO HEALTH HOSPITAL

EGLINDALE AVE.

SOUTHPOINT DR.

VALENTINE AVE.

CLOVER AVE.

CORNING AVE.

BRAINARD AVE.

HOLMDEN AVE.

VIEW RD.

W. 17TH

W. 14TH ST.

I.R. 71 NB

I.R. 71 SB

RAMP SBOR-M

S.R. 176

STEEL YARD COMMONS

BEGIN WORK
℄ SB I.R. 71
STA. 163+00.00

BEGIN PROJECT
℄ SB I.R. 71
STA. 161+18.06, 0.0' LT
℄ RAMP J7
STA. 93+22.53, 0.00' LT
SLM XX.XX

E(070) 501

STA. 160+18.06 ℄ SB I.R. 71 12.0' RT =
STA. 94+23.25 ℄ RAMP J7 0.0'

END WORK
℄ SB I.R. 71
STA. 145+91.99, 36.33' RT
℄ RAMP J7
STA. 110+00.00, 26.14' RT

END PROJECT
℄ SB I.R. 71
STA. 148+16.78, 19.26' RT
℄ RAMP J7
STA. 106+25.54, 6.00' LT
SLM XX.XX

E(070) 501

CURVE 101
℄ RAMP J7
P.I. Sta. 111+45.42
Δ= 54° 10' 50" (LT)
Dc = 5° 30' 00"
R = 1,041.74'
T = 532.86'
L = 985.10'
E = 128.37'
e = 0.053

CURVE 102
℄ RAMP J7
P.I. Sta. 100+90.86
Δ= 1° 25' 24" (RT)
Dc = 0° 47' 00"
R = 7,314.35'
T = 90.85'
L = 181.70'
E = 0.56'
e = 0.022

CURVE 103
℄ SB I.R. 71
P.I. Sta. 140+68.97
Δ= 29° 43' 32" (LT)
Dc = 3° 00' 00"
R = 1,909.86'
T = 506.84'
L = 990.85'
E = 66.11'
e = 0.055

CURVE 104
℄ SB I.R. 71
P.I. Sta. 147+36.97
Δ= 5° 30' 56" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 184.00'
L = 367.71'
E = 4.43'
e = 0.037

CURVE 105
℄ SB I.R. 71
P.I. Sta. 153+34.45
Δ= 2° 08' 15" (LT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 106.88'
L = 213.74'
E = 1.00'
e = 0.027

PCC Sta. 145+52.97

CURVE 103

CURVE 104

PT Sta. 149+20.69

PC Sta. 152+27.57

CURVE 105

PT Sta. 154+41.31

PC Sta. 165+80.77

EX. HIGH MAST LIGHT

CURVE 101

PC Sta. 106+12.56

EX. HIGH MAST LIGHT TO BE REPLACED

PT Sta. 101+81.70

PC Sta. 100+00.00

CURVE 102

EX. HIGH MAST LIGHT TO BE REPLACED

PI Sta. 94+23.25

EX. HIGH MAST LIGHT (TO BE DETERMINED)

PT Sta. 115+97.66

POT Sta. 116+64.46

S 42° 22' 55" E

N 12° 30' 45" E

S 11° 47' 55" W

N 10° 22' 31" E

S 10° 22' 31" W

S 03° 31' 57" W

105 110 115 145 150 155 160 165 95 100

HORIZONTAL SCALE IN FEET
0 50 100 200

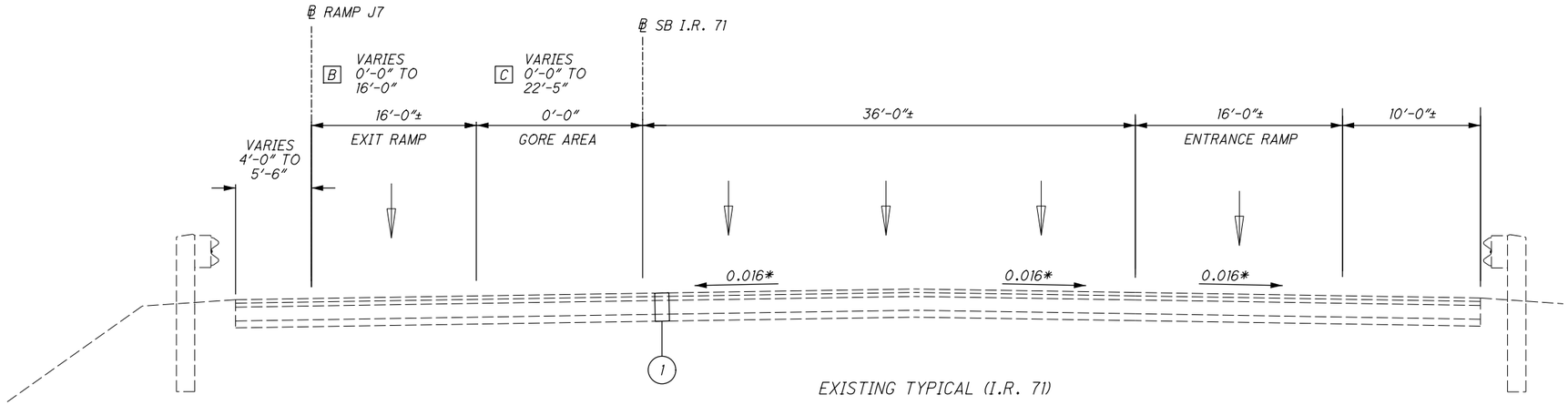
SCHEMATIC PLAN

CUY-71-17.83/
CUY-176-12.76

...\Roadway\sheets\82378GB0001.dgn 10/5/2017 7:57:39 AM SMilroy

(1) 10" REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT SUBBASE, GRADING "A" OR "B", WITH WEARING SURFACE

(2) 9" REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT SUBBASE, GRADING "A" OR "B", WITH WEARING SURFACE



EXISTING TYPICAL (I.R. 71)

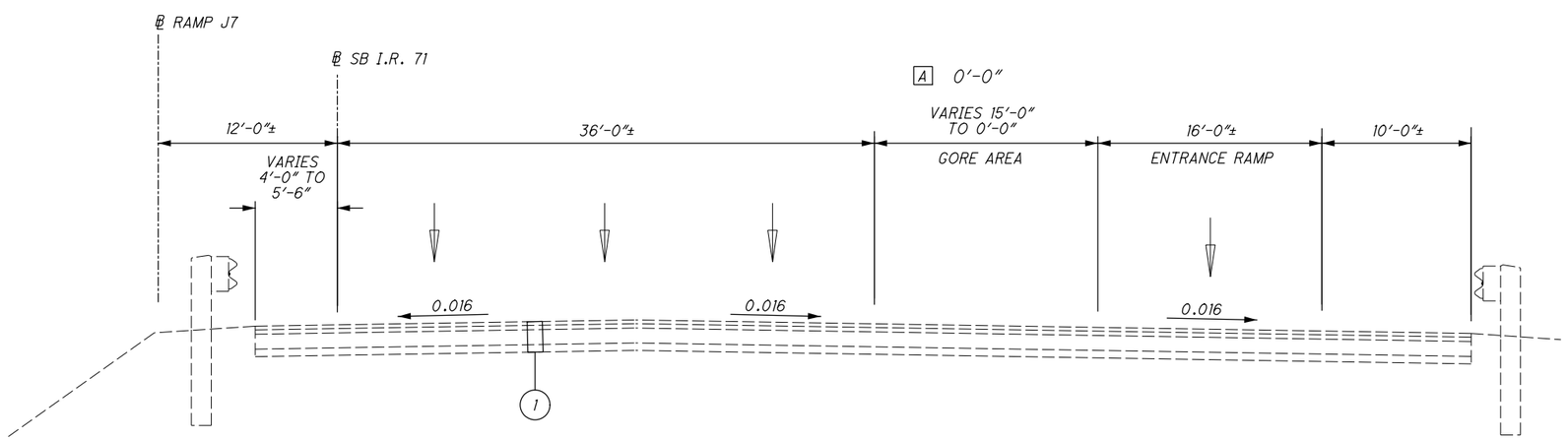
STA. 100+50.00 TO 107+62.87

A STA. 98+76.00 TO STA. 100+50.00

B STA. 100+50.00 TO STA. 107+62.87

C STA. 105+88.23 TO STA. 107+62.87

* - SUPERELEVATED SECTION STARTS APPROX. STA. 103+50, TRANSITION FROM 1.6% N.C. TO 3.7%

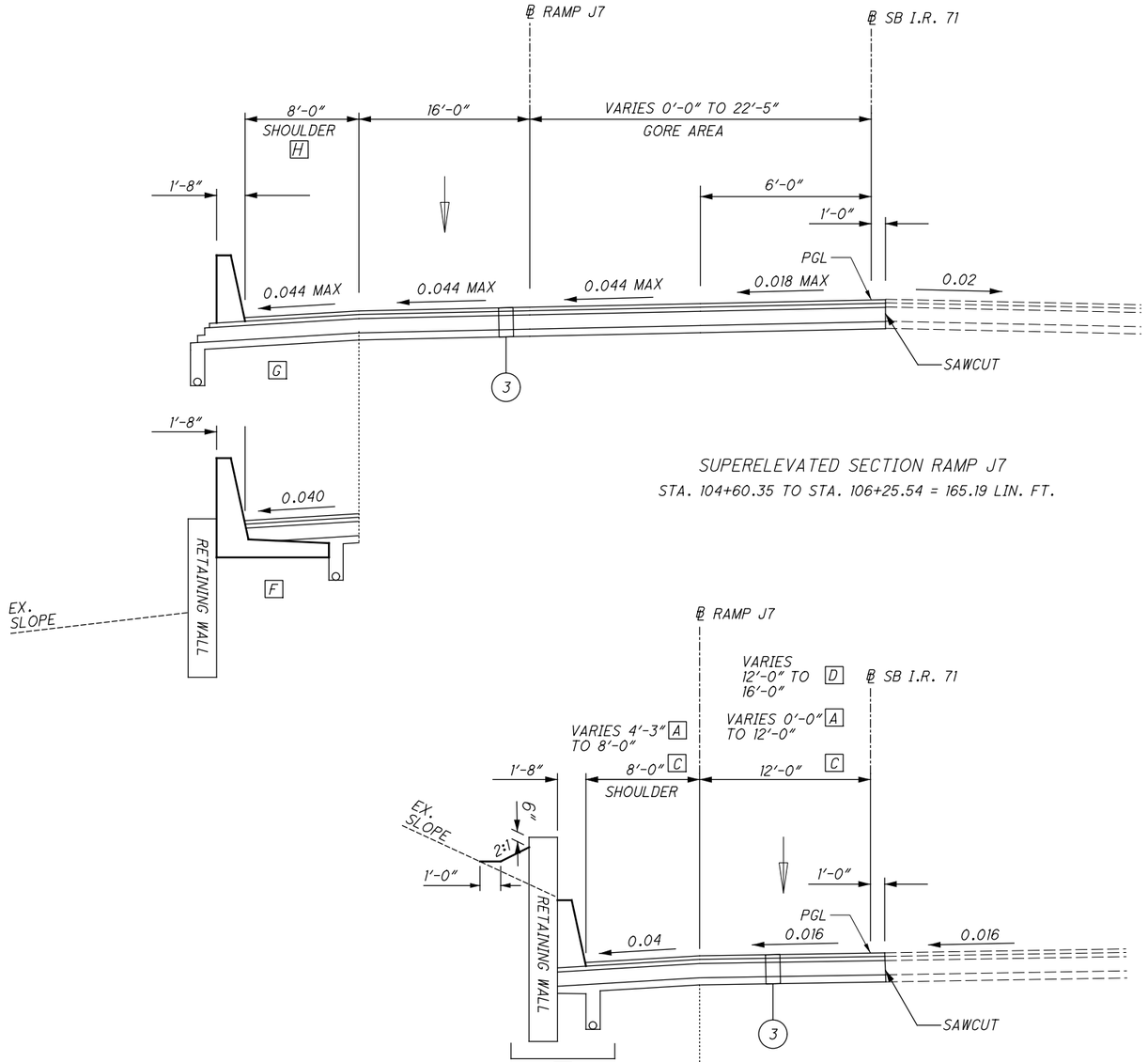


EXISTING TYPICAL (I.R. 71)

STA. 93+22.53 TO STA. 100+50.00

EXISTING TYPICAL SECTIONS

CUY-71-17.83/
CUY-176-12.76



SUPERELEVATED SECTION RAMP J7

STA. 104+60.35 TO STA. 106+25.54 = 165.19 LIN. FT.

NORMAL SECTION - RAMP J7

STA. 93+22.53 TO STA. 104+60.35 = 1,137.82 LIN. FT.

(3) ITEM 443 - 1-1/2" STONE MATRIX ASPHALT CONCRETE, 12.5MM, PG 70-22M (446)
ITEM 407 - TACK COAT FOR INTERMEDIATE COURSE
ITEM 442 - 1-3/4" ASPHALT CONCRETE INTERMEDIATE COURSE 19MM, TYPE A (446)
ITEM 407 - TACK COAT
ITEM 302 - 8" ASPHALT CONCRETE BASE
ITEM 304 - 6" AGGREGATE BASE
ITEM 204 - SUBGRADE COMPACTION

[A] STA. 93+22.53 TO STA. 94+23.25
[B] STA. 94+23.53 TO STA. 94+60.00
[C] STA. 94+23.53 TO STA. 100+00.00
[D] STA. 100+00.00 TO STA. 104+60.35
[E] STA. 94+60.00 TO STA. 104+60.35
[F] STA. 104+60.35 TO STA. 105+50.00
[G] STA. 105+50.00 TO STA. 106+25.54
[H] STA. 105+50.00 TO STA. 106+00.00

PROPOSED TYPICAL SECTIONS

CUY-71-17.83/
CUY-176-12.76

CURVE 101
℄ RAMP J7
P.I. STA. 111+45.42
Δ= 54° 10′ 50″ (LT)
Dc = 5° 30′ 00″
R = 1,041.74′
T = 532.86′
L = 985.10′
E = 128.37′
e = 0.053

CURVE 104
℄ SB I.R. 71
P.I. STA. 147+36.97
Δ= 5° 30′ 56″ (LT)
Dc = 1° 30′ 00″
R = 3,819.72′
T = 184.00′
L = 367.71′
E = 4.43′
e = 0.037

S.R. 176 NORTHBOUND

I.R. 71 NORTHBOUND

PC Sta. 106+12.56

℄ RAMP J7

MATCH BARRIER

CONSTRUCTION LIMITS

STA. 106+25.54
7.7′ LT.

CURVE 101

16.0′

16.0′

106

SAWCUT

℄ SB I.R. 71

RAMP J7

107

108

148

STA. 106+25.54
20.6′ RT.

I.R. 71 SOUTHBOUND

CURVE 104

147

146

HORIZONTAL SCALE IN FEET
0 5 10 20

CALCULATED JTH
CHECKED -

RAMP TERMINAL DETAIL
RAMP J7

CUY-71-17.83/
CUY-176-12.76

30
30

...\Roadway\sheets\82378GI6701.dgn 10/5/2017 7:58:34 AM SMilroy

ABBREVIATED STUDY			
District: 12	County: Cuyahoga	Route: SR 176	Section: 13.73-13.83
CUY-176-13.73-13.83 **2011 HSP # 43 (Urban Non-Freeway)** Prepared April 22, 2014 By Bryan Emery			

Existing Conditions

The study location is a 0.1 mile section of SR 176 at the interchange with I-71 NB/SB, I-90 WB/EB, and I-490 EB. The identified study limits are the northern-most identified logpoints on SR-176, therefore many crashes on these ramps and merge/diverge areas are logged to the study area by default. SR 176 is classified as an Urban Principal Arterial – Other Freeway/Expressway and posted for 60 MPH.

Figure 1- Map of SR 176 – Study Location and 176/71 SB Split

The interchange includes numerous on and off ramps with limited spacing, resulting in high volumes of weaving traffic and conflict points. The interchange is also included in the alternate route plan for the construction of the Innerbelt Bridge, further reducing capacity and increasing congestion.

Crash Information

A query on these log points identified 25 crashes that occurred within the study limits from 2009-2011. All crashes were reviewed and hand logged revisions were made where needed. Eighteen crashes were mis-logged and occurred on ramps or I-71. All crashes were analyzed to determine any trends throughout the interchange. The following tables represent the breakdown of total number of crashes per year, type of crash, road condition, day of the week, and time of day.

TRAFFIC CRASH YEAR	Number	%
2009	**9**	36.0%
2010	**6**	24.0%
2011	**10**	40.0%
Grand Total	**25**	**100.0%**

TYPE OF CRASH	Number	%
Fixed Object	**12**	48.0%
Sideswipe - Passing	**6**	24.0%
Rear End	**6**	24.0%
Overturning	**1**	4.0%
Grand Total	**25**	**100.0%**

ROAD CONDITION	Number	%
Road - Dry	**12**	48.0%
Road - Wet	**7**	28.0%
Road - Snow	**5**	20.0%
Road Condition Not Stated	**1**	4.0%
Grand Total	**25**	**100.0%**

DAY OF WEEK	Number	%
Friday	**6**	24.0%
Wednesday	**5**	20.0%
Tuesday	**4**	16.0%
Monday	**3**	12.0%
Saturday	**3**	12.0%
Thursday	**3**	12.0%
Sunday	**1**	4.0%
Grand Total	**25**	**100.0%**

HOUR OF DAY	Number	%
1	**1**	4.0%
2	**2**	8.0%
4	**1**	4.0%
5	**1**	4.0%
7	**1**	4.0%
8	**3**	12.0%
11	**1**	4.0%
12	**1**	4.0%
13	**1**	4.0%
15	**2**	8.0%
16	**1**	4.0%
17	**1**	4.0%
18	**4**	16.0%
19	**1**	4.0%
20	**2**	8.0%
23	**2**	8.0%
Grand Total	**25**	**100.0%**

Safety History

Rank	Year	List	Segment
#43	2011	Urban Non-Freeway	13.73 – 13.83
#3	2011	Congestion	13.24 – 13.83
#1	2010	Congestion	13.74 – 13.83
#9	2009	Congestion	13.74 – 13.83

Other Studies

Michael Baker Jr. recently completed a Traffic Flow Evaluation on the SR-176/I-90/I-71/I-490 interchange in August 2013. The study investigated potential queuing in the PM peak on the I-90 EB/I-490 WB to SR-176/I-71 SB merge. A weave analysis of the area resulted in LOS F with a v/c ratio of 1.213. The study also investigated dangerous driver behavior, which involved merging onto I-71 SB and across three lanes of traffic to exit onto SR-176 SB in order to avoid the queue. Despite these operational issues, no quick fixes were recommended due to their potential effect on other sections of the interchange and freeways.

Probable Causes

Overall, fixed object crashes were the most frequent in the study area, with 48% (12 crashes). Sideswipe-passing and rear-end crashes accounted for 24% each (6 crashes), which are not unusual in segments and interchanges with capacity deficiencies. Nearly half of all crashes occurred in either wet or snow-covered pavement conditions (28% and 20% respectively), suggesting a lack of skid resistance may be a contributing factor. Both 8-9 AM and 6-7 PM saw a slight increase in crash frequency (3 crashes and 4 crashes respectively). Seven crashes (28%) occurred during the overnight hours (11 PM – 5 AM) suggesting sleep impaired/inattentive drivers combined with poor night visibility may be contributing factors.

A breakdown of crashes on each of the ramps is as follows:

- I-71 SB to SR-176 SB: 8 Crashes (32%)
- I-90 EB to SR-176 SB: 3 Crashes (12%)
- SR-176 to I-90WB/I-490EB: 2 Crashes (8%)

An additional four crashes (26%) occurred on I-71 between the SR-176 merge and SR-176 exit. The remaining seven crashes (28%) occurred on SR-176 at the I-71 NB/I-90 EB exit ramp.

Of the eight crashes on the I-71 SB to SR-176 SB exit ramp, seven (88%) were fixed object and one was sideswipe-passing. Four of the crashes (50%) cited slipping on snow/ice conditions when entering onto the ramp. The remaining four crashes (50%) involved reckless drivers merging or travelling too fast

while attempting to exit. The exit ramp has a posted advised speed of 45 MPH. Almost 38% (3 crashes) involved injuries. Currently the I-71 SB exit ramp is a left-exit without a deceleration lane, and instead develops with a gradual taper. The left-exit may therefore result in a potentially dangerous difference in speed between traffic travelling in the high speed lanes of I-71 and slowing traffic attempting to exit onto SR-176 at the advised 45 MPH speed. Drivers may also tend to exit at an unsafe speed for the curve after travelling between 60 to 65 MPH on I-71 due to the lack of deceleration distance or advance warning of the 45 MPH advisory speed. The current placement of the advisory sign appears to be behind a light pole and overhead sign support, which may obstruct its visibility for drivers attempting to exit.

Figure 2- I-71 SB to SR-176 Exit Ramp (SLM 18.04) (July 31, 2012)

Of the four crashes on I-71, three (75%) involved wet pavement conditions. One crash involved an erratic driver attempting to merge across all three lanes to exit onto SR-176 SB.

Of the seven crashes on SR-176, four (50%) involved congested traffic northbound near the I-71 NB/I-90 EB exit ramp.

Countermeasures

The study performed by Michael Baker Jr. evaluated a proposed restriping of the I-90 EB ramp as an add-lane onto SR-176, but did not recommend it due to the minimal improvements and potential safety concerns at the resulting merge closer to Valentine Rd. PID 21810 resurfaced I-71 with a 50% slag pavement treatment in Fall 2013, which should increase skid resistance in the study area. Other sections of SR-176 within the study area were resurfaced in 2013 as part of the Innerbelt Bridge Project. Pavement markings and raised pavement markers were also improved, which may increase visibility at night and in heavy rain.

The following additional countermeasures should be considered for improving this interchange:

Short Term

- Perform a ball bank study on the I-71 SB exit ramp to SR-176 to determine whether the 45 MPH advisory speed is appropriate.
- Review speed advisory sign placement on the I-71 SB exit ramp to SR-176, and consider relocating or supplementing.
- Continue to monitor crash trends throughout the Innerbelt Project alternate route plan.

Medium Term

- Consider a detailed study of the entire corridor, including all ramps and segments of the SR-176, IR-71, IR-90, and IR-490 interchange after the alternate route plan is no longer in effect.
- Consider installing an impact attenuator and guardrail at the nose of the I-71 SB to SR-176 SB exit ramp to help mitigate injury crashes.
- Consider providing a deceleration lane for the left-exit I-71 SB to SR-176 exit ramp.

Implementation Plan

No easy solutions exist for fundamental congestion problems and complex interchange configurations. Continue to monitor the interchange throughout the Innerbelt Bridge construction and temporary traffic conditions. Construction is expected to be complete in 2016. As data becomes available after the alternate route plan is no longer in effect, consider a detailed study of the entire interchange.

CUY-71-18.29 SAFETY STUDY

APPENDIX C: TRAFFIC FLOW STUDY (NOV 2014)

Project Description

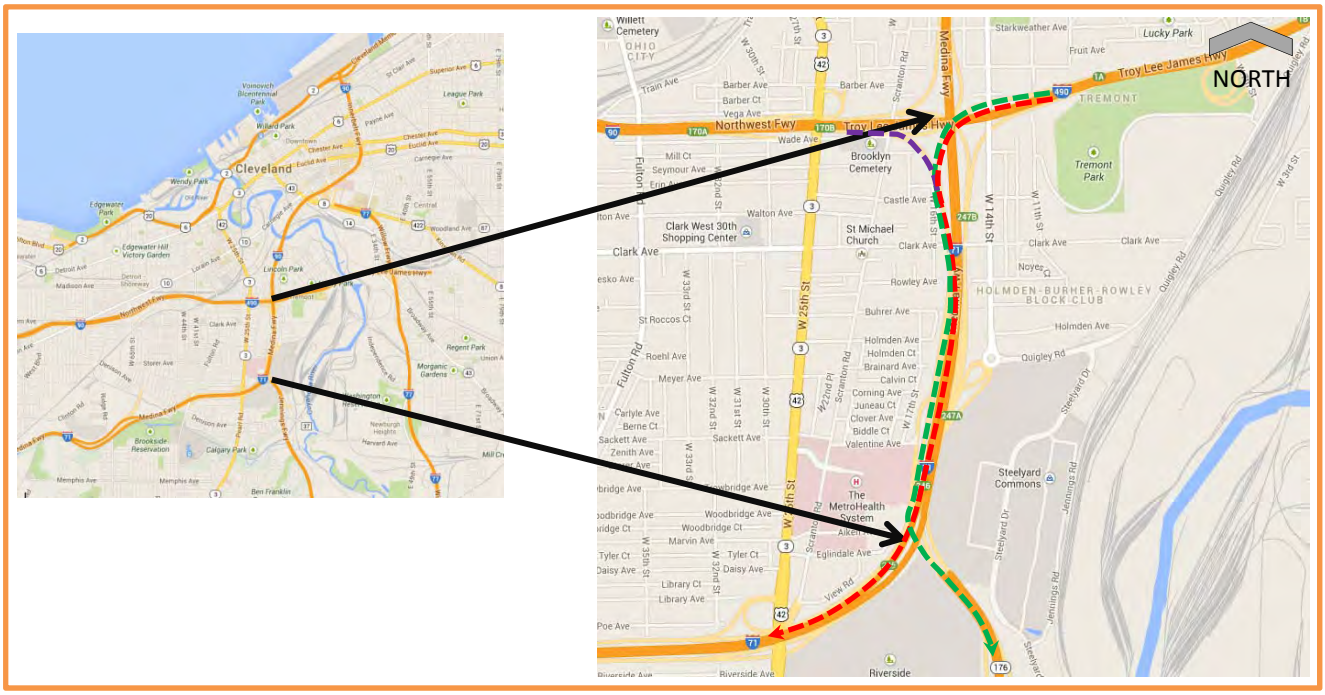
Michael Baker Jr., Inc. (Baker) was requested by ODOT District 12 to evaluate traffic conditions at the roadway section from the I-490 ramps to I-71 southbound and SR-176. The current configuration consists of one lane from I-90 eastbound that merges into two lanes from I-490 westbound. The left lane exits to I-71 southbound and the right lane proceeds to SR-176. Due to construction of the Innerbelt Bridge project, which is anticipated to continue through 2016, this area is anticipated to experience continued congestion as a component of the westbound alternate route plan (WARP).

There are two concerns regarding the movement of traffic through this area. The primary concern is the potential for a queue to develop from the I-90 eastbound merge onto the I-490 westbound ramps to I-71 southbound or SR-176. A queue from the merge could back-up onto mainline I-90 eastbound and interfere with mainline as well as adjacent interchange traffic.

The secondary concern for the area is that motorists have been observed merging onto I-71 southbound, crossing three lanes of traffic to exit I-71 at the left diverge to SR-176. This movement is considered difficult both to the motorists attempting the movement as well as other motorists in the area.

Exhibit 1 shows a location map of the area being evaluated.

Exhibit 1: Project Location



A memorandum dated August 15, 2013, was submitted to ODOT to document the findings of the analysis. Traffic data for that analysis was comprised of a variety of sources and included assumptions regarding the origin-destination of traffic within the weave area. Following that analysis, ODOT authorized Baker to collect new count and origin-destination data and re-analyze the weave area. This memorandum documents the findings of that data collection and analysis effort.

Data Collection Update

The previous analysis was based primarily on traffic data was collected at stations 87618, 87718, and 107118, which were counted June 24 – 26, 2013. The resultant PM peak hour traffic volumes that were presented are displayed in **Exhibit 2**. Count data was not available for the ramp to I-71 southbound, so assumptions were made based on downstream volumes in order to estimate volumes for the I-71 southbound ramp as well as the SR-176 ramp. The estimated volumes are shown in red on **Exhibit 2**. For analysis purposes, weave volumes were also estimated based on the downstream resultant volumes and the existing split of volumes in lane #1 and lane #2 on the I-490 westbound ramp. The weave volumes from the IMS were reviewed and it was determined that the splits that were used in the IMS did not fit the most-recent count data.

To update the analysis with more recent and complete count data, Miovision technology was utilized to collect traffic volume data and origin-destination data. Data collection occurred on March 6, 2014 (Thursday) and March 7, 2014 (Friday) from 2:00 PM to 6:00 PM. Three locations were identified as "origins"; 41st Street on-ramp to I-90 EB (site A), I-90 EB ramp to I-71 SB (site B), and I-490 WB ramp to I-71 SB (site C). Destination vehicles were observed at the ramp to SR 176 SB (site D). There was significant variability in the hourly origin-destination data for the March 6, 2014, which potentially indicates an issue with traffic flow during that period. The March 7, 2014 data was more consistent from hour to hour. To further validate the results of the origin-destination data, Baker conducted field observations on November 19, 2014. The field observations confirmed the origin-destination study data from March 7, 2014. **Exhibit 2** was updated to display the new traffic count data, based on the March 7, 2014, 4:00 PM peak hour values. The OD Study is included as an attachment to this document.

The initial analysis assumed 60% of the traffic from the I-90 EB ramp was destined for SR-176. The March 2014 origin-destination study showed that 86% of the traffic from the I-90 EB ramp was destined for SR-176. Similarly, the initial analysis assumed 40% of the traffic from the I-490 WB ramp was destined for SR-176. The March 2014 OD study showed that 29% of the traffic from I-490 WB was destined for SR-176. **Exhibit 3** illustrates the origin of the traffic destined for the SR 176-SB ramp during the March 7, 2014 PM Peak Hour.

Exhibit 2: PM Peak Hour Traffic Volumes

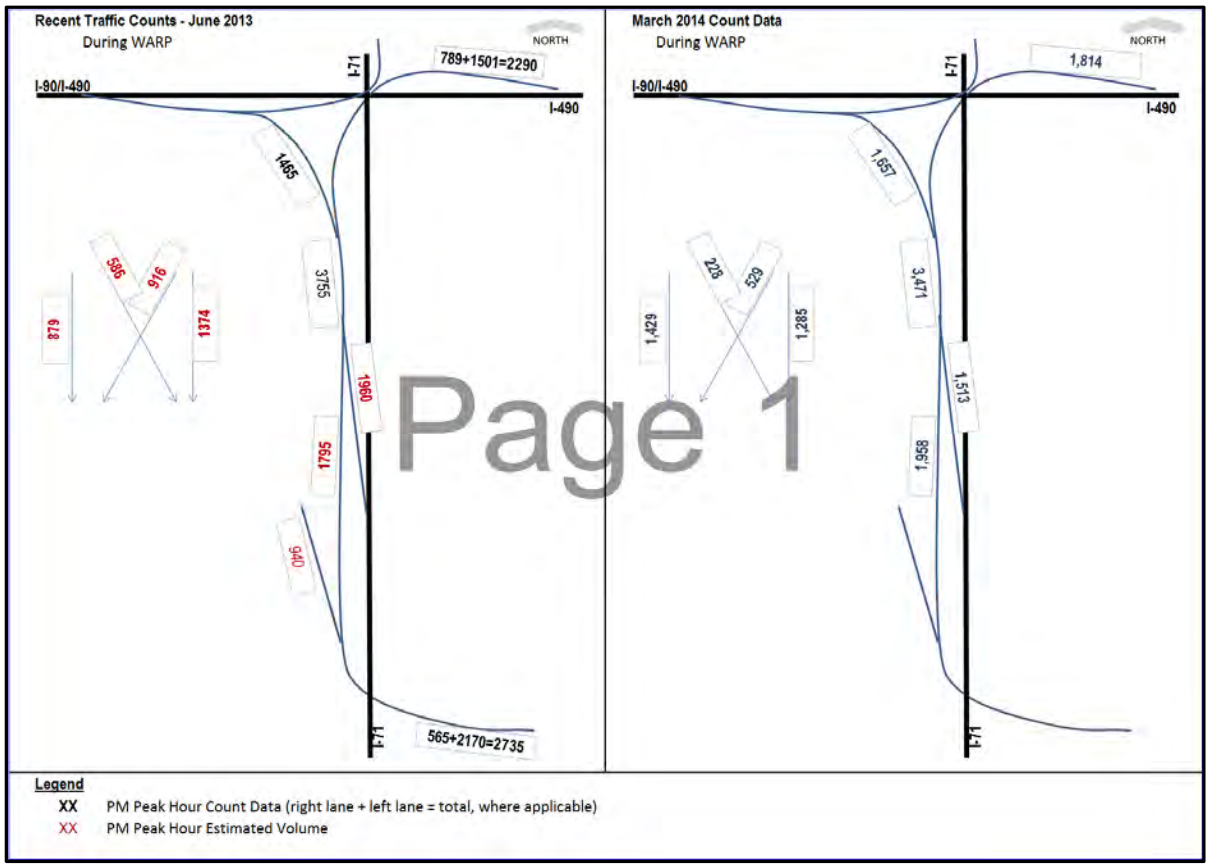
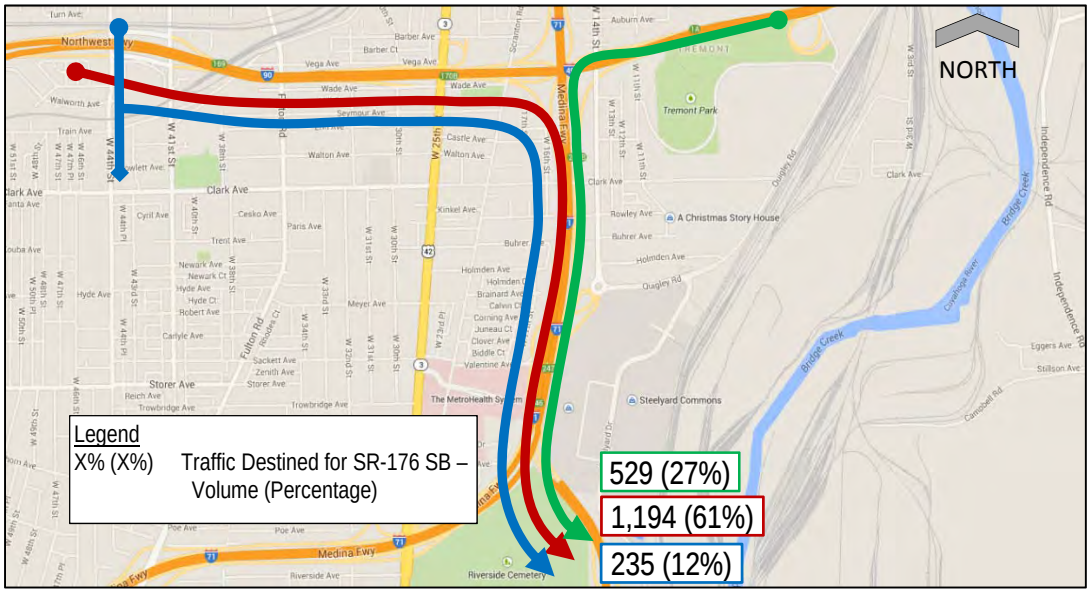


Exhibit 3: SR-176 Southbound Ramp O-D Study Results



Analysis Update

The previous analysis was updated to reflect the March 2014 traffic volumes. The existing condition was analyzed as a two-sided weaving segment (single-lane on-ramp closely followed by a single-lane off-ramp on the opposite side of the freeway). This configuration assumes the I-490 westbound to SR-176 southbound movement is defined as the "freeway" and the I-90 eastbound and I-71 southbound are defined as "ramps". From a physical "freeway" perspective, this seems somewhat counter-intuitive, but it more appropriately captures the operational "weave" from I-90 eastbound. The results of the HCS Weave Analysis are included as an attachment. The results of the Weave Analysis indicate a LOS F with a weaving segment v/c ratio of 1.080. The analysis of the 2013 volumes resulted in a weaving segment v/c ratio of 1.213.

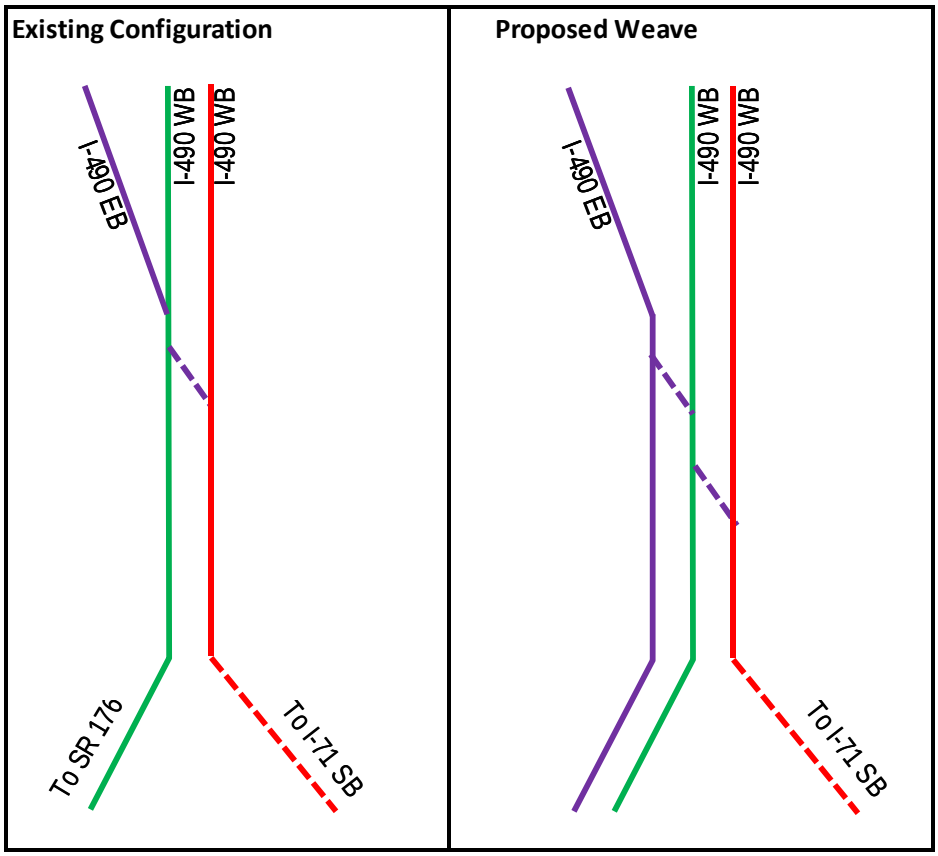
A proposed configuration was considered to reconfigure the I-90 eastbound ramp to an add lane onto SR-176. The SR-176 ramp would be restriped to accommodate two lanes, which would merge into a single lane prior to the intersection with the Valentine Ramp. This configuration is presented in **Exhibit 4**. Traffic destined for SR-176 would remain in the I-90 eastbound ramp lane, but traffic destined for I-71 southbound would be forced to merge across the rightmost I-490 westbound ramp lane to reach the leftmost lane to merge onto I-71 southbound. This movement would require two lane changes, instead of the one lane change under existing conditions. The HCS Weave Analysis was also conducted for this proposed configuration as a two sided weave condition. The results of the analysis are included as an attachment. The proposed configuration operates at an LOS E, with a weave density of 37.8 pc/mi/ln and a weaving segment v/c ratio of 0.720. **Table 1** summarizes the analysis results for both the 2013 and 2014 volumes.

Table 1: Summary of LOS Results

Data Utilized in Analysis	Existing Condition		Proposed Condition	
	Level of Service	v/c	Level of Service	v/c
March 2014 Data	F	1.080	E	0.720
June 2013 Data	F	1.213	E	0.808

Operationally, the proposed configuration performs better, but only marginally better at the I-90 eastbound and I-490 westbound ramp interchange, however it potentially introduces additional safety concerns at the point where the two SR-176 ramp lanes would need to merge to a single lane, just prior to the intersection with Valentine Road. As discussed in the following section, capacity is also an issue when the SR-176 ramp would reduce back to a single lane.

Exhibit 4: Existing and Proposed Lane Configuration



Additional Option – Remove access to I-71 SB from I-90 EB

Another option was considered given that the weave analysis operates at LOS E with the updated traffic volumes. Physically barricading the I-90 EB to I-71 SB movement was examined. This essentially removes the weaving condition. The existing condition of two lanes within the analysis area was examined. It is assumed that the I-490 WB traffic would be funneled into two separate lanes shortly after the I-490 WB ramp diverge point near the I-490 WB mainline. The condition would create a merge condition in which the I-90 EB single-lane traffic (1429 vph) would merge with the I-490 WB single-lane traffic (529 vph). The I-490 WB to I-71 SB traffic (1,285 vph) would not mix with the other traffic. It is assumed that the current I-90 EB to I-71 SB traffic (228 vph) would utilize alternative routes such as W. 25th Street.

This condition cannot be directly analyzed using HCS since the ramp analysis module does not allow for a single lane merge with a single lane mainline, thus **Table 2** shows a capacity check. The results show that the single-lane ramps leading to the SR-176 SB are under capacity,

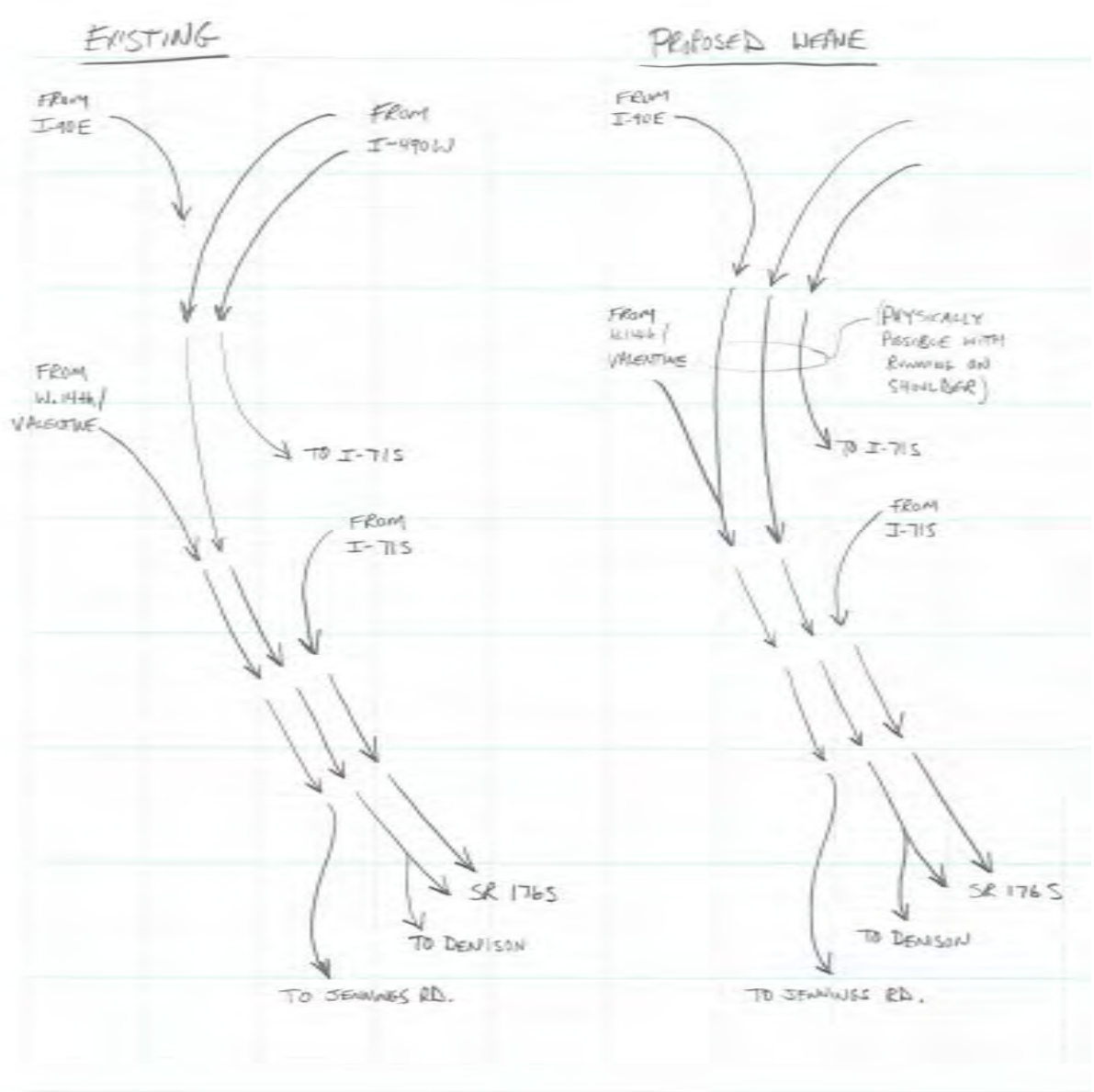
however the combination of the two movements into the SR-176 SB ramp volume of 1,958 vph is over capacity. This capacity issue also exists under the weave analysis discussed previously in the memorandum. The Ideal Capacity reported in the table (2,000) is based on the ideal of a single lane ramp roadway, with an assumed FFS of >30-40 mi/hr (HCM Exhibit 13-10). Due to the complex geometry and ramp movements present, the capacity may be even lower.

Table 2: Additional Option Capacity Check

Location	Condition				Ideal Capacity (pcphpl)	Over or Under?
	PM Peak Hour	Truck Percent.	Terrain	Passenger Car Equivalents		
I-90 EB Ramp to SR-176 SB	1,429	8%	Level	1,486	2,000	Under
I-490 WB Ramp to SR-176 SB	529	8%	Level	550	2,000	Under
SR-176 SB Ramp (Combined)	1,958	8%	Level	2,036	2,000	Over
I-490 WB to I-71 S	1,285	8%	Level	1,336	2,000	Under

This analysis revealed that the volume exceeds the capacity on the ramp to SR-176. As SR-176 continues, there are multiple complex movements that may further add to the congestion. **Exhibit 5** displays the existing movement configuration for the traffic moving through interchange along SR-176, from the I-90 EB/I-490 WB interchange to the Denison Road off-ramp. In approximately 0.8 mile, there are four access points that require or allow lane changes on SR-176 (right add lane from W. 14th/Valentine, left add lane from I-71 SB, right drop lane to Steelyard Drive, and right diverge to Denison Road.). These add and drop lanes force motorists to make multiple lane changes.

Exhibit 5: Existing and Proposed Lane Configuration, through SR-176 interchange to Denison Road interchange



One constant of all analyses run on this section of freeway is that the single lane to SR-176 is consistently at or over capacity, regardless of the upstream lane usage. The potential lane change scenario shown above in **Exhibit 5** ("Proposed Weave") utilizes the proposed lane configuration described in **Exhibit 4** (adding a third lane through the weave segment) and converts the West 14th/Valentine on-ramp from an add ramp to a merge. This adds additional

capacity to SR-176, potentially relieving congesting and queuing on SR-176. An additional variable to consider is whether dropping a lane at Jennings Rd. or forcing the traffic from I-71 S to merge into two through lanes of SR-176S is the appropriate treatment here.

Baker proposes additional analysis described below (that can be accomplished within our currently authorized fee) be considered to investigate potential improvements in this area, south of the current study area.

Conclusions

Operational issues currently exist in the area of the I-90/I-490/SR-176/I-71 interchange. The updated traffic count and origin-destination data support the analysis conducted previously. **The critical point in the corridor appears to be the ramp from I-90E/I-490W to SR-176 S. This ramp is shown to be over capacity in every analysis scenario.**

During the previous analysis, one primary option was considered which would only require restriping of existing pavement. This option involved reducing the I-490 WB ramp from 2 lanes to 1 lane prior to weave area, allowing for the I-90 EB ramp to enter the weave area as a lane addition. It was determined that a capacity issue would result at the lane reduction point which could potentially queue back to the I-490 WB mainline. **This option is still considered not feasible based on a comparison of the 2014 and 2013 traffic volumes**. It would likely just push the congestion point north to I-490 without solving the overall issue.

The previous analysis also included field observations, as follows, which are still relevant:

1) There is minimal or obstructed signage indicating the merge from the I-90 EB ramp with the I-490 WB ramp, thus creating an unexpected merge situation given the speed and fluid movement of the I-90 EB ramp.
2) On the SR-176 ramp, the vertical high point just before the Valentine Road traffic merge point seems to create an issue for motorists in which they tend to hit their brakes.

One likely improvement to operations in the area would be enhanced signage, thus a signing plan should be examined further. A safety assessment is also recommended to validate the lane change issues that are suspected. Sideswipe crashes are often associated with the merge and lane change movements seen through this corridor, and a study to validate this may be prudent.

One option that is feasible is restriping the corridor to add a third lane as described in the "Proposed Weave" shown in **Exhibit 4** and **Exhibit 5**. If further analysis supports furthering the "Proposed Weave" option, shoulders would need to be evaluated for their ability to carry

traffic, but horizontal clearance through this portion of the corridor appears to accommodate a third lane with minimum 6' shoulders
Baker proposing the following next steps:

1. Perform additional traffic counts south of the study area of this memo, extending south to the exit to Denison Avenue.
2. Baker to analyze the "Proposed Weave" shown in **Exhibit 5**.
3. Baker to analyze the "Proposed Weave" shown in **Exhibit 5** considering additional modifications, such as removing the drop to Jennings Road by left merging I-71S ramp on to SR-176S or continuing three lanes of SR-176 south beyond the Jennings Road exit, dropping the rightmost lane at Denison Road.

Baker can perform the work described above with funds remaining from currently authorized traffic task orders, but we would like to discuss with ODOT District 12 prior to proceeding.

Attachment B – Analysis Worksheets

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ljd
Agency/Company	Michael Baker Jr., Inc.
Date Performed	11/20/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-71 SB CD
Weaving Segment Location	I-490 EB/WB and SR 176
Analysis Year	2014 Count Data

Project Description CCG1 - existing configuration

Inputs

Weaving configuration	Two-Sided	Segment type	C-D Roadway/ Multilane Highways
Weaving number of lanes, N	2		
Weaving segment length, L_S	1200ft	Freeway minimum speed, S_{MIN}	45
Freeway free-flow speed, FFS	45 mph	Freeway maximum capacity, C_{IFL}	2250
		Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	529	0.90	8	0	1.5	1.2	0.962	1.00	611
V_{RF}	1429	0.90	8	0	1.5	1.2	0.962	1.00	1651
V_{FR}	1285	0.90	8	0	1.5	1.2	0.962	1.00	1485
V_{RR}	228	0.90	8	0	1.5	1.2	0.962	1.00	263
V_{NW}	3747							V =	3856
V_W	263								
VR	0.066								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	0 lc	Minimum weaving lane changes, LC_{MIN}	lc/h
Interchange density, ID	0.5 int/mi	Weaving lane changes, LC_W	lc/h
Minimum RF lane changes, LC_{RF}	0 lc/pc	Non-weaving lane changes, LC_{NW}	lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	lc/h
Minimum RR lane changes, LC_{RR}	1 lc/pc	Non-weaving vehicle index, I_{NW}	

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3856 veh/h	Weaving intensity factor, W	
Weaving segment capacity, c_w	3571 veh/h	Weaving segment speed, S	mph
Weaving segment v/c ratio	1.080	Average weaving speed, S_W	mph
Weaving segment density, D	pc/mi/ln	Average non-weaving speed, S_{NW}	mph
Level of Service, LOS	F	Maximum weaving length, L_{MAX}	6341 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Michael Baker Jr., Inc.
Date Performed	8/05/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-71 SB CD
Weaving Segment Location	I-490 EB/WB and SR 176
Analysis Year	2014 Count Data

Project Description CCG1 - Add I-90 EB on lane

Inputs

Weaving configuration	Two-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1200ft
Freeway free-flow speed, FFS	45 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	529	0.90	8	0	1.5	1.2	0.962	1.00	611
V_{RF}	1429	0.90	8	0	1.5	1.2	0.962	1.00	1651
V_{FR}	1285	0.90	8	0	1.5	1.2	0.962	1.00	1485
V_{RR}	228	0.90	8	0	1.5	1.2	0.962	1.00	263
V_{NW}	3747							V =	3856
V_W	263								
VR	0.066								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	0 lc	Minimum weaving lane changes, LC_{MIN}	526 lc/h
Interchange density, ID	0.5 int/mi	Weaving lane changes, LC_W	672 lc/h
Minimum RF lane changes, LC_{RF}	0 lc/pc	Non-weaving lane changes, LC_{NW}	844 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1516 lc/h
Minimum RR lane changes, LC_{RR}	2 lc/pc	Non-weaving vehicle index, I_{NW}	225

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3856 veh/h	Weaving intensity factor, W	0.272
Weaving segment capacity, c_w	5357 veh/h	Weaving segment speed, S	35.3 mph
Weaving segment v/c ratio	0.720	Average weaving speed, S_W	45.0 mph
Weaving segment density, D	37.8 pc/mi/ln	Average non-weaving speed, S_{NW}	34.8 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6341 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

CUY-71-18.29 SAFETY STUDY

APPENDIX D: TRAFFIC VOLUME MEMO (MARCH 2018)

Michael Baker INTERNATIONAL

We Make a Difference

To: Dave Lastovka, PE, Ohio Department of Transportation
Keith Hamilton, PE, Ohio Department of Transportation

From: Angela Coates, PE, Michael Baker International

CC: Lori Duguid, PE, PTOE, Michael Baker International
Scott Knebel, PE, Crawford, Murphy & Tilly

Date: March 13, 2018

Subject: CUY-71-18.29 (PID 98063)
Traffic Volume Assessment Memorandum

Introduction

Michael Baker International has been tasked to conduct a technical review of the July 2008 Certified Traffic plates to determine whether they are still relevant for use in a safety study that encompasses the I-90/I-490/I-71/SR-176 interchange. Certified Traffic was developed for the entire Cleveland Innerbelt Study in July 2008 and includes the full build-out of all phases of the Innerbelt projects. At the time of this study, only CCG1, and CCG2 have been fully implemented. The operational condition for the entire Innerbelt program area does not match "no build" nor "build" from the Certified Traffic plates. More recent traffic volume data was compiled from various sources and used to identify any major discrepancies in the July 2008 Certified Traffic, as well as potential interim conditions that may have led to these differences.

Study Parameters

This study compares AM and PM peak design hour volumes between (1) 2015 Build Certified Traffic Volumes developed in July 2008, and (2) newly developed volumes from the 2017 counts.

The following data sources were used to complete the comparison and identify trends:

- 2015 Build Certified Traffic Volumes (July 2008)
- 2017 Traffic Counts (ODOT)
- Historic Short-Term Counts (ODOT-TMMS)
- Traffic Flow Evaluation Study (Nov. 2014)

Additionally, Streetlight Origin-Destination data was used to identify weaving volumes needed for the safety analysis.

2017 Design Hour Volume Development

Count Program Summary

ODOT placed portable counters at several locations throughout the study area in December 2017, collecting 48-hour link volume data at each of the locations listed in **Table 1**. Nearly all of the locations listed were counted during the week of December 4, 2017 with the exception of Location #3 (I-71 Southbound); count data at this location was collected over the weekend of December 15, 2017.

Table 1. Link Count Summary

Location No.	Route	Description	Count Begin	Count End
1	I-90 EB	Ramp from I-90 EB to Access Road SB (I-71)	Monday, December 04, 2017	Wednesday, December 06, 2017
2	I-490 WB	Ramp from I-490 WB to Access Road SB (I-71)	Monday, December 04, 2017	Wednesday, December 06, 2017
3	I-71 SB	I-71 SB, just south of split from I-90 WB	Friday, December 15, 2017	Sunday, December 17, 2017
4	Access Road	Ramp from I-90 EB/I-490 WB Access Road to I-71 SB	Tuesday, December 05, 2017	Thursday, December 07, 2017
5	I-71 SB	Ramp from I-71 SB to SR-176	Tuesday, December 05, 2017	Thursday, December 07, 2017
6	Access Road/ Valentine Avenue	Ramp from I-90 EB/I-490 WB Access Road to SR-176	Tuesday, December 05, 2017	Thursday, December 07, 2017
7	I-71 SB	Ramp from I-71 SB to W. 25th Street	Tuesday, December 05, 2017	Thursday, December 07, 2017
8	I-71 SB	I-71 SB, just south of SR-176 Exit	Tuesday, December 05, 2017	Wednesday, December 06, 2017
9	Valentine Avenue	Ramp from Valentine Avenue to Access Road SB (SR-176)	Tuesday, December 05, 2017	Thursday, December 07, 2017
10	Valentine Avenue	Ramp from Valentine Avenue to Access Road SB (I-71)	Tuesday, December 05, 2017	Thursday, December 07, 2017

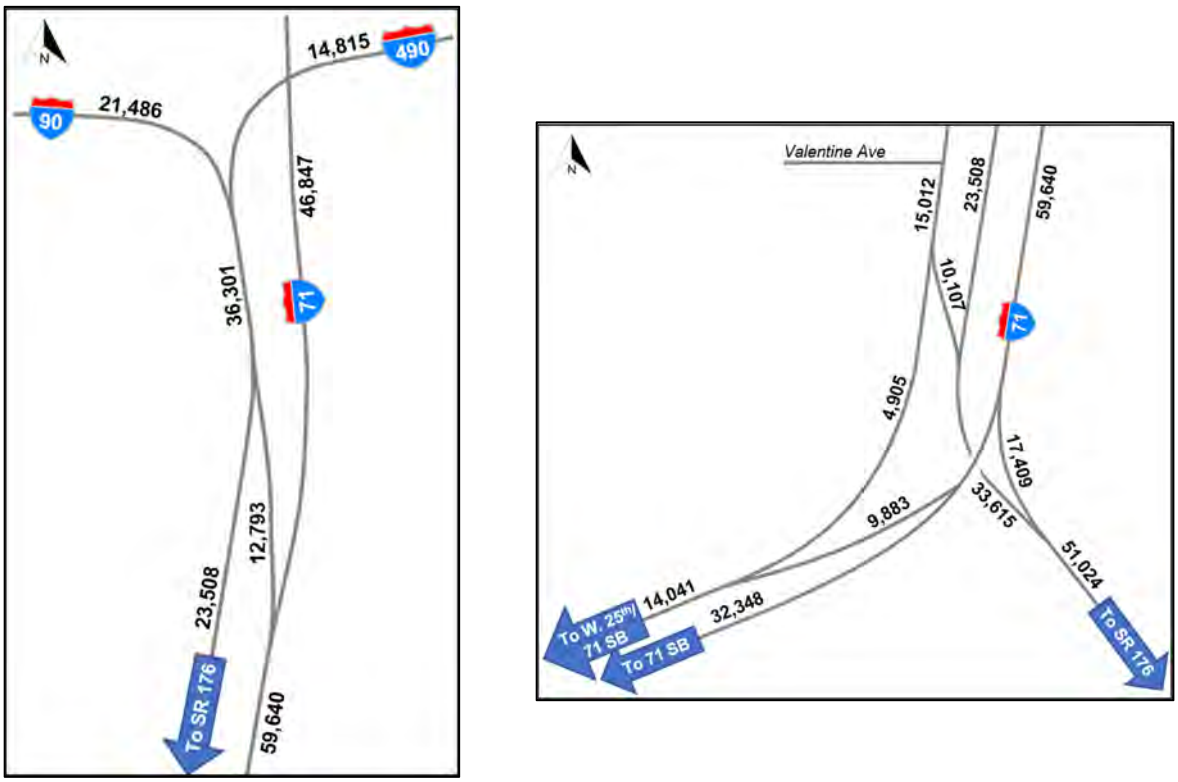
In addition to these, a 13-hour turning movement count (6:00 AM – 7:00 PM) was performed at the intersection of Valentine Avenue and the I-71/SR-176 Ramps. All newly collected count data is included in the Appendix to this memo.

AADT Estimation

The annual average daily traffic (AADT) volumes for each of the locations listed in Table 1 were estimated by ODOT and were accessed through the Traffic Monitoring Management System (TMMS). The average 24-hour volumes from the counts were compared to the AADT values to check for reasonableness, and volume balancing throughout the study area was checked.

The resulting 2017 AADT volumes are illustrated in **Figure 1**.

Figure 1. 2017 AADT Volumes



Design Hour Volume Estimation

Design hour volumes were estimated from AADT volumes by considering the K-Factors that were applied to 2016 traffic count data. This was done to provide an even comparison to the certified traffic, which is based on DHV and not peak hour. The 2016 AADTs and design hour volumes for all locations were obtained from the TMMS, and resulting K-Factors were calculated. The DHV and K-factors reported in the TMMS report are not refined K-factors, based on the certified traffic methodology, but were assumed to be a reasonable estimate for the purposes of this evaluation.

These K-Factors were then compared to the actual PM peak hour percentage from the 2017 counts. The 2016 K-Factor was adjusted if found to be notably lower than the PM peak hour percentage. The K-Factor for Location #3 on I-71 SB was estimated to be 10% from the 2014 K&D report, which contains the most recent data at the permanent count station at Log 19.04 on I-71. The K-Factor at Location #12 on Valentine Avenue was estimated to be the PM peak hour percentage of 12%.

The PM peak hour was found to be higher than the AM peak hour at all locations. The AM design hour volumes were estimated from PM design hour volumes by applying the same AM-to-PM ratio as calculated from the December 2017 counts.

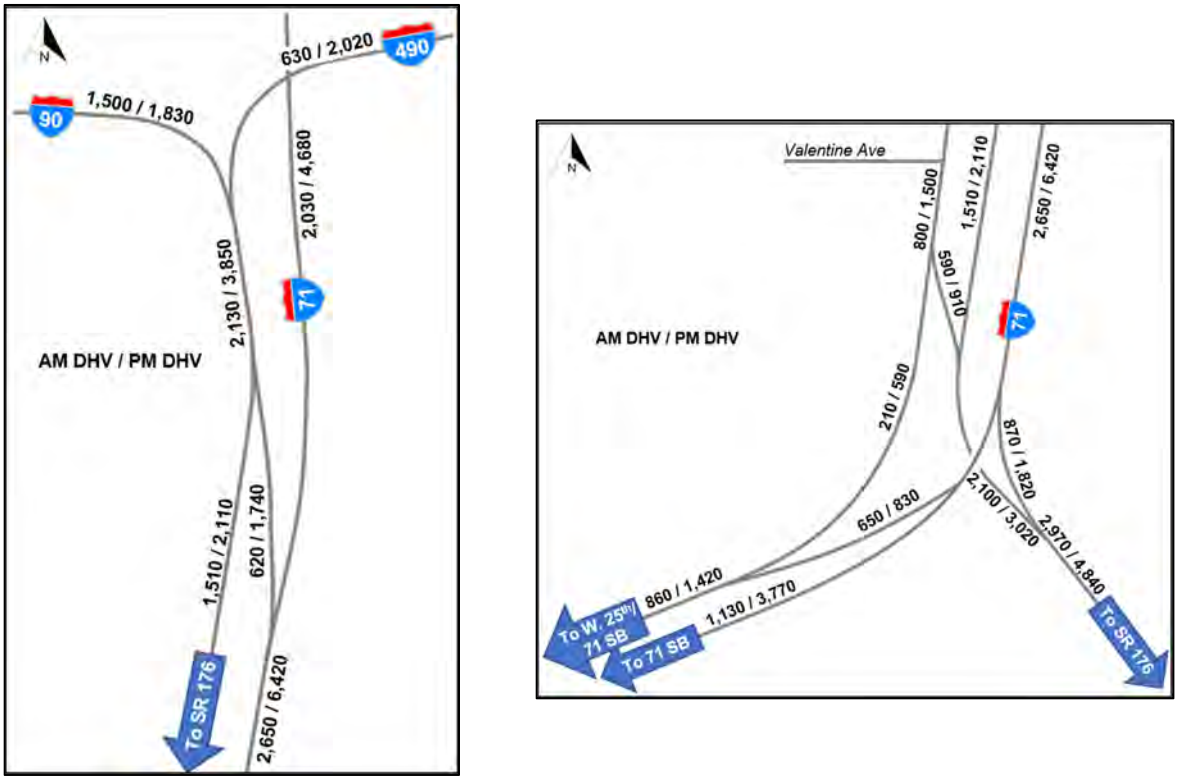
A summary of AADTs, K-Factors, and AM-to-PM ratios is found in **Table 2**. The resulting 2017 design hour volume estimates are shown in **Figure 2**.

Table 2. 2016 and 2017 K-Factors

Location No.	2016			2017	
	AADT	DHV (PM)	K-Factor (PM)	K-Factor (PM)	AM-to-PM Ratio
1	18,614	1,589	8.5%	8.5%	0.82
2	15,955	2,179	13.7%	13.7%	0.31
3	41,384	N/A	-	10.0%	Balanced*
4	12,340	1,678	13.6%	13.6%	0.35
5	14,491	1,515	10.5%	10.5%	0.48
6	31,014	2,784	9.0%	9.0%	0.69
7	8,724	732	8.4%	8.4%	0.78
8	39,233	N/A	-	Balanced*	0.39
9	N/A	N/A	-	Balanced*	Balanced*
10	N/A	N/A	-	12.0%	0.36

*K-Factors were not used; Design hour volumes estimated through balancing

Figure 2. 2017 Design Hour Volumes



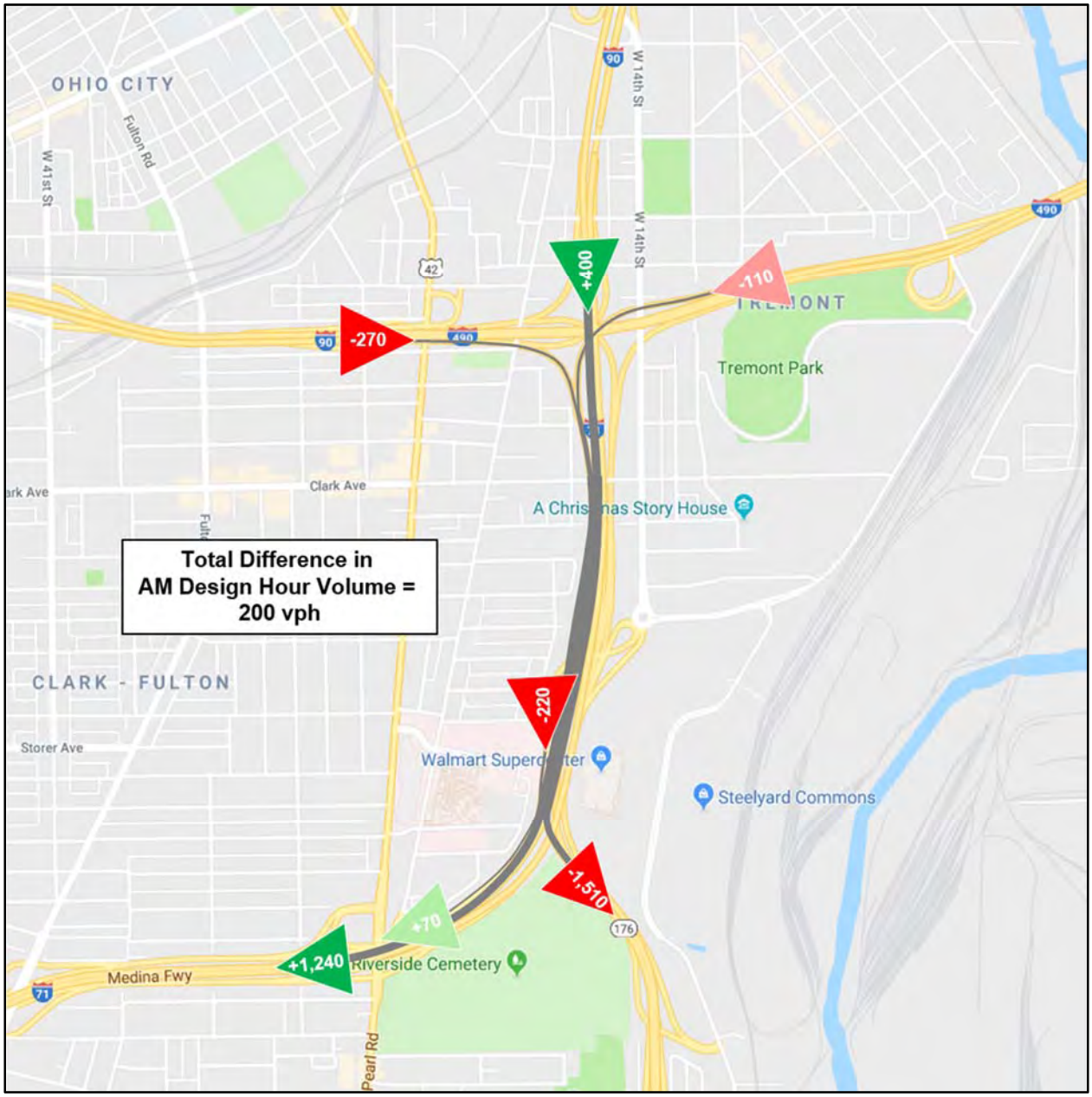
Design Hour Volume Comparison

Figure 3 illustrates the magnitude of difference in PM design hour volumes between the 2017 adjusted volumes and the Certified Traffic entering and exiting the study area. Negative numbers represent locations where Certified Traffic volumes are less than 2017 design hour volumes. This comparison suggests a substantial difference in traffic patterns between the two sets of data. The volume of traffic entering the study area from the I-90 EB and I-490 WB ramps is underestimated by 31%, or 1,190 vph. It appears that the traffic that is unaccounted for is ultimately destined for southbound SR-176, which is underestimated by 29% or 1,380 vph. The volume of inbound traffic from I-71 SB is very close between the two data sets. The outbound volume to I-71 SB is slightly higher in the Certified Traffic but still relatively similar to the 2017 count data.

Figure 3. Difference in PM Design Hour Traffic Volumes, 2015 Certified Traffic vs. 2017 Counts

The magnitude of difference in AM design hour volumes between the 2017 adjusted volumes and the Certified Traffic entering and exiting the study area is shown in **Figure 4**. While the total difference in traffic within the study area is similar, there are major differences primarily in the distribution of outbound traffic. Certified traffic volumes departing to I-71 SB are over 90% greater than the 2017 counts, while the volume departing to SR-176 SB is 50% less.

Figure 4. Difference in AM Design Hour Traffic Volumes, 2015 Certified Traffic vs. 2017 Counts



Historic traffic count data was investigated to determine if these differences are due to a traffic diversion from the Innerbelt interim condition. **Figure 5** shows the historical trend in AADT volumes on routes entering the study area. The volume of traffic on I-490 WB has steadily increased from 2008 to 2017. Volumes on I-90 EB have increased substantially since 2014 while volumes on I-90 WB/I-71 SB have decreased. Even though the changes appear to be significant when graphed, they still only represent around 20% change in AADT, with a nearly 0% net change.

Figure 5. AADT by Year, Inbound Routes

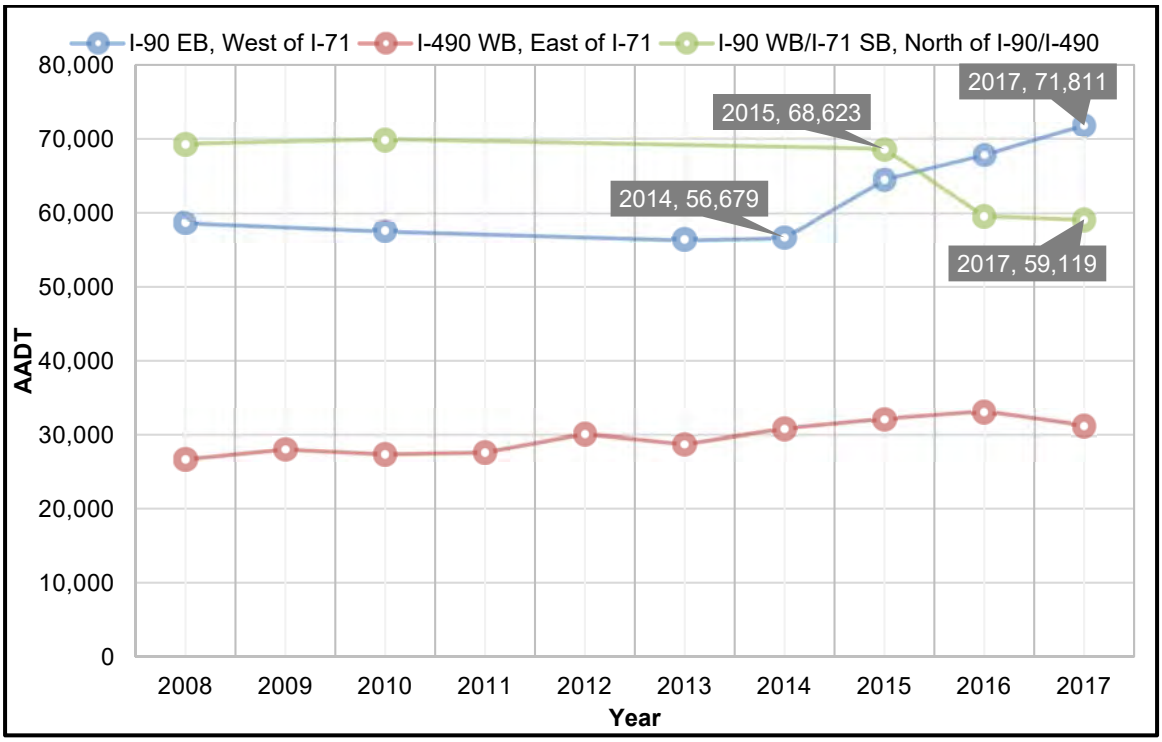
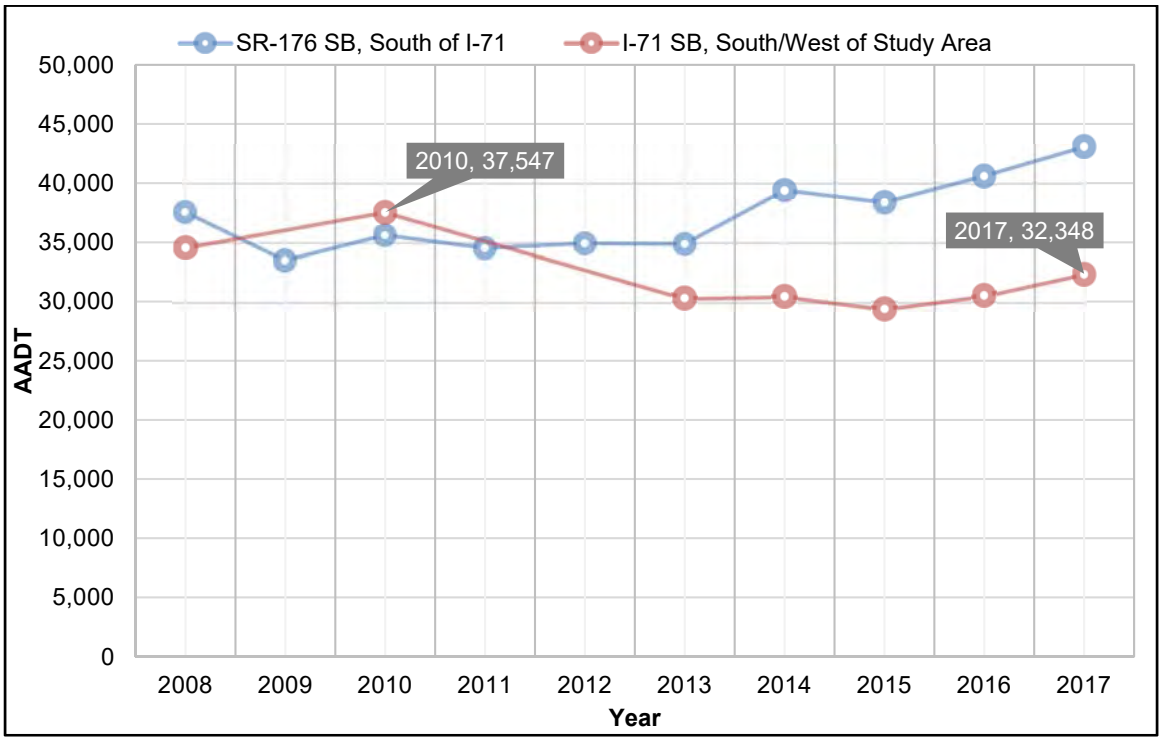


Figure 6 shows trends in AADTs on the major outbound routes. Volumes on SR-176 were relatively flat prior to 2014, but have been increasing since then. While I-71 SB showed growth initially, the volume has been generally flat since 2013. Even though there have been some fluctuations in AADT on both I-71 SB and SR-176, the change has been overall less than 15-20% over the 10 year period, with a nearly net 0% change overall.

Figure 6. AADT by Year, Outbound Routes



Figures 7 and 8 shows the how AADT values have changed from before Innerbelt construction began to the year 2016, separated by direction of travel. Traffic volumes in the eastbound and westbound directions increased substantially west of I-77. The AADT has decreased on I-71 and has increased on I-77 north of I-490. These results indicate that some southbound traffic diversion may be occurring from I-71 to I-77 north of I-490. However, this traffic would likely be destined to I-71 SB or to I-90 WB instead of SR-176 SB; SR-176 ultimately feeds into I-480, which may be reached from I-77 as well. These results indicate a general shift in the growth trend from the west and to the southeast, which would not be related to Innerbelt construction.

Figure 7. Change AADT, Before Innerbelt Construction (2007/2008) to Interim Condition (2017), West

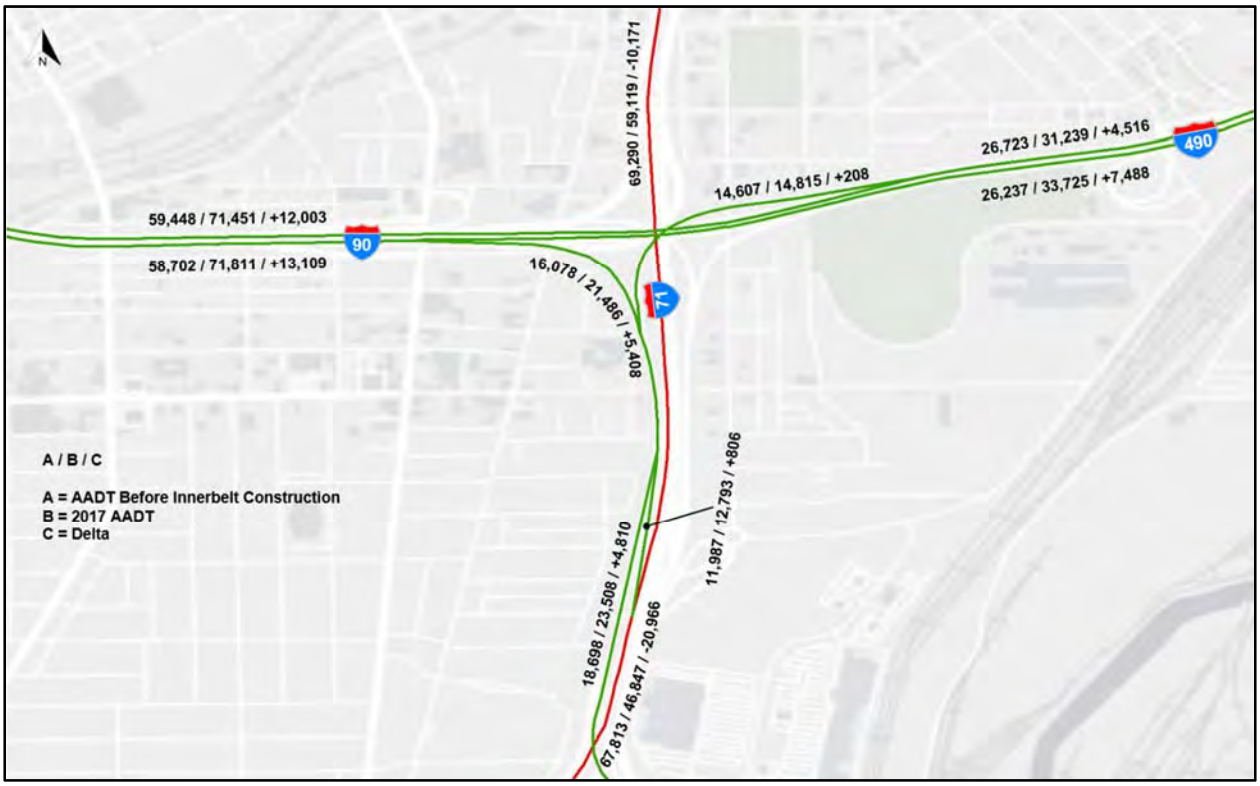


Figure 8. Change AADT, Before Innerbelt Construction (2007/2008) to Interim Condition (2017), East

Weaving Volumes

Weaving volumes were estimated from I-90 EB/I-490 WB to I-71 SB/SR-176 using Streetlight Data; results were averaged over the year of 2017 for the average day (Monday – Sunday). The final weaving volumes shown in **Figure 9** were determined by considering the origin-destination patterns from Streetlight along with the design hour volumes in Figure 2. The resulting distributions of traffic are summarized in **Table 3**.

Figure 9. 2017 Design Hour Volumes, Weaves

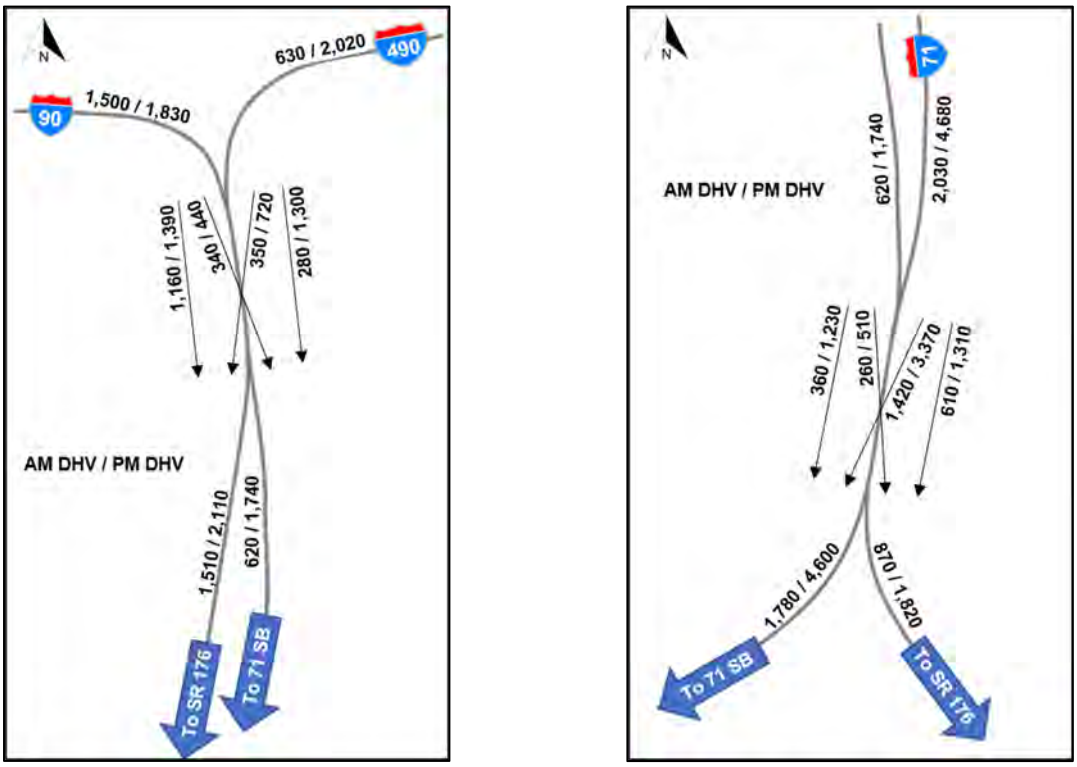


Table 3. Streetlight Origin-Destination Proportions, I-90 EB/I-490 WB to I-71 SB/SR-176

Origin	Destination		
	I-71 SB	SR-176 SB	
		via Access Rd Ramp	via I-71 SB Ramp
AM Peak			
I-90 EB	11%	77%	12%
I-490 WB	32%	56%	12%
I-71 SB	70%	0%	30%
PM Peak			
I-90 EB	6%	76%	18%
I-490 WB	55%	36%	9%
I-71 SB	72%	0%	28%

These results show that the clear majority of traffic from I-90 EB and I-490 WB is destined to SR-176 SB. The movement from I-90 EB/I-490 WB to SR-176 SB is intended to be made via the Access Road ramp to SR-176 SB. However, it has been observed that drivers will instead utilize the Access Road ramp to I-71 SB, traverse across three lanes of traffic, and take the I-71 SB ramp to SR-176. This occurrence is likely due to congestion on SR-176 SB and the resulting ramp queues. Approximately 12% of traffic uses the I-71 SB ramp to access SR 176 during the AM. In the PM, Streetlight data suggests that more traffic from I-90 EB crosses I-71 SB to SR 176 (18%).

Summary

The results presented in this study show that the growth trends and traffic distribution that were initially predicted and used to develop the July 2008 Certified Traffic plates have not held entirely true. There has been a much larger increase in traffic particularly arriving from the west and destined to the southeast on SR-176. These shifts in traffic do not appear to be related to the interim condition of the Innerbelt construction project. As a result, it is recommended that the traffic count data collected in December 2017 be considered in the completion of the subject safety study. A sensitivity analysis may be required to evaluate the recommended countermeasures at varying magnitudes of traffic volumes.

Appendix A. July 2008 Certified Traffic Plates

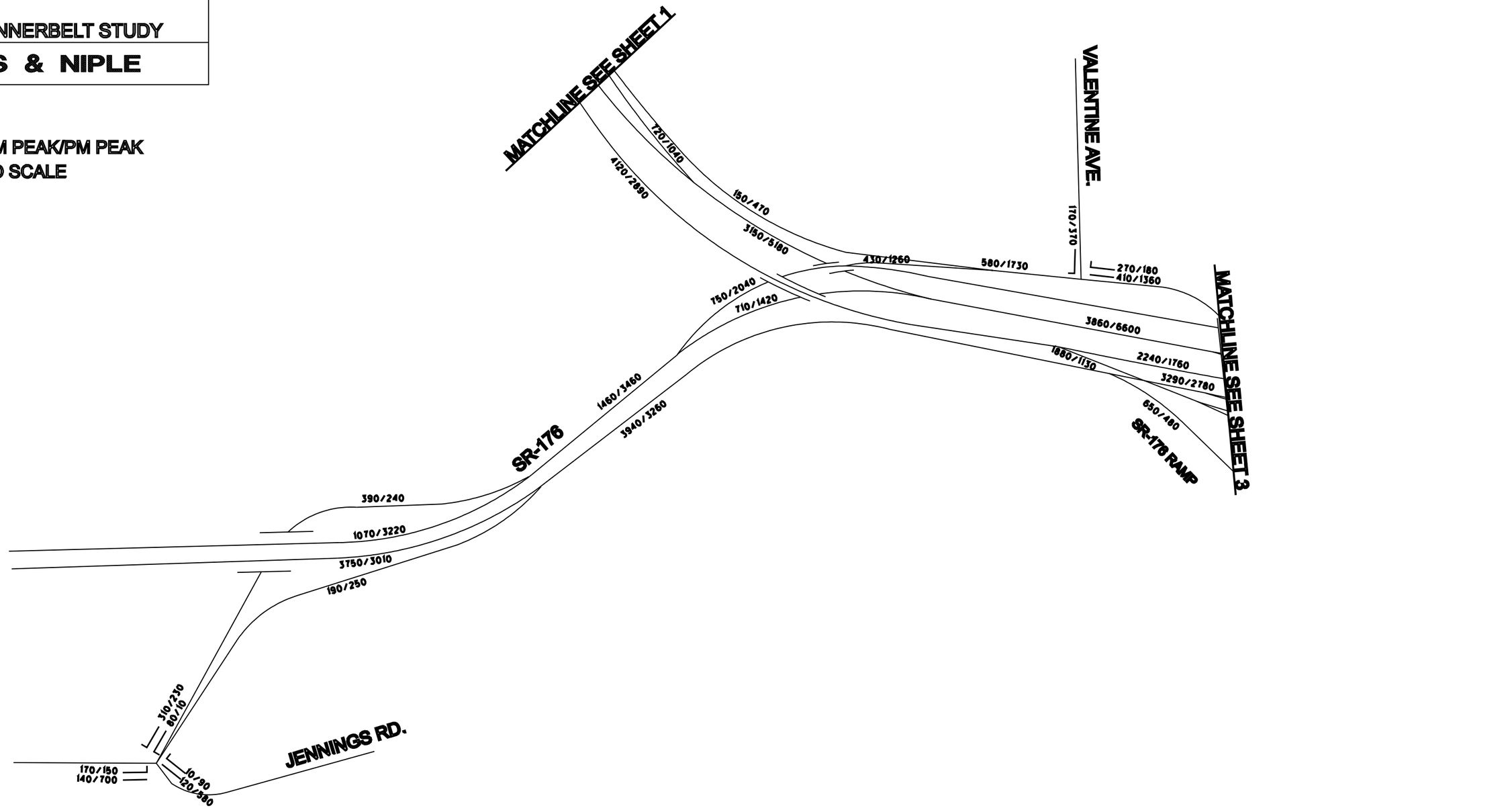
CLEVELAND, OHIO JULY 2008

FIGURE 2 0F 15
2015 BUILD
CERTIFIED TRAFFIC VOLUMES

CLEVELAND INNERBELT STUDY

BURGESS & NIPLE

XXXX/XXXX = AM PEAK/PM PEAK
NOT TO SCALE



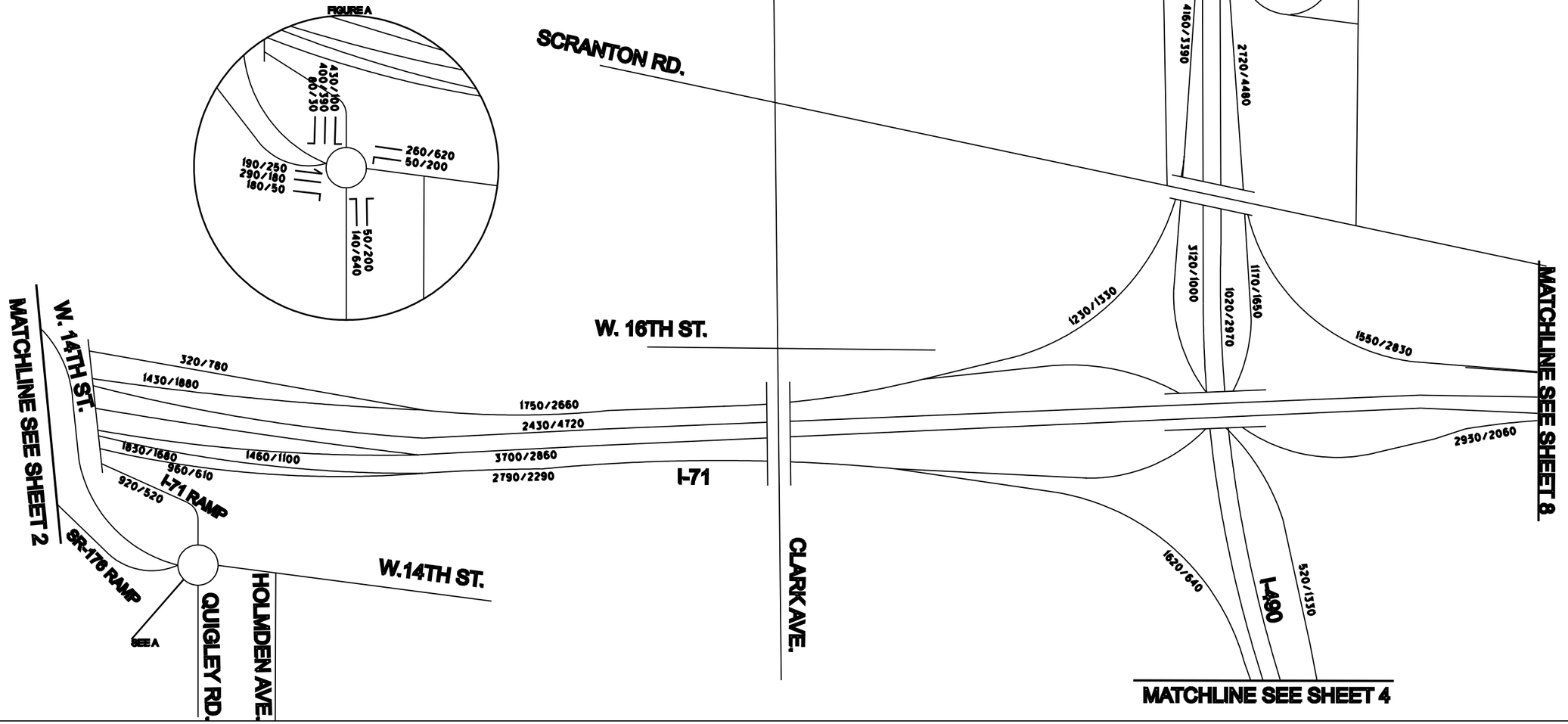
CLEVELAND, OHIO JULY 2008

FIGURE 3 0F 15
2015 BUILD
CERTIFIED TRAFFIC VOLUMES

CLEVELAND INNERBELT STUDY

BURGESS & NIPLE

XXXX/XXXX = AM PEAK/PM PEAK
NOT TO SCALE



Appendix B. 2016 Count Data

Ohio Department of Transportation
87618 Weekly Volume Report - Mon 11/07/2016 - Sun 11/13/2016

Location ID:	87618	**Type:**	SPOT
Located On:	RAMP FROM IR90 EB TO ACCESS RD SB		
Direction	RAMP		
Community:	-	**Period:**	Mon 11/07/2016 - Sun 11/13/2016
AADT:	18614		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM	89	104						97
1:00 AM	69	81						75
2:00 AM	87	88						88
3:00 AM	195	185						190
4:00 AM	621	622						622
5:00 AM	1292	1244						1268
6:00 AM	1186	1275						1231
7:00 AM	1202	1238						1220
8:00 AM	1189	1137						1163
9:00 AM	1029	1138						1084
10:00 AM	1071	1152						1112
11:00 AM	1131	1185						1158
12:00 PM	1173	1255						1214
1:00 PM	1352	1444						1398
2:00 PM	1589	1368						1479
3:00 PM	1443	1098						1271
4:00 PM	875	999						937
5:00 PM	1137	815						976
6:00 PM	901	790						846
7:00 PM	701	715						708
8:00 PM	613	583						598
9:00 PM	421	479						450
10:00 PM	310	303						307
11:00 PM	170	157						164
Total	**19846**	**19455**	**0**	**0**	**0**	**0**	**0**	
24HrTotal	19846	19455						19651
AM Pk Hr	5:00	6:00						
AM Peak	1292	1275						1284
PM Pk Hr	2:00	1:00						
PM Peak	1589	1444						1517
% Peak Hr	8.01%	7.42%						7.50%
% Peak Hr	8.01%	7.42%						7.71%

Ohio Department of Transportation
87718 Weekly Volume Report - Mon 07/25/2016 - Sun 07/31/2016

Location ID:	87718	**Type:**	SPOT
Located On:	RAMP FROM IR490 WB TO ACCESS RD SB		
Direction	RAMP		
Community:	-	**Period:**	Mon 07/25/2016 - Sun 07/31/2016
AADT:	15955		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM	191	174						183
1:00 AM	108	122						115
2:00 AM	90	89						90
3:00 AM	86	64						75
4:00 AM	83	118						101
5:00 AM	202	202						202
6:00 AM	387	431						409
7:00 AM	648	593						621
8:00 AM	602	653						628
9:00 AM	612	557						585
10:00 AM	720	656						688
11:00 AM	723	676						700
12:00 PM	825	829						827
1:00 PM	875	866						871
2:00 PM	1176	1191						1184
3:00 PM	1655	1692						1674
4:00 PM	1904	2050						1977
5:00 PM	2086	2179						2133
6:00 PM	1002	1060						1031
7:00 PM	674	699						687
8:00 PM	556	519						538
9:00 PM	403	458						431
10:00 PM	359	514						437
11:00 PM	310	413						362
Total	**16277**	**16805**	**0**	**0**	**0**	**0**	**0**	
24HrTotal	16277	16805						16541
AM Pk Hr	11:00	11:00						
AM Peak	723	676						700
PM Pk Hr	5:00	5:00						
PM Peak	2086	2179						2133
% Peak Hr	12.82%	12.97%						13.00%
% Peak Hr	12.82%	12.97%						12.89%

Ohio Department of Transportation
99818 Weekly Volume Report - Mon 11/28/2016 - Sun 12/04/2016

Location ID:	99818	**Type:**	SPOT
Located On:	RAMPS FROM IR90-490 SB TO IR71 SB	**:**	RAMPS FROM IR90-490 SB TO IR71 SB, IN CLEVEL
Direction	RAMP		
Community:	-	**Period:**	Mon 11/28/2016 - Sun 12/04/2016
AADT:	12340		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM			128					128
1:00 AM			93					93
2:00 AM			90					90
3:00 AM			86					86
4:00 AM			107					107
5:00 AM			226					226
6:00 AM			421					421
7:00 AM			524					524
8:00 AM			552					552
9:00 AM			549					549
10:00 AM			523					523
11:00 AM			531					531
12:00 PM			666					666
1:00 PM			720					720
2:00 PM			942					942
3:00 PM			1459					1459
4:00 PM			1678					1678
5:00 PM			1524					1524
6:00 PM			876					876
7:00 PM			509					509
8:00 PM			454					454
9:00 PM			365					365
10:00 PM			312					312
11:00 PM			211					211
Total	**0**	**0**	**13546**	**0**	**0**	**0**	**0**	
24HrTotal			13546					13546
AM Pk Hr			8:00					
AM Peak			552					552
PM Pk Hr			4:00					
PM Peak			1678					1678
% Peak Hr			12.39%					12.00%
% Peak Hr			12.39%					12.39%

Ohio Department of Transportation
99718 Weekly Volume Report - Mon 08/29/2016 - Sun 09/04/2016

Location ID:	99718	**Type:**	SPOT
Located On:	RAMP FROM IR71 SB TO SR176 JENNINGS FWY	**:**	RAMP FROM IR71 SB TO SR176 JENNINGS FWY, II
Direction	RAMP		
Community:	-	**Period:**	Mon 08/29/2016 - Sun 09/04/2016
AADT:	14491		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM		83	100					92
1:00 AM		78	103					91
2:00 AM		105	103					104
3:00 AM		222	234					228
4:00 AM		541	534					538
5:00 AM		691	715					703
6:00 AM		631	697					664
7:00 AM		598	554					576
8:00 AM		651	675					663
9:00 AM		829	814					822
10:00 AM		839	908					874
11:00 AM		951	916					934
12:00 PM		1193	1164					1179
1:00 PM		1309	1416					1363
2:00 PM		1454	1476					1465
3:00 PM		1461	1515					1488
4:00 PM		1010	1108					1059
5:00 PM		851	806					829
6:00 PM		650	647					649
7:00 PM		536	551					544
8:00 PM		569	581					575
9:00 PM		350	386					368
10:00 PM		185	193					189
11:00 PM		125	97					111
Total	**0**	**15912**	**16293**	**0**	**0**	**0**	**0**	
24HrTotal			15912	16293				16103
AM Pk Hr		11:00	11:00					
AM Peak		951	916					934
PM Pk Hr		3:00	3:00					
PM Peak		1461	1515					1488
% Peak Hr		9.18%	9.30%					9.00%
% Peak Hr			9.18%	9.30%				9.24%

Ohio Department of Transportation
107118 Weekly Volume Report - Mon 08/29/2016 - Sun 09/04/2016

Location ID:	107118	**Type:**	SPOT
Located On:	RAMPS FROM IR90-490 TO SR176 JENNINGS FRWY SB		
Direction	RAMP		
Community:	-	**Period:**	Mon 08/29/2016 - Sun 09/04/2016
AADT:	31014		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM		139	168					154
1:00 AM		152	158					155
2:00 AM		247	229					238
3:00 AM		743	697					720
4:00 AM		1569	1535					1552
5:00 AM		1676	1709					1693
6:00 AM		1448	1604					1526
7:00 AM		1518	1684					1601
8:00 AM		1620	1555					1588
9:00 AM		1793	1704					1749
10:00 AM		1775	1909					1842
11:00 AM		1977	2020					1999
12:00 PM		2323	2416					2370
1:00 PM		2784	2735					2760
2:00 PM		2768	2727					2748
3:00 PM		2736	2623					2680
4:00 PM		2095	2154					2125
5:00 PM		1744	1686					1715
6:00 PM		1468	1366					1417
7:00 PM		1166	1130					1148
8:00 PM		945	873					909
9:00 PM		582	570					576
10:00 PM		346	335					341
11:00 PM		213	265					239
Total	**0**	**33827**	**33852**	**0**	**0**	**0**	**0**	
24HrTotal			33827	33852				33840
AM Pk Hr		11:00	11:00					
AM Peak		1977	2020					1999
PM Pk Hr		1:00	1:00					
PM Peak		2784	2735					2760
% Peak Hr		8.23%	8.08%					8.00%
% Peak Hr			8.23%	8.08%				8.15%

Ohio Department of Transportation
82918 Weekly Volume Report - Mon 08/29/2016 - Sun 09/04/2016

Location ID:	82918	**Type:**	SPOT
Located On:	RAMP FROM IR71 SB TO US42-3 W25TH	**:**	RAMP FROM IR71 SB TO US42-3 W25TH, IN CLEV
Direction	RAMP		
Community:	-	**Period:**	Mon 08/29/2016 - Sun 09/04/2016
AADT:	8724		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM		60	62					61
1:00 AM		44	36					40
2:00 AM		40	54					47
3:00 AM		148	155					152
4:00 AM		411	394					403
5:00 AM		562	539					551
6:00 AM		509	546					528
7:00 AM		406	452					429
8:00 AM		484	502					493
9:00 AM		465	515					490
10:00 AM		564	542					553
11:00 AM		555	593					574
12:00 PM		688	732					710
1:00 PM		674	722					698
2:00 PM		729	697					713
3:00 PM		685	630					658
4:00 PM		542	560					551
5:00 PM		434	401					418
6:00 PM		402	422					412
7:00 PM		315	302					309
8:00 PM		293	308					301
9:00 PM		205	208					207
10:00 PM		134	133					134
11:00 PM		68	118					93
Total	**0**	**9417**	**9623**	**0**	**0**	**0**	**0**	
24HrTotal			9417	9623				9520
AM Pk Hr		10:00	11:00					
AM Peak		564	593					579
PM Pk Hr		2:00	12:00					
PM Peak		729	732					731
% Peak Hr		7.74%	7.61%					8.00%
% Peak Hr			7.74%	7.61%				7.67%

Appendix C. 2017 Count Data

INTER-OFFICE COMMUNICATION

TO: Dave Gardner, Traffic Monitoring Section

FROM: Brian Blayney, D12 Traffic Planning Engineer

SUBJECT: Traffic Counts

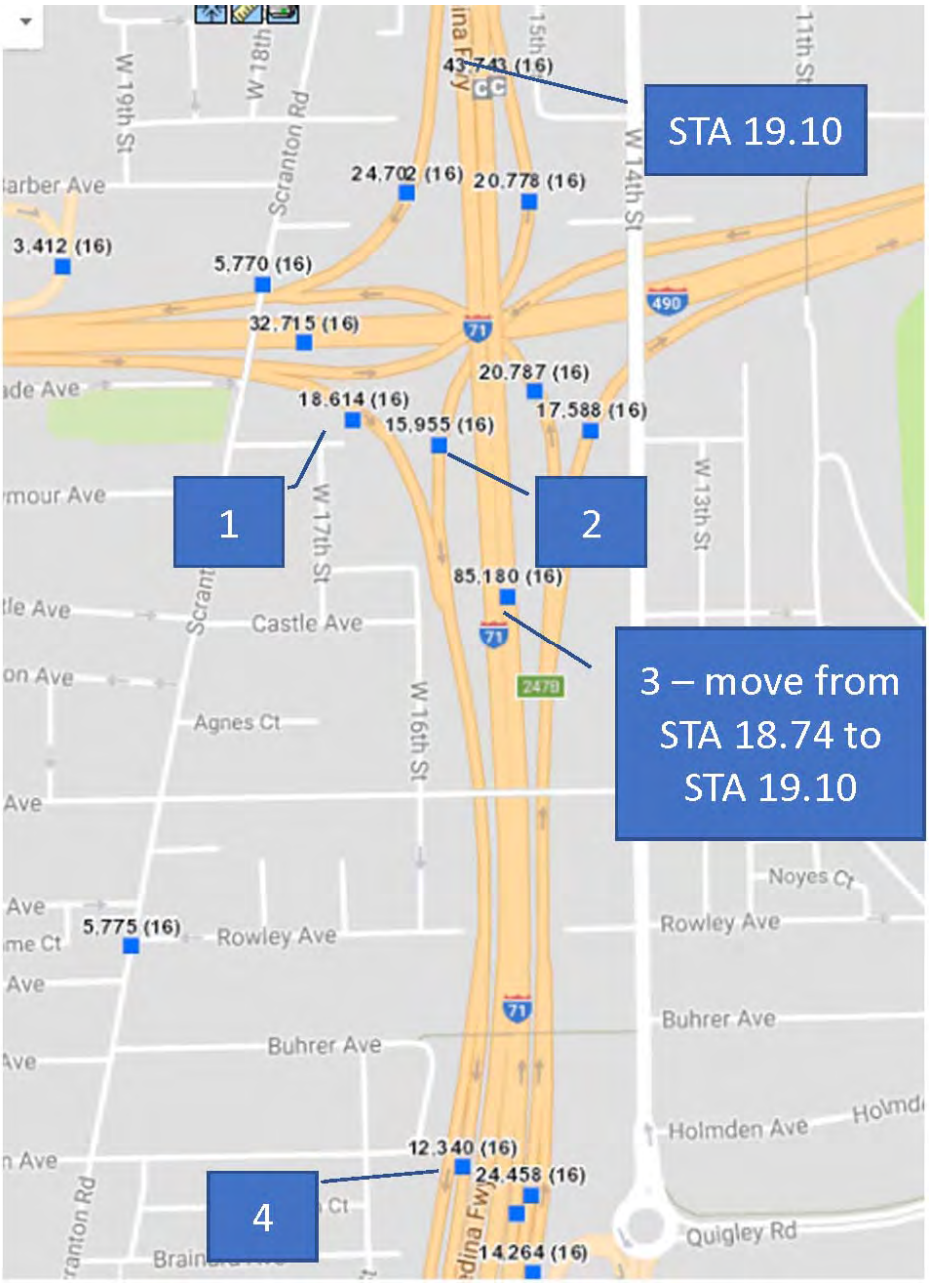
DATE: March 13, 2018

I request traffic data collection at the following locations:

Location						Type of Count		
Station No.		**County**	**Route**	**Intersecting Road**	**Log Point**	**Turning Movement**	**Machine Count**	
							Volume	Class
87618	1	CUY	EB I-90 ramp	Ramp from I-90 EB to Access Road SB (I-71)	0.06		X	X
87718	2	CUY	WB I-490 ramp	Ramp from I-490 WB to Access Road SB (I-71)	0.31		X	X
23618	3	CUY	SB I-71	SB I-71 north of Access Road ramp.	19.10		X	X
99818	4	CUY	Access Rd ramp	Ramp from EB I-90/ WB I-490 to I-71 SB	0.02		X	X
99718	5	CUY	SB I-71	Ramp from SB I-71 to SR 176	13.31		X	X
107118	6	CUY	Access Rd ramp	Ramp from I-90/I-490 to SR 176	1.04		X	X
82918	7	CUY	SB I-71	Ramp from SB I-71 to W 25th Street	0.02		X	X
23518	8	CUY	SB I-71	SB I-71 north of W 25th Street ramp	17.95		X	X
	9	CUY	Valentine ramp	Entrance ramp from Valentine Ave to Access Road (SB SR 176)			X	X
	10	CUY		Valentine Ave at W. 14th Street		X		

	Count Information			
	Ped. Count (Yes/No)	**Duration of Count**	**Reason For Count** (County, Rte, Log, PID, etc.)	**Customer Target Completion Date**
1-9	No	48-hour class count on Tuesday, Wednesday, Thursday	Planning Traffic forecast for safety study	12/16/2017 (See note below)
10	No	8 hour TMC	Planning Traffic forecast for safety study	12/16/2017 (See note below)

Note: Traffic data is to be collected on the same day to minimize the need for ramp balancing




Buhrer Ave
Holmden Ave
12,340 (16)
24,458 (16)
Holmden Ct
Scranton Rd
Brainard Ave
Quigley Rd
14,264 (16)
Calvin Ct
W 17th St
Medina Fwy
Corning Ave
247A
71
10
Biddle Ct
Valentine Ave
9
246
Steelyard
8
247A
14,491 (16)
83,569 (16)
5
Eglindale Ave
245
71
Steelyard Dr
6
8,724 (16)
View Rd
7
10,610 (16)

Ohio Department of Transportation
87618 Weekly Volume Report - Mon 12/04/2017 - Sun 12/10/2017

Location ID:	87618	**Type:**	SPOT
Located On:	RAMP FROM IR90 EB TO ACCESS RD SB		
Direction	RAMP		
Community:	-	**Period:**	Mon 12/04/2017 - Sun 12/10/2017
AADT:	21005		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM		201	185					193
1:00 AM		120	111					116
2:00 AM		104	102					103
3:00 AM		106	117					112
4:00 AM		207	224					216
5:00 AM		622	640					631
6:00 AM		1191	1299					1245
7:00 AM		1148	1428					1288
8:00 AM		1202	1335					1269
9:00 AM		1259	1350					1305
10:00 AM		1117	1128					1123
11:00 AM		1153	1195					1174
12:00 PM		1190	1253					1222
1:00 PM		1265	1299					1282
2:00 PM		1447	1528					1488
3:00 PM		1665	1617					1641
4:00 PM		1490	1287					1389
5:00 PM		1431	1240					1336
6:00 PM		1159	1214					1187
7:00 PM		912	921					917
8:00 PM		832	887					860
9:00 PM		736	833					785
10:00 PM		507	563					535
11:00 PM	299	303						301
Total	**299**	**21367**	**21756**	**0**	**0**	**0**	**0**	
24HrTotal		21363	22059					21711
AM Pk Hr		9:00						
AM Peak		1259						1259
PM Pk Hr		3:00						
PM Peak		1665						1665
% Peak Hr		7.79%						8.00%
% Peak Hr		1.40%	7.55%					4.47%

Ohio Department of Transportation
87718 Weekly Volume Report - Mon 12/04/2017 - Sun 12/10/2017

Location ID:	87718	**Type:**	SPOT
Located On:	RAMP FROM IR490 WB TO ACCESS RD SB		
Direction	RAMP		
Community:	-	**Period:**	Mon 12/04/2017 - Sun 12/10/2017
AADT:	14482		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM		135	112					124
1:00 AM		72	65					69
2:00 AM		68	54					61
3:00 AM		64	50					57
4:00 AM		104	81					93
5:00 AM		190	213					202
6:00 AM		380	405					393
7:00 AM		589	601					595
8:00 AM		591	631					611
9:00 AM		514	563					539
10:00 AM		566	578					572
11:00 AM		683	648					666
12:00 PM		776	728					752
1:00 PM		815	829					822
2:00 PM		1076	1172					1124
3:00 PM		1745	1695					1720
4:00 PM		1949	1974					1962
5:00 PM		1738	1930					1834
6:00 PM		869	980					925
7:00 PM		447	607					527
8:00 PM		495	473					484
9:00 PM		284	476					380
10:00 PM		226	354					290
11:00 PM	199	154						177
Total	**199**	**14530**	**15219**	**0**	**0**	**0**	**0**	
24HrTotal		14575	15373					14974
AM Pk Hr		11:00						
AM Peak		683						683
PM Pk Hr		4:00						
PM Peak		1949						1949
% Peak Hr		13.41%						13.00%
% Peak Hr		1.37%	12.68%					7.02%

Ohio Department of Transportation
23618_SB Weekly Volume Report - Mon 12/11/2017 - Sun 12/17/2017

Location ID:	23618_SB	**Type:**	SPOT
Located On:	MEDINA FWY		
Direction	SB		
Community:	CLEVELAND	**Period:**	Mon 12/11/2017 - Sun 12/17/2017
AADT:	67657		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM						2494	2560	2527
1:00 AM						2747	2791	2769
2:00 AM						3534	3619	3577
3:00 AM						4521	4477	4499
4:00 AM						5295	5040	5168
5:00 AM						5083	4921	5002
6:00 AM						3313	3479	3396
7:00 AM						2501	2428	2465
8:00 AM						1931	1820	1876
9:00 AM						1469	2605	2037
10:00 AM						1319	1707	1513
11:00 AM						949	959	954
12:00 PM					533	568		551
1:00 PM					265	286		276
2:00 PM					210	268		239
3:00 PM					214	229		222
4:00 PM					309	345		327
5:00 PM					694	724		709
6:00 PM					1405	1547		1476
7:00 PM					2086	2210		2148
8:00 PM					2015	2056		2036
9:00 PM					1685	1774		1730
10:00 PM					1923	2015		1969
11:00 PM					2191	2249		2220
Total	**0**	**0**	**0**	**0**	**13530**	**49427**	**36406**	
24HrTotal						48686	50677	49682
AM Pk Hr						4:00		
AM Peak						5295		5295
PM Pk Hr						11:00		
PM Peak						2249		2249
% Peak Hr						10.71%		11.00%
% Peak Hr						4.50%	10.45%	7.47%

Ohio Department of Transportation
99818 Weekly Volume Report - Mon 12/04/2017 - Sun 12/10/2017

Location ID:	99818	**Type:**	SPOT
Located On:	RAMPS FROM IR90-490 SB TO IR71 SB	**:**	RAMPS FROM IR90-490 SB TO IR71 SB, IN CLEVELAND
Direction	RAMP		
Community:	-	**Period:**	Mon 12/04/2017 - Sun 12/10/2017
AADT:	12563		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM			121	137				129
1:00 AM			57	74				66
2:00 AM			47	71				59
3:00 AM			57	60				59
4:00 AM			85	103				94
5:00 AM			224	226				225
6:00 AM			401	427				414
7:00 AM			567	587				577
8:00 AM			579	591				585
9:00 AM			533	508				521
10:00 AM		492	538					515
11:00 AM		597	567					582
12:00 PM		619	614					617
1:00 PM		730	684					707
2:00 PM		892	934					913
3:00 PM		1489	1444					1467
4:00 PM		1608	1516					1562
5:00 PM		1382	1525					1454
6:00 PM		739	815					777
7:00 PM		387	515					451
8:00 PM		405	460					433
9:00 PM		281	447					364
10:00 PM		229	322					276
11:00 PM		150	224					187
Total	**0**	**10000**	**13276**	**2784**	**0**	**0**	**0**	
24HrTotal			12671	13389				13030
AM Pk Hr			8:00					
AM Peak			579					579
PM Pk Hr			5:00					
PM Peak			1525					1525
% Peak Hr			11.49%					11.00%
% Peak Hr			12.69%	11.39%				12.04%

Ohio Department of Transportation
99718 Weekly Volume Report - Mon 12/04/2017 - Sun 12/10/2017

Location ID:	99718	**Type:**	SPOT
Located On:	RAMP FROM IR71 SB TO SR176 JENNINGS FWY	**:**	RAMP FROM IR71 SB TO SR176 JENNINGS FWY, II
Direction	RAMP		
Community:	-	**Period:**	Mon 12/04/2017 - Sun 12/10/2017
AADT:	16765		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM			223	254				239
1:00 AM			132	133				133
2:00 AM			96	102				99
3:00 AM			93	95				94
4:00 AM			87	106				97
5:00 AM			261	255				258
6:00 AM			512	520				516
7:00 AM			743	781				762
8:00 AM			726	753				740
9:00 AM			658	642				650
10:00 AM			789	765				777
11:00 AM		858	894					876
12:00 PM		959	1039					999
1:00 PM		1035	1071					1053
2:00 PM		1257	1311					1284
3:00 PM		1583	1563					1573
4:00 PM		1650	1553					1602
5:00 PM		1665	1634					1650
6:00 PM		1162	1267					1215
7:00 PM		896	842					869
8:00 PM		686	690					688
9:00 PM		574	954					764
10:00 PM		493	631					562
11:00 PM		322	374					348
Total	**0**	**13140**	**18143**	**4406**	**0**	**0**	**0**	
24HrTotal			17460	18229				17845
AM Pk Hr			11:00					
AM Peak			894					894
PM Pk Hr			5:00					
PM Peak			1634					1634
% Peak Hr			9.01%					9.00%
% Peak Hr			9.54%	8.96%				9.25%

Ohio Department of Transportation
23190421 Weekly Volume Report - Mon 12/04/2017 - Sun 12/10/2017

Location ID:	23190421	**Type:**	SPOT
Located On:	RAMP 1	**SOUTH OF:**	VALENTINE AVE.
Direction	RAMP		
Community:	CLEVELAND	**Period:**	Mon 12/04/2017 - Sun 12/10/2017
AADT:			

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM			134	161				148
1:00 AM			72	85				79
2:00 AM			55	59				57
3:00 AM			83	83				83
4:00 AM			88	89				89
5:00 AM			187	202				195
6:00 AM			414	392				403
7:00 AM			701	706				704
8:00 AM			699	580				640
9:00 AM			598	574				586
10:00 AM			626	623				625
11:00 AM			725	692				709
12:00 PM		808	780					794
1:00 PM		798	822					810
2:00 PM		1039	1082					1061
3:00 PM		1378	1381					1380
4:00 PM		1552	1607					1580
5:00 PM		1448	1555					1502
6:00 PM		936	1022					979
7:00 PM		792	743					768
8:00 PM		614	544					579
9:00 PM		437	554					496
10:00 PM		318	365					342
11:00 PM		250	311					281
Total	**0**	**10370**	**15148**	**4246**	**0**	**0**	**0**	
24HrTotal			14752	15012				14882
AM Pk Hr			11:00					
AM Peak			725					725
PM Pk Hr			4:00					
PM Peak			1607					1607
% Peak Hr			10.61%					11.00%
% Peak Hr			10.52%	10.70%				10.61%

Ohio Department of Transportation
82918 Weekly Volume Report - Mon 12/04/2017 - Sun 12/10/2017

Location ID:	82918	**Type:**	SPOT
Located On:	RAMP FROM IR71 SB TO US42-3 W25TH	**:**	RAMP FROM IR71 SB TO US42-3 W25TH, IN CLEV
Direction	RAMP		
Community:	-	**Period:**	Mon 12/04/2017 - Sun 12/10/2017
AADT:	9738		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM			129	134				132
1:00 AM			71	79				75
2:00 AM			63	64				64
3:00 AM			40	43				42
4:00 AM			47	57				52
5:00 AM			151	166				159
6:00 AM			433	435				434
7:00 AM			595	626				611
8:00 AM			611	615				613
9:00 AM			487	506				497
10:00 AM			509	491				500
11:00 AM			494	547				521
12:00 PM		567	550					559
1:00 PM		633	618					626
2:00 PM		772	753					763
3:00 PM		785	783					784
4:00 PM		797	703					750
5:00 PM		795	703					749
6:00 PM		559	639					599
7:00 PM		379	447					413
8:00 PM		363	363					363
9:00 PM		281	371					326
10:00 PM		270	292					281
11:00 PM		197	215					206
Total	**0**	**6398**	**10067**	**3763**	**0**	**0**	**0**	
24HrTotal			10028	10200				10114
AM Pk Hr			8:00					
AM Peak			611					611
PM Pk Hr			3:00					
PM Peak			783					783
% Peak Hr			7.78%					8.00%
% Peak Hr			7.95%	7.68%				7.81%

Ohio Department of Transportation
23518_SB Weekly Volume Report - Mon 12/04/2017 - Sun 12/10/2017

Location ID:	23518_SB	**Type:**	SPOT
Located On:	MEDINA FWY		
Direction	SB		
Community:	CLEVELAND	**Period:**	Mon 12/04/2017 - Sun 12/10/2017
AADT:	43534		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM		437	473					455
1:00 AM		230	212					221
2:00 AM		191	219					205
3:00 AM		199	194					197
4:00 AM		340	343					342
5:00 AM		645	668					657
6:00 AM		1306	1441					1374
7:00 AM		1935	2002					1969
8:00 AM		1863	1926					1895
9:00 AM		1580	1662					1621
10:00 AM		1653	1791					1722
11:00 AM		1928	1948					1938
12:00 PM		2147	2108					2128
1:00 PM		2427	2468					2448
2:00 PM		3169	3339					3254
3:00 PM		4430	4343					4387
4:00 PM		5240	4923					5082
5:00 PM		4812	4888					4850
6:00 PM		2934	3037					2986
7:00 PM		1979	2108					2044
8:00 PM		1651	1595					1623
9:00 PM		1152	2094					1623
10:00 PM		1058	1399					1229
11:00 PM		773	821					797
Total	**0**	**44079**	**46002**	**0**	**0**	**0**	**0**	
24HrTotal			44079	46002				45041
AM Pk Hr		7:00	7:00					
AM Peak		1935	2002					1969
PM Pk Hr		4:00	4:00					
PM Peak		5240	4923					5082
% Peak Hr		11.89%	10.70%					11.50%
% Peak Hr			11.89%	10.70%				11.29%

Ohio Department of Transportation
23190421_2_SB Weekly Volume Report - Mon 12/04/2017 - Sun 12/10/2017

Location ID:	23190421_2_SB	**Type:**	SPOT
Located On:	RAMP 1	**SOUTH OF:**	VALENTINE AVE.
Direction	2		
Community:	CLEVELAND	**Period:**	Mon 12/04/2017 - Sun 12/10/2017
AADT:			

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM			91	99				95
1:00 AM			43	59				51
2:00 AM			45	44				45
3:00 AM			52	50				51
4:00 AM			54	51				53
5:00 AM			129	144				137
6:00 AM			282	265				274
7:00 AM			474	461				468
8:00 AM			465	379				422
9:00 AM			411	398				405
10:00 AM			426	395				411
11:00 AM			479	459				469
12:00 PM		523	507					515
1:00 PM		509	538					524
2:00 PM		642	690					666
3:00 PM		845	824					835
4:00 PM		879	931					905
5:00 PM		824	909					867
6:00 PM		567	621					594
7:00 PM		511	460					486
8:00 PM		388	331					360
9:00 PM		265	352					309
10:00 PM		184	216					200
11:00 PM		175	194					185
Total	**0**	**6312**	**9524**	**2804**	**0**	**0**	**0**	
24HrTotal			9263	9377				9320
AM Pk Hr			11:00					
AM Peak			479					479
PM Pk Hr			4:00					
PM Peak			931					931
% Peak Hr			9.78%					10.00%
% Peak Hr			9.49%	9.93%				9.71%

Ohio Department of Transportation
23190421_1_SB Weekly Volume Report - Mon 12/04/2017 - Sun 12/10/2017

Location ID:	23190421_1_SB	**Type:**	SPOT
Located On:	RAMP 1	**SOUTH OF:**	VALENTINE AVE.
Direction	1		
Community:	CLEVELAND	**Period:**	Mon 12/04/2017 - Sun 12/10/2017
AADT:			

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM			43	62				53
1:00 AM			29	26				28
2:00 AM			10	15				13
3:00 AM			31	33				32
4:00 AM			34	38				36
5:00 AM			58	58				58
6:00 AM			132	127				130
7:00 AM			227	245				236
8:00 AM			234	201				218
9:00 AM			187	176				182
10:00 AM			200	228				214
11:00 AM			246	233				240
12:00 PM		285	273					279
1:00 PM		289	284					287
2:00 PM		397	392					395
3:00 PM		533	557					545
4:00 PM		673	676					675
5:00 PM		624	646					635
6:00 PM		369	401					385
7:00 PM		281	283					282
8:00 PM		226	213					220
9:00 PM		172	202					187
10:00 PM		134	149					142
11:00 PM		75	117					96
Total	**0**	**4058**	**5624**	**1442**	**0**	**0**	**0**	
24HrTotal			5489	5635				5562
AM Pk Hr			11:00					
AM Peak			246					246
PM Pk Hr			4:00					
PM Peak			676					676
% Peak Hr			12.02%					12.00%
% Peak Hr			12.26%	12.00%				12.13%

OHIO DEPARTMENT OF TRANSPORTATION – DIVISION OF PLANNING -
OFFICE OF TECHNICAL SERVICES

INTERSECTION TRAFFIC COUNT SHOWING TURNING MOVEMENTS

Co.	Station No.	Route	Log	Location	City/Town	FC	Year
CUY	507658	CR 122	00.00	VALENTINE AVE. AT W.14TH ST. & IR71/SR176 ON RAMP	CLEVELAND	U 05	2017

Recorder	Hour	Period	Day	Date	Weather	Road Condition
TRAFFIC GROUP	6:00 AM	7:00 PM	TUE	12/5/2017	CLOUDY/COLD	DRY

Leg Names:
N – W. 14TH ST.
S – IR71/SR176 ON RAMP
E –
W– VALENTINE AVE.

Expansion Factor P&A:	1.21
Expansion Factor B&C:	1.15
Seasonal Factor P&A:	1.09
Seasonal Factor B&C:	0.95
Combined Factor P&A:	1.32
Combined Factor B&C:	1.09

***Note:** Expansion factor used – 2016 Hour Of Day FC05 (URBAN)

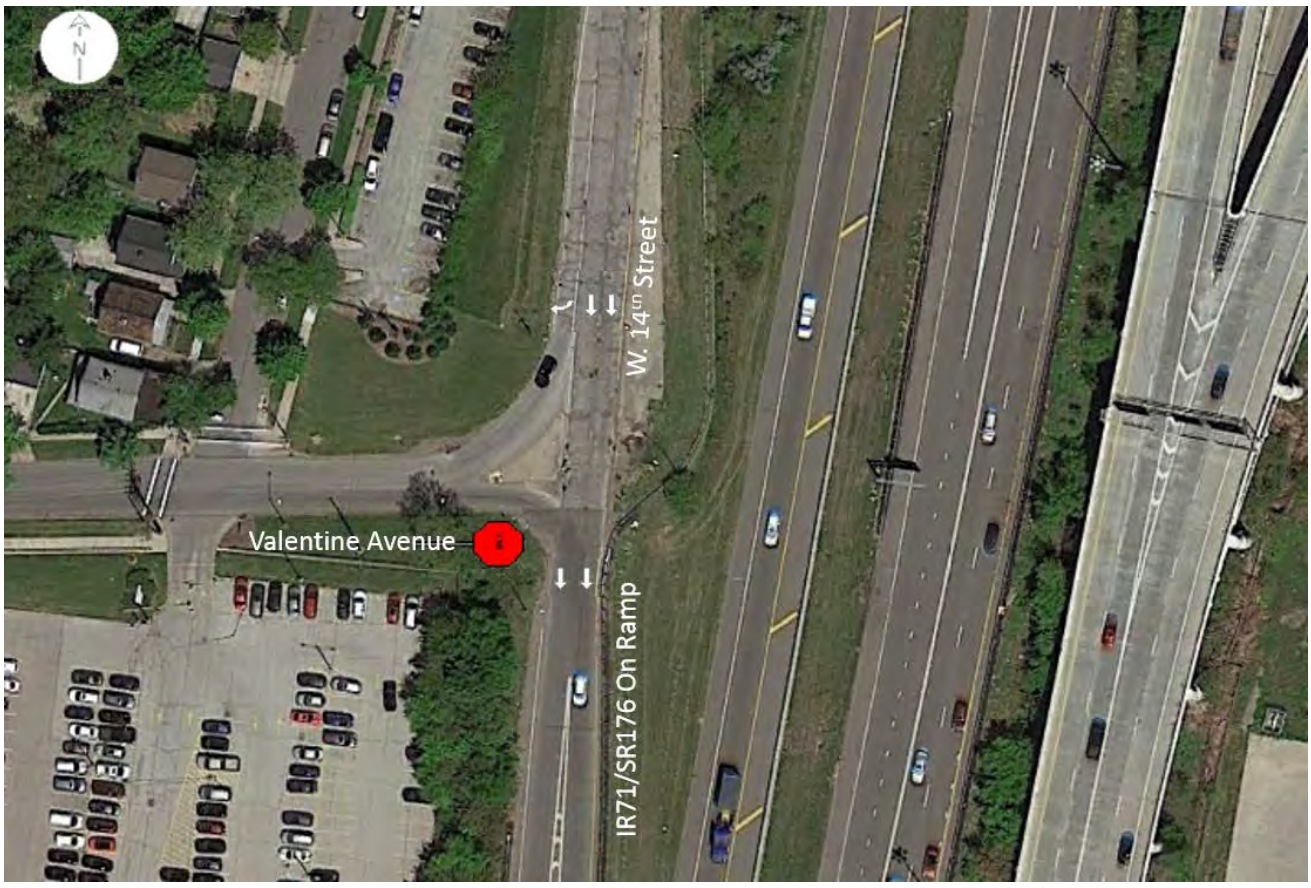
TRAFFIC COUNT REPORT

Specializing in Portable Studies

- Volume
- Classification
- Speed
- Origin and Destination Studies
- ALPR
- Turning Movement Counts
- Non –Intrusive Portable

Station #: 507658
County: CUY
Location: Valentine Avenue at W. 14th Street & IR71/SR176 On Ramp
Log Point: N/A
Count Type: Turning Movement
GPS Coordinates: 41.46326, -81.694701
Count Duration: 13 hour
Conducted By: Erin Boylan
Summarized By: Anthony Guckert

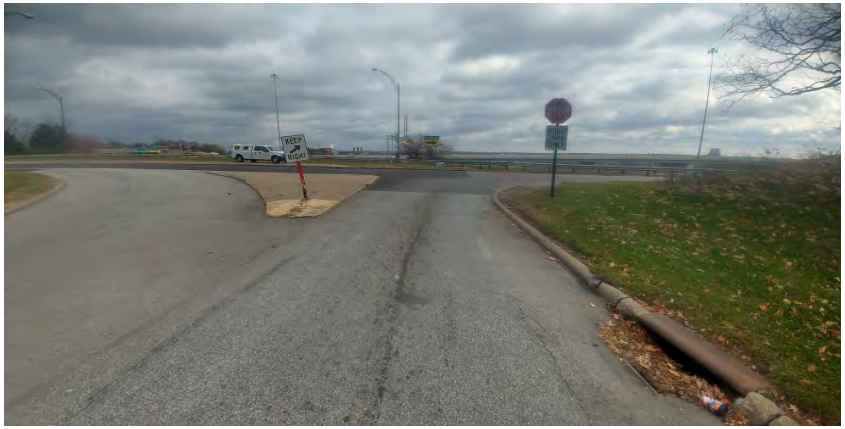
Count Date/Time: 12/5/2017 from 6:00 am to 7:00 pm



The Traffic Group Inc. 9900 Franklin Square Drive Suite H Baltimore, Maryland 21236
410.931.6600 fax: 410.931.6601 1.800.583.8411 www.trafficgroup.com

Station #: 507658
County: CUY
Location: Valentine Avenue at W. 14th Street & IR71/SR176 On Ramp
Log Point: N/A
GPS Coordinates: 41.46326, -81.694701

Looking Southbound From North Leg



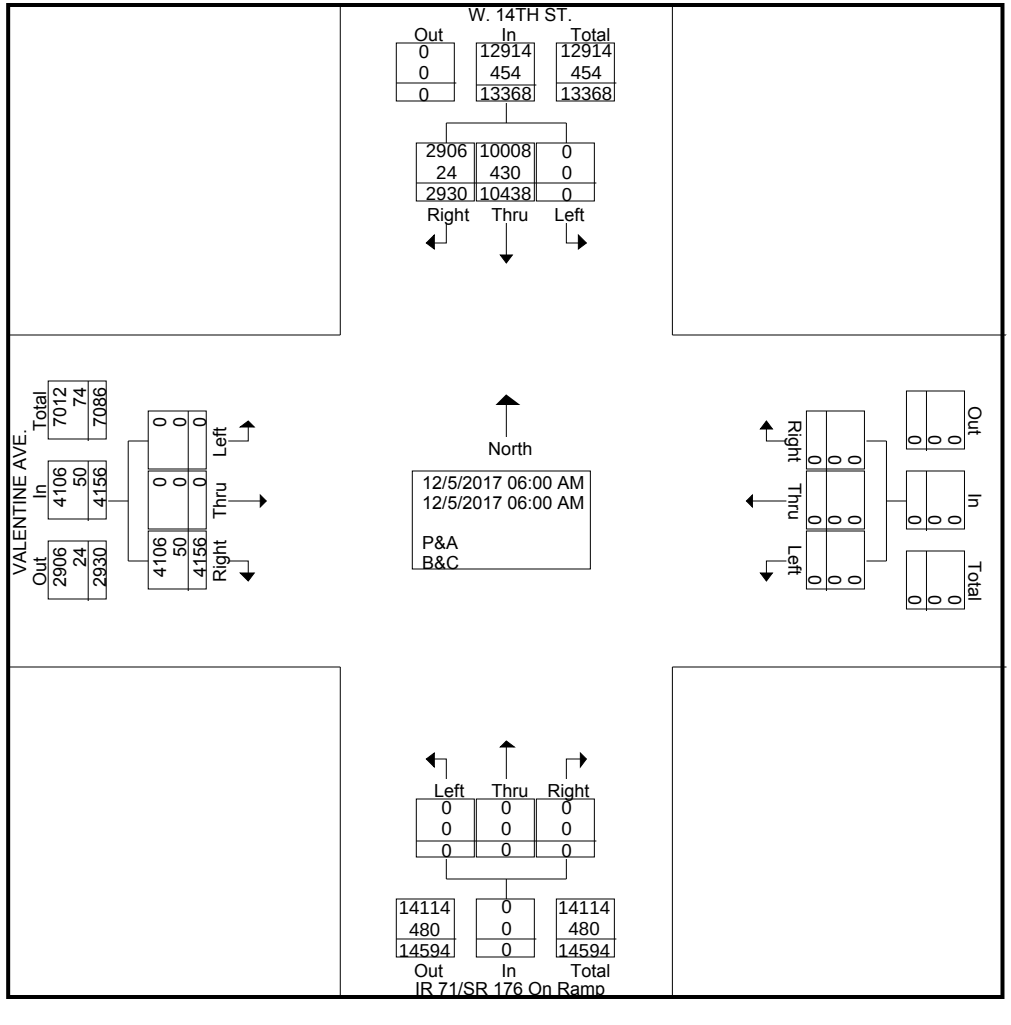
Looking Eastbound From West Leg

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF TECHNICAL SERVICES
1980 WEST BROAD STREET, 2ND FLOOR N.E.
COLUMBUS, OHIO 43223
(614) 466-3728

IR 71 Ramps & Valentine Ave.
Counted By: The Traffic Group, Inc.
Weather: Cloudy, Cold
Notes: ADT

Site Code : 507658
Start Date : 12/5/2017
Page No : 1



OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF TECHNICAL SERVICES
1980 WEST BROAD STREET, 2ND FLOOR N.E.
COLUMBUS, OHIO 43223
(614) 466-3728

Valentine Ave. at W. 14th St. & I-71/SR-176 On Ramp
Counted By: The Traffic Group, Inc.
Weather: Cloudy, Cold
Notes: Raw Data

Site Code : 507658
Start Date : 12/5/2017
Page No : 1

Groups Printed- P&A

	VALENTINE AVE. Eastbound				Westbound				IR 71 Ramp Northbound				W. 14TH ST. Southbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
06:00 AM	20	0	0	20	0	0	0	0	0	0	0	0	15	47	0	62	82
06:15 AM	41	0	0	41	0	0	0	0	0	0	0	0	37	44	0	81	122
06:30 AM	48	0	0	48	0	0	0	0	0	0	0	0	76	66	0	142	190
06:45 AM	36	0	0	36	0	0	0	0	0	0	0	0	110	75	0	185	221
Total	145	0	0	145	0	0	0	0	0	0	0	0	238	232	0	470	615
07:00 AM	28	0	0	28	0	0	0	0	0	0	0	0	46	72	0	118	146
07:15 AM	46	0	0	46	0	0	0	0	0	0	0	0	51	79	0	130	176
07:30 AM	91	0	0	91	0	0	0	0	0	0	0	0	56	115	0	171	262
07:45 AM	62	0	0	62	0	0	0	0	0	0	0	0	78	91	0	169	231
Total	227	0	0	227	0	0	0	0	0	0	0	0	231	357	0	588	815
08:00 AM	50	0	0	50	0	0	0	0	0	0	0	0	45	96	0	141	191
08:15 AM	48	0	0	48	0	0	0	0	0	0	0	0	58	93	0	151	199
08:30 AM	36	0	0	36	0	0	0	0	0	0	0	0	55	91	0	146	182
08:45 AM	28	0	0	28	0	0	0	0	0	0	0	0	46	85	0	131	159
Total	162	0	0	162	0	0	0	0	0	0	0	0	204	365	0	569	731
09:00 AM	41	0	0	41	0	0	0	0	0	0	0	0	35	65	0	100	141
09:15 AM	58	0	0	58	0	0	0	0	0	0	0	0	28	95	0	123	181
09:30 AM	36	0	0	36	0	0	0	0	0	0	0	0	39	99	0	138	174
09:45 AM	47	0	0	47	0	0	0	0	0	0	0	0	37	88	0	125	172
Total	182	0	0	182	0	0	0	0	0	0	0	0	139	347	0	486	668
10:00 AM	32	0	0	32	0	0	0	0	0	0	0	0	35	99	0	134	166
10:15 AM	35	0	0	35	0	0	0	0	0	0	0	0	24	104	0	128	163
10:30 AM	41	0	0	41	0	0	0	0	0	0	0	0	25	93	0	118	159
10:45 AM	36	0	0	36	0	0	0	0	0	0	0	0	41	94	0	135	171
Total	144	0	0	144	0	0	0	0	0	0	0	0	125	390	0	515	659
11:00 AM	37	0	0	37	0	0	0	0	0	0	0	0	30	96	0	126	163
11:15 AM	50	0	0	50	0	0	0	0	0	0	0	0	31	117	0	148	198

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF TECHNICAL SERVICES
1980 WEST BROAD STREET, 2ND FLOOR N.E.
COLUMBUS, OHIO 43223
(614) 466-3728

Valentine Ave. at W. 14th St. & I-71/SR-176 On Ramp
Counted By: The Traffic Group, Inc.
Weather: Cloudy, Cold
Notes: Raw Data

Site Code : 507658
Start Date : 12/5/2017

Groups Printed- P&A

	VALENTINE AVE. Eastbound				Westbound				IR 71 Ramp Northbound				W. 14TH ST. Southbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
11:30 AM	54	0	0	54	0	0	0	0	0	0	0	0	30	133	0	163	217
11:45 AM	47	0	0	47	0	0	0	0	0	0	0	0	40	113	0	153	200
Total	188	0	0	188	0	0	0	0	0	0	0	0	131	459	0	590	778
12:00 PM	50	0	0	50	0	0	0	0	0	0	0	0	26	116	0	142	192
12:15 PM	50	0	0	50	0	0	0	0	0	0	0	0	27	134	0	161	211
12:30 PM	60	0	0	60	0	0	0	0	0	0	0	0	52	130	0	182	242
12:45 PM	53	0	0	53	0	0	0	0	0	0	0	0	45	139	0	184	237
Total	213	0	0	213	0	0	0	0	0	0	0	0	150	519	0	669	882
01:00 PM	56	0	0	56	0	0	0	0	0	0	0	0	43	120	0	163	219
01:15 PM	63	0	0	63	0	0	0	0	0	0	0	0	34	102	0	136	199
01:30 PM	65	0	0	65	0	0	0	0	0	0	0	0	54	121	0	175	240
01:45 PM	45	0	0	45	0	0	0	0	0	0	0	0	34	130	0	164	209
Total	229	0	0	229	0	0	0	0	0	0	0	0	165	473	0	638	867
02:00 PM	49	0	0	49	0	0	0	0	0	0	0	0	33	166	0	199	248
02:15 PM	64	0	0	64	0	0	0	0	0	0	0	0	37	178	0	215	279
02:30 PM	85	0	0	85	0	0	0	0	0	0	0	0	44	170	0	214	299
02:45 PM	75	0	0	75	0	0	0	0	0	0	0	0	57	170	0	227	302
Total	273	0	0	273	0	0	0	0	0	0	0	0	171	684	0	855	1128
03:00 PM	71	0	0	71	0	0	0	0	0	0	0	0	25	234	0	259	330
03:15 PM	100	0	0	100	0	0	0	0	0	0	0	0	45	207	0	252	352
03:30 PM	105	0	0	105	0	0	0	0	0	0	0	0	42	245	0	287	392
03:45 PM	102	0	0	102	0	0	0	0	0	0	0	0	43	255	0	298	400
Total	378	0	0	378	0	0	0	0	0	0	0	0	155	941	0	1096	1474
04:00 PM	97	0	0	97	0	0	0	0	0	0	0	0	40	266	0	306	403
04:15 PM	88	0	0	88	0	0	0	0	0	0	0	0	37	296	0	333	421
04:30 PM	107	0	0	107	0	0	0	0	0	0	0	0	36	285	0	321	428
04:45 PM	101	0	0	101	0	0	0	0	0	0	0	0	48	257	0	305	406
Total	393	0	0	393	0	0	0	0	0	0	0	0	161	1104	0	1265	1658

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF TECHNICAL SERVICES
1980 WEST BROAD STREET, 2ND FLOOR N.E.
COLUMBUS, OHIO 43223
(614) 466-3728

Valentine Ave. at W. 14th St. & I-71/SR-176 On Ramp
Counted By: The Traffic Group, Inc.
Weather: Cloudy, Cold
Notes: Raw Data

Site Code : 507658
Start Date : 12/5/2017

Groups Printed- P&A

	VALENTINE AVE. Eastbound				Westbound				IR 71 Ramp Northbound				W. 14TH ST. Southbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
05:00 PM	89	0	0	89	0	0	0	0	0	0	0	0	30	288	0	318	407
05:15 PM	82	0	0	82	0	0	0	0	0	0	0	0	36	304	0	340	422
05:30 PM	94	0	0	94	0	0	0	0	0	0	0	0	38	254	0	292	386
05:45 PM	64	0	0	64	0	0	0	0	0	0	0	0	40	219	0	259	323
Total	329	0	0	329	0	0	0	0	0	0	0	0	144	1065	0	1209	1538
06:00 PM	83	0	0	83	0	0	0	0	0	0	0	0	48	201	0	249	332
06:15 PM	58	0	0	58	0	0	0	0	0	0	0	0	35	161	0	196	254
06:30 PM	59	0	0	59	0	0	0	0	0	0	0	0	49	150	0	199	258
06:45 PM	48	0	0	48	0	0	0	0	0	0	0	0	54	135	0	189	237
Total	248	0	0	248	0	0	0	0	0	0	0	0	186	647	0	833	1081
Grand Total	3111	0	0	3111	0	0	0	0	0	0	0	0	2200	7583	0	9783	12894
Apprch %	100	0	0		0	0	0		0	0	0		22.5	77.5	0		
Total %	24.1	0	0	24.1	0	0	0	0	0	0	0	0	17.1	58.8	0	75.9	

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF TECHNICAL SERVICES
1980 WEST BROAD STREET, 2ND FLOOR N.E.
COLUMBUS, OHIO 43223
(614) 466-3728

Valentine Ave. at W. 14th St. & I-71/SR-176 On Ramp
Counted By: The Traffic Group, Inc.
Weather: Cloudy, Cold
Notes: Raw Data

Site Code : 507658
Start Date : 12/5/2017

Groups Printed- B&C

	VALENTINE AVE. Eastbound				Westbound				IR 71 Ramp Northbound				W. 14TH ST. Southbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	5
06:15 AM	2	0	0	2	0	0	0	0	0	0	0	0	0	7	0	7	9
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	2
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	5
Total	2	0	0	2	0	0	0	0	0	0	0	0	0	19	0	19	21
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	9	9
07:15 AM	1	0	0	1	0	0	0	0	0	0	0	0	3	15	0	18	19
07:30 AM	1	0	0	1	0	0	0	0	0	0	0	0	2	5	0	7	8
07:45 AM	3	0	0	3	0	0	0	0	0	0	0	0	0	11	0	11	14
Total	5	0	0	5	0	0	0	0	0	0	0	0	5	40	0	45	50
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	4
08:15 AM	2	0	0	2	0	0	0	0	0	0	0	0	2	11	0	13	15
08:30 AM	1	0	0	1	0	0	0	0	0	0	0	0	0	12	0	12	13
08:45 AM	4	0	0	4	0	0	0	0	0	0	0	0	0	16	0	16	20
Total	7	0	0	7	0	0	0	0	0	0	0	0	2	43	0	45	52
09:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10	10
09:15 AM	2	0	0	2	0	0	0	0	0	0	0	0	0	13	0	13	15
09:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	8	8
09:45 AM	1	0	0	1	0	0	0	0	0	0	0	0	0	10	0	10	11
Total	3	0	0	3	0	0	0	0	0	0	0	0	0	41	0	41	44
10:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	11	0	12	12
10:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	2	7	0	9	9
10:30 AM	2	0	0	2	0	0	0	0	0	0	0	0	0	13	0	13	15
10:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	7	7
Total	2	0	0	2	0	0	0	0	0	0	0	0	4	37	0	41	43
11:00 AM	1	0	0	1	0	0	0	0	0	0	0	0	1	7	0	8	9
11:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	9	9

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF TECHNICAL SERVICES
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COLUMBUS, OHIO 43223
(614) 466-3728

Valentine Ave. at W. 14th St. & I-71/SR-176 On Ramp
Counted By: The Traffic Group, Inc.
Weather: Cloudy, Cold
Notes: Raw Data

Site Code : 507658
Start Date : 12/5/2017

Groups Printed- B&C

	VALENTINE AVE. Eastbound				Westbound				IR 71 Ramp Northbound				W. 14TH ST. Southbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
11:30 AM	3	0	0	3	0	0	0	0	0	0	0	0	0	13	0	13	16
11:45 AM	2	0	0	2	0	0	0	0	0	0	0	0	2	10	0	12	14
Total	6	0	0	6	0	0	0	0	0	0	0	0	3	39	0	42	48
12:00 PM	1	0	0	1	0	0	0	0	0	0	0	0	2	8	0	10	11
12:15 PM	1	0	0	1	0	0	0	0	0	0	0	0	1	7	0	8	9
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	14	0	15	15
12:45 PM	1	0	0	1	0	0	0	0	0	0	0	0	1	4	0	5	6
Total	3	0	0	3	0	0	0	0	0	0	0	0	5	33	0	38	41
01:00 PM	7	0	0	7	0	0	0	0	0	0	0	0	2	13	0	15	22
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	10	0	11	11
01:30 PM	1	0	0	1	0	0	0	0	0	0	0	0	0	11	0	11	12
01:45 PM	1	0	0	1	0	0	0	0	0	0	0	0	0	9	0	9	10
Total	9	0	0	9	0	0	0	0	0	0	0	0	3	43	0	46	55
02:00 PM	1	0	0	1	0	0	0	0	0	0	0	0	0	9	0	9	10
02:15 PM	2	0	0	2	0	0	0	0	0	0	0	0	0	10	0	10	12
02:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10	10
02:45 PM	3	0	0	3	0	0	0	0	0	0	0	0	0	11	0	11	14
Total	6	0	0	6	0	0	0	0	0	0	0	0	0	40	0	40	46
03:00 PM	1	0	0	1	0	0	0	0	0	0	0	0	0	5	0	5	6
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	13	13
03:30 PM	1	0	0	1	0	0	0	0	0	0	0	0	0	6	0	6	7
03:45 PM	1	0	0	1	0	0	0	0	0	0	0	0	1	8	0	9	10
Total	3	0	0	3	0	0	0	0	0	0	0	0	1	32	0	33	36
04:00 PM	2	0	0	2	0	0	0	0	0	0	0	0	0	4	0	4	6
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	3
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	5	5
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	3
Total	2	0	0	2	0	0	0	0	0	0	0	0	1	14	0	15	17

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF TECHNICAL SERVICES
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COLUMBUS, OHIO 43223
(614) 466-3728

Valentine Ave. at W. 14th St. & I-71/SR-176 On Ramp
Counted By: The Traffic Group, Inc.
Weather: Cloudy, Cold
Notes: Raw Data

Site Code : 507658
Start Date : 12/5/2017

Groups Printed- B&C

	VALENTINE AVE. Eastbound				Westbound				IR 71 Ramp Northbound				W. 14TH ST. Southbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
05:30 PM	1	0	0	1	0	0	0	0	0	0	0	0	0	5	0	5	6
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	3
Total	1	0	0	1	0	0	0	0	0	0	0	0	0	10	0	10	11
06:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
06:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	2
06:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	3
*** BREAK ***																	
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	6	6
Grand Total	49	0	0	49	0	0	0	0	0	0	0	0	24	397	0	421	470
Apprch %	100	0	0		0	0	0		0	0	0		5.7	94.3	0		
Total %	10.4	0	0	10.4	0	0	0	0	0	0	0	0	5.1	84.5	0	89.6	

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF TECHNICAL SERVICES
1980 WEST BROAD STREET, 2ND FLOOR N.E.
COLUMBUS, OHIO 43223
(614) 466-3728

Valentine Ave. at W. 14th St. & I-71/SR-176 On Ramp
Counted By: The Traffic Group, Inc.
Weather: Cloudy, Cold
Notes: Raw Data

Site Code : 507658
Start Date : 12/5/2017

Groups Printed- P&A - B&C

	VALENTINE AVE. Eastbound				Westbound				IR 71 Ramp Northbound				W. 14TH ST. Southbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
06:00 AM	20	0	0	20	0	0	0	0	0	0	0	0	15	52	0	67	87
06:15 AM	43	0	0	43	0	0	0	0	0	0	0	0	37	51	0	88	131
06:30 AM	48	0	0	48	0	0	0	0	0	0	0	0	76	68	0	144	192
06:45 AM	36	0	0	36	0	0	0	0	0	0	0	0	110	80	0	190	226
Total	147	0	0	147	0	0	0	0	0	0	0	0	238	251	0	489	636
07:00 AM	28	0	0	28	0	0	0	0	0	0	0	0	46	81	0	127	155
07:15 AM	47	0	0	47	0	0	0	0	0	0	0	0	54	94	0	148	195
07:30 AM	92	0	0	92	0	0	0	0	0	0	0	0	58	120	0	178	270
07:45 AM	65	0	0	65	0	0	0	0	0	0	0	0	78	102	0	180	245
Total	232	0	0	232	0	0	0	0	0	0	0	0	236	397	0	633	865
08:00 AM	50	0	0	50	0	0	0	0	0	0	0	0	45	100	0	145	195
08:15 AM	50	0	0	50	0	0	0	0	0	0	0	0	60	104	0	164	214
08:30 AM	37	0	0	37	0	0	0	0	0	0	0	0	55	103	0	158	195
08:45 AM	32	0	0	32	0	0	0	0	0	0	0	0	46	101	0	147	179
Total	169	0	0	169	0	0	0	0	0	0	0	0	206	408	0	614	783
09:00 AM	41	0	0	41	0	0	0	0	0	0	0	0	35	75	0	110	151
09:15 AM	60	0	0	60	0	0	0	0	0	0	0	0	28	108	0	136	196
09:30 AM	36	0	0	36	0	0	0	0	0	0	0	0	39	107	0	146	182
09:45 AM	48	0	0	48	0	0	0	0	0	0	0	0	37	98	0	135	183
Total	185	0	0	185	0	0	0	0	0	0	0	0	139	388	0	527	712
10:00 AM	32	0	0	32	0	0	0	0	0	0	0	0	36	110	0	146	178
10:15 AM	35	0	0	35	0	0	0	0	0	0	0	0	26	111	0	137	172
10:30 AM	43	0	0	43	0	0	0	0	0	0	0	0	25	106	0	131	174
10:45 AM	36	0	0	36	0	0	0	0	0	0	0	0	42	100	0	142	178
Total	146	0	0	146	0	0	0	0	0	0	0	0	129	427	0	556	702
11:00 AM	38	0	0	38	0	0	0	0	0	0	0	0	31	103	0	134	172
11:15 AM	50	0	0	50	0	0	0	0	0	0	0	0	31	126	0	157	207

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Valentine Ave. at W. 14th St. & I-71/SR-176 On Ramp
Counted By: The Traffic Group, Inc.
Weather: Cloudy, Cold
Notes: Raw Data

Site Code : 507658
Start Date : 12/5/2017

Groups Printed- P&A - B&C

	VALENTINE AVE. Eastbound				Westbound				IR 71 Ramp Northbound				W. 14TH ST. Southbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
11:30 AM	57	0	0	57	0	0	0	0	0	0	0	0	30	146	0	176	233
11:45 AM	49	0	0	49	0	0	0	0	0	0	0	0	42	123	0	165	214
Total	194	0	0	194	0	0	0	0	0	0	0	0	134	498	0	632	826
12:00 PM	51	0	0	51	0	0	0	0	0	0	0	0	28	124	0	152	203
12:15 PM	51	0	0	51	0	0	0	0	0	0	0	0	28	141	0	169	220
12:30 PM	60	0	0	60	0	0	0	0	0	0	0	0	53	144	0	197	257
12:45 PM	54	0	0	54	0	0	0	0	0	0	0	0	46	143	0	189	243
Total	216	0	0	216	0	0	0	0	0	0	0	0	155	552	0	707	923
01:00 PM	63	0	0	63	0	0	0	0	0	0	0	0	45	133	0	178	241
01:15 PM	63	0	0	63	0	0	0	0	0	0	0	0	35	112	0	147	210
01:30 PM	66	0	0	66	0	0	0	0	0	0	0	0	54	132	0	186	252
01:45 PM	46	0	0	46	0	0	0	0	0	0	0	0	34	139	0	173	219
Total	238	0	0	238	0	0	0	0	0	0	0	0	168	516	0	684	922
02:00 PM	50	0	0	50	0	0	0	0	0	0	0	0	33	175	0	208	258
02:15 PM	66	0	0	66	0	0	0	0	0	0	0	0	37	188	0	225	291
02:30 PM	85	0	0	85	0	0	0	0	0	0	0	0	44	180	0	224	309
02:45 PM	78	0	0	78	0	0	0	0	0	0	0	0	57	181	0	238	316
Total	279	0	0	279	0	0	0	0	0	0	0	0	171	724	0	895	1174
03:00 PM	72	0	0	72	0	0	0	0	0	0	0	0	25	239	0	264	336
03:15 PM	100	0	0	100	0	0	0	0	0	0	0	0	45	220	0	265	365
03:30 PM	106	0	0	106	0	0	0	0	0	0	0	0	42	251	0	293	399
03:45 PM	103	0	0	103	0	0	0	0	0	0	0	0	44	263	0	307	410
Total	381	0	0	381	0	0	0	0	0	0	0	0	156	973	0	1129	1510
04:00 PM	99	0	0	99	0	0	0	0	0	0	0	0	40	270	0	310	409
04:15 PM	88	0	0	88	0	0	0	0	0	0	0	0	37	299	0	336	424
04:30 PM	107	0	0	107	0	0	0	0	0	0	0	0	37	289	0	326	433
04:45 PM	101	0	0	101	0	0	0	0	0	0	0	0	48	260	0	308	409
Total	395	0	0	395	0	0	0	0	0	0	0	0	162	1118	0	1280	1675

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Counted By: The Traffic Group, Inc.
Weather: Cloudy, Cold
Notes: Raw Data

Site Code : 507658
Start Date : 12/5/2017

Groups Printed- P&A - B&C

	VALENTINE AVE. Eastbound				Westbound				IR 71 Ramp Northbound				W. 14TH ST. Southbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
05:00 PM	89	0	0	89	0	0	0	0	0	0	0	0	30	289	0	319	408
05:15 PM	82	0	0	82	0	0	0	0	0	0	0	0	36	305	0	341	423
05:30 PM	95	0	0	95	0	0	0	0	0	0	0	0	38	259	0	297	392
05:45 PM	64	0	0	64	0	0	0	0	0	0	0	0	40	222	0	262	326
Total	330	0	0	330	0	0	0	0	0	0	0	0	144	1075	0	1219	1549
06:00 PM	83	0	0	83	0	0	0	0	0	0	0	0	48	202	0	250	333
06:15 PM	58	0	0	58	0	0	0	0	0	0	0	0	35	163	0	198	256
06:30 PM	59	0	0	59	0	0	0	0	0	0	0	0	49	153	0	202	261
06:45 PM	48	0	0	48	0	0	0	0	0	0	0	0	54	135	0	189	237
Total	248	0	0	248	0	0	0	0	0	0	0	0	186	653	0	839	1087
Grand Total	3160	0	0	3160	0	0	0	0	0	0	0	0	2224	7980	0	10204	13364
Apprch %	100	0	0		0	0	0		0	0	0		21.8	78.2	0		
Total %	23.6	0	0	23.6	0	0	0	0	0	0	0	0	16.6	59.7	0	76.4	
P&A	3111	0	0	3111	0	0	0	0	0	0	0	0	2200	7583	0	9783	12894
% P&A	98.4	0	0	98.4	0	0	0	0	0	0	0	0	98.9	95	0	95.9	96.5
B&C	49	0	0	49	0	0	0	0	0	0	0	0	24	397	0	421	470
% B&C	1.6	0	0	1.6	0	0	0	0	0	0	0	0	1.1	5	0	4.1	3.5

Ohio Department of Transportation
107118 Weekly Volume Report - Mon 12/04/2017 - Sun 12/10/2017

Location ID:	107118	**Type:**	SPOT
Located On:	RAMPS FROM IR90-490 TO SR176 JENNINGS FRWY SB		
Direction	RAMP		
Community:	-	**Period:**	Mon 12/04/2017 - Sun 12/10/2017
AADT:	33076		

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM			285	329				307
1:00 AM			167	195				181
2:00 AM			160	178				169
3:00 AM			172	173				173
4:00 AM			271	269				270
5:00 AM			772	781				777
6:00 AM			1603	1513				1558
7:00 AM			1963	1883				1923
8:00 AM			1905	1843				1874
9:00 AM			1858	1749				1804
10:00 AM			1612	1709				1661
11:00 AM		1756	1809					1783
12:00 PM		1916	1947					1932
1:00 PM		1887	2036					1962
2:00 PM		2329	2484					2407
3:00 PM		2766	2721					2744
4:00 PM		2806	2735					2771
5:00 PM		2717	2723					2720
6:00 PM		1933	2096					2015
7:00 PM		1541	1501					1521
8:00 PM		1351	1290					1321
9:00 PM		1033	1248					1141
10:00 PM		710	834					772
11:00 PM		518	605					562
Total	**0**	**23263**	**34797**	**10622**	**0**	**0**	**0**	
24HrTotal			34031	34651				34341
AM Pk Hr			7:00					
AM Peak			1963					1963
PM Pk Hr			4:00					
PM Peak			2735					2735
% Peak Hr			7.86%					8.00%
% Peak Hr			8.25%	7.89%				8.07%

CUY-71-18.29 SAFETY STUDY

APPENDIX E: SAFETY ANALYSIS

CUY-71-18.29 Safety Analysis (2015-2017)

	Number
Total	**132**

CRASH_SEVERITY	Number	%
Injury Crash	**34**	25.8%
Property Damage Crash	**98**	74.2%
Grand Total	**132**	**100.0%**

TRAFFIC_CRASH_YEAR	Number	%
2015	**34**	25.8%
2016	**51**	38.6%
2017	**47**	35.6%
Grand Total	**132**	**100.0%**

DAY_OF_WEEK	Number	%
Monday	**32**	24.2%
Thursday	**27**	20.5%
Wednesday	**23**	17.4%
Tuesday	**17**	12.9%
Friday	**15**	11.4%
Sunday	**13**	9.8%
Saturday	**5**	3.8%
Grand Total	**132**	**100.0%**

HOUR_OF_DAY	Number	%
00	**3**	2.3%
01	**3**	2.3%
02	**2**	1.5%
03	**1**	0.8%
05	**3**	2.3%
06	**3**	2.3%
07	**3**	2.3%
08	**3**	2.3%
09	**3**	2.3%
10	**6**	4.5%
11	**5**	3.8%
12	**5**	3.8%
13	**5**	3.8%
14	**9**	6.8%
15	**19**	14.4%
16	**14**	10.6%
17	**20**	15.2%
18	**9**	6.8%
19	**3**	2.3%
20	**2**	1.5%
21	**1**	0.8%
22	**6**	4.5%
23	**4**	3.0%
Grand Total	**132**	**100.0%**

TYPE_OF_CRASH	Number	%
Rear End	**58**	43.9%
Sideswipe - Passing	**40**	30.3%
Fixed Object	**28**	21.2%
Other Non-Collision	**2**	1.5%
Unknown	**1**	0.8%
Overturning	**1**	0.8%
Right Turn	**1**	0.8%
Angle	**1**	0.8%
Grand Total	**132**	**100.0%**

CUY-71-18.29 Safety Analysis (2015-2017)

WEATHER_CONDITION	Number	%
Clear	**69**	52.3%
Cloudy	**36**	27.3%
Rain	**12**	9.1%
Other/Unknown	**8**	6.1%
Snow	**7**	5.3%
Grand Total	**132**	**100.0%**

ROAD_CONDITION	Number	%
Dry	**88**	66.7%
Wet	**29**	22.0%
Snow	**11**	8.3%
Unknown	**3**	2.3%
Ice	**1**	0.8%
Grand Total	**132**	**100.0%**

LIGHT_CONDITION	Number	%
Daylight	**85**	64.4%
Dark - Lighted Roadway	**34**	25.8%
Dusk	**6**	4.5%
Unknown	**6**	4.5%
Dark - Unknown Roadway Lighting	**1**	0.8%
Grand Total	**132**	**100.0%**

NUMBER_OF_VEHICLES		Number	%
	1	**31**	23.5%
	2	**87**	65.9%
	3	**12**	9.1%
	4	**2**	1.5%
Grand Total		**132**	**100.0%**

LOCATION	Number	%
Not An Intersection	**104**	78.8%
On Ramp	**8**	6.1%
Y-Intersection	**8**	6.1%
Off Ramp	**3**	2.3%
Four-Way Intersection	**2**	1.5%
Crossover	**2**	1.5%
Unknown	**2**	1.5%
T-Intersection	**2**	1.5%
Traffic Circle/Roundabout	**1**	0.8%
Grand Total	**132**	**100.0%**

CRASH_MONTH_NBR		Number	%
	1	**24**	18.2%
	2	**16**	12.1%
	3	**13**	9.8%
	4	**8**	6.1%
	5	**5**	3.8%
	6	**3**	2.3%
	7	**13**	9.8%
	8	**12**	9.1%
	9	**5**	3.8%
	10	**11**	8.3%
	11	**9**	6.8%
	12	**13**	9.8%
Grand Total		**132**	**100.0%**

ROAD_CONTOUR	Number	%
Straight Level	**86**	65.2%
Curve Level	**19**	14.4%
Curve Grade	**13**	9.8%
Straight Grade	**12**	9.1%
Unknown	**2**	1.5%
Grand Total	**132**	**100.0%**

SPECIAL_AREA	Number	%
(blank)	**132**	100.0%
Grand Total	**132**	**100.0%**

ANIMAL_TYPE	Number	%
(blank)	**132**	100.0%
Grand Total	**132**	**100.0%**

CUY-71-18.29 Safety Analysis (2015-2017)

ACTION1	Number	%
Straight Ahead	73	55.3%
Changing Lanes	22	16.7%
Unknown	18	13.6%
Slowing Or Stopped In Traffic	9	6.8%
Negotiating A Curve	6	4.5%
Backing	1	0.8%
Overtaking/Passing	1	0.8%
Making Right Turn	1	0.8%
Leaving Traffic Lane	1	0.8%
Grand Total	**132**	**100.0%**

CONTRIBUTING_FACTOR1	Number	%
Failure To Control	32	24.2%
Followed To Closely/ACDA	28	21.2%
Unknown	25	18.9%
Improper Lane Change/Passing/Offroad	17	12.9%
None-Motorist	11	8.3%
Failure To Yield	5	3.8%
Unsafe Speed	3	2.3%
Other Improper Action	3	2.3%
Swerving To Avoid	3	2.3%
Improper Start From Parked Position	1	0.8%
Left Of Center	1	0.8%
Wrong Side/Wrong Way	1	0.8%
Improper Backing	1	0.8%
Load Shifting/Falling/Spilling	1	0.8%
Grand Total	**132**	**100.0%**

	Number	%
Total	**132**	**100.0%**

TRAFFIC_CONTROL1	Number	%
No Controls	119	90.2%
Pavement Markings	8	6.1%
Not Reported	3	2.3%
Yield Sign	1	0.8%
Stop Sign	1	0.8%
Grand Total	**132**	**100.0%**

DRIVER_ALCOHOL1	Number	%
No	130	98.5%
Yes	2	1.5%
Grand Total	**132**	**100.0%**

DRIVER_DRUGS1	Number	%
No	130	98.5%
Yes	2	1.5%
Grand Total	**132**	**100.0%**

CUY-71-18.29 Safety Analysis (2015-2017)

DIRECTION_FROM1	Number	%
North	**110**	83.3%
Unknown	**15**	11.4%
Northwest	**2**	1.5%
East	**2**	1.5%
West	**2**	1.5%
South	**1**	0.8%
Grand Total	**132**	**100.0%**

DIRECTION_TO1	Number	%
South	**109**	82.6%
Unknown	**17**	12.9%
North	**2**	1.5%
Southeast	**1**	0.8%
West	**1**	0.8%
Southwest	**1**	0.8%
East	**1**	0.8%
Grand Total	**132**	**100.0%**

POSTED_SPEED1	Number	%
60	**95**	72.0%
50	**14**	10.6%
	7	5.3%
35	**6**	4.5%
45	**3**	2.3%
55	**3**	2.3%
65	**2**	1.5%
25	**1**	0.8%
40	**1**	0.8%
Grand Total	**132**	**100.0%**

ESTIMATED_SPEED1	Number	%
50	**1**	100.0%
Grand Total	**1**	**100.0%**

VEHICLE_TYPE1	Number	%
Mid Size	**41**	31.1%
Unknown Or Hit/Skip	**20**	15.2%
Sport Utility Vehicle	**19**	14.4%
Compact	**16**	12.1%
Full Size	**14**	10.6%
Pickup	**8**	6.1%
Single Unit Truck Or Van 2 Axle, 6 Tires	**3**	2.3%
Van	**3**	2.3%
Minivan	**2**	1.5%
Motorcycle	**2**	1.5%
Sub-Compact	**2**	1.5%
Single Unit Truck; 3+ Axles	**1**	0.8%
Truck/Tractor (Bobtail)	**1**	0.8%
Grand Total	**132**	**100.0%**

VEHICLE_TYPE2	Number	%
Mid Size	**32**	24.2%
	31	23.5%
Sport Utility Vehicle	**24**	18.2%
Compact	**16**	12.1%
Pickup	**8**	6.1%
Minivan	**6**	4.5%
Full Size	**5**	3.8%
Unknown Or Hit/Skip	**2**	1.5%
Bus/Van (9-15 Seats Inc Driver)	**2**	1.5%
Single Unit Truck Or Van 2 Axle, 6 Tires	**2**	1.5%
Tractor/Semi-Trailer	**2**	1.5%
Van	**1**	0.8%
Sub-Compact	**1**	0.8%
Grand Total	**132**	**100.0%**

CUY-71-18.29 Safety Analysis (2015-2017)

ACTION2	Number	%
Straight Ahead	**59**	44.7%
Slowing Or Stopped In Traffic	**34**	25.8%
	31	23.5%
Unknown	**3**	2.3%
Entering Traffic Lane	**1**	0.8%
Other Motorist Action	**1**	0.8%
Negotiating A Curve	**1**	0.8%
Changing Lanes	**1**	0.8%
Parked	**1**	0.8%
Grand Total	**132**	**100.0%**

CONTRIBUTING_FACTOR2	Number	%
None-Motorist	**91**	68.9%
	31	23.5%
Unknown	**6**	4.5%
Failure To Control	**2**	1.5%
Swerving To Avoid	**1**	0.8%
Followed To Closely/ACDA	**1**	0.8%
Grand Total	**132**	**100.0%**

DIRECTION_FROM2	Number	%
North	**111**	84.1%
	15	11.4%
Northwest	**3**	2.3%
West	**3**	2.3%
Grand Total	**132**	**100.0%**

DIRECTION_TO2	Number	%
South	**114**	86.4%
	15	11.4%
East	**2**	1.5%
Southeast	**1**	0.8%
Grand Total	**132**	**100.0%**

DRIVER_ALCOHOL2	Number	%
(blank)	**132**	100.0%
Grand Total	**132**	**100.0%**

DRIVER_DRUGS2	Number	%
(blank)	**132**	100.0%
Grand Total	**132**	**100.0%**

CUY-71-18.29 Safety Analysis (2015-2017)

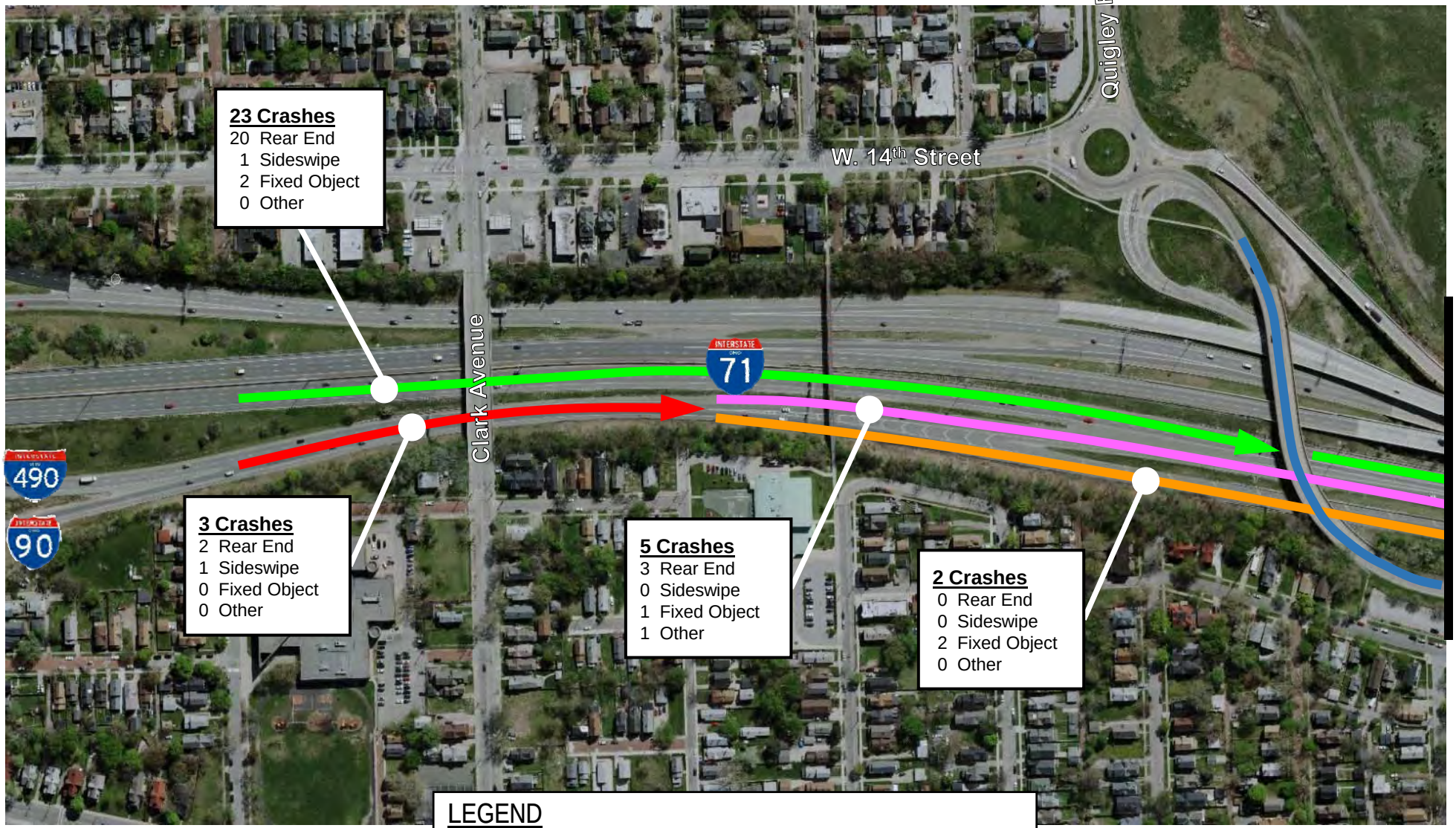
SEVERITY	CRASH_SEVERITY	
TRAFFIC_CRASH_YEAR	Property Damage Crash	Injury Crash
2015	26	8
2016	42	9
2017	30	17
Grand Total	**98**	**34**

TRAFFIC_CRASH_YEAR	Fatalities	Incapacitating Injuries
2015	0	2
2016	0	0
2017	0	0
Grand Total	**0**	**2**

TRAFFIC_CRASH_YEAR	INJ_TYPE2_SERIOUS_VISIBLE	INJ_TYPE3_MINOR_VISIBLE	INJ_TYPE4_NO_VISIBLE
2015	2	2	10
2016	0	6	15
2017	0	3	29
Grand Total	**2**	**11**	**54**


Crash Frequency
& Crash Type Diagram
(2015-2017)
90
490
42
71
42
176
71
N
132 Total Crashes
64 Rear End
35 Sideswipe
30 Fixed Object
3 Other
LEGEND
Project Study Limits

Crash Frequency
& Crash Type Diagram
(2015-2017)

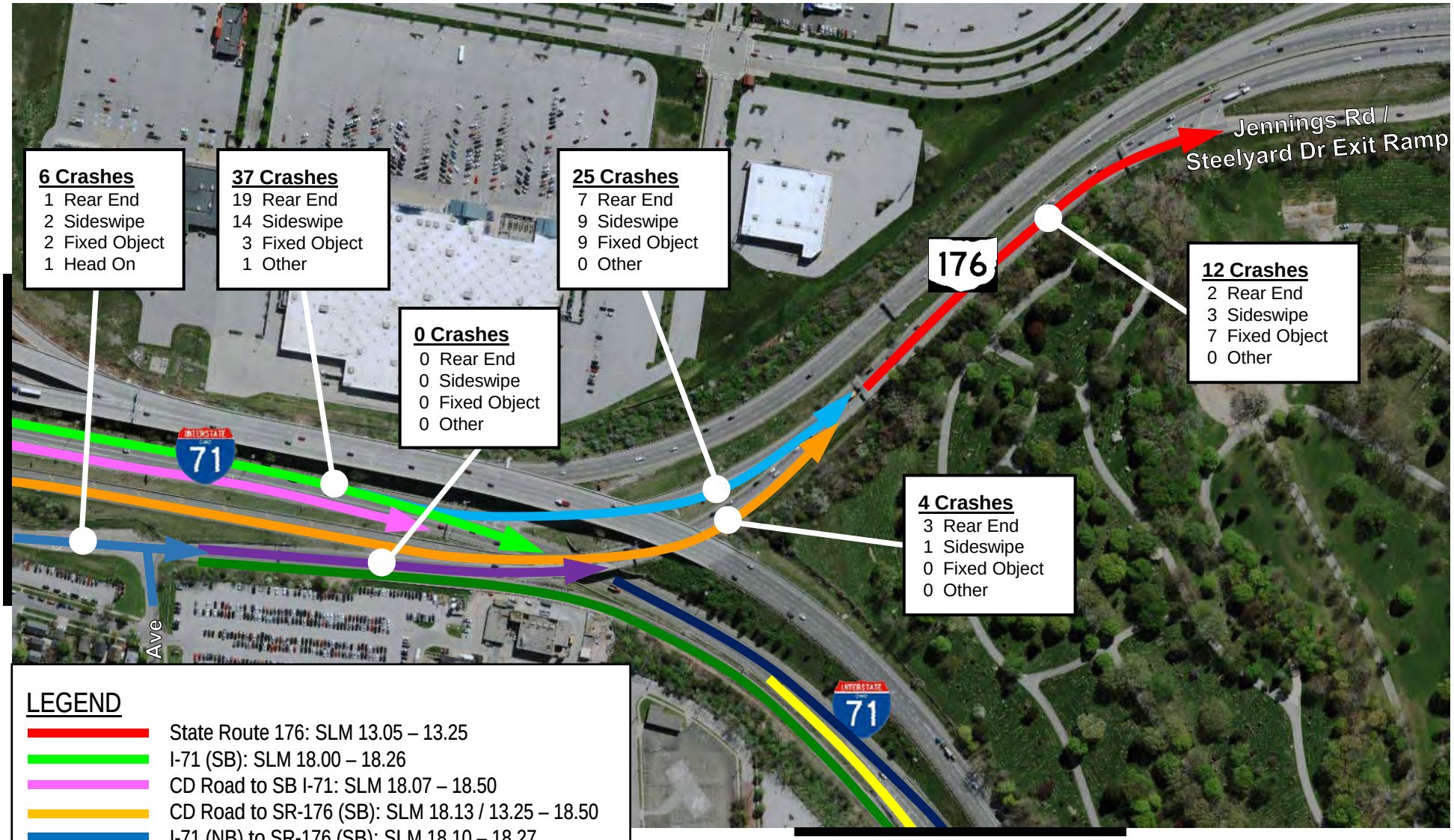


LEGEND

- I-90 & I-490 CD Road: SLM 18.26 – 18.50
- I-71 (SB): SLM 18.26 – 18.76
- CD Road to SB I-71: SLM 18.07 – 18.50
- CD Road to SR-176 (SB): SLM 18.13 / 13.25 – 18.50
- I-71 (NB) to SR-176 (SB): SLM 18.10 – 18.27

Crash Frequency
& Crash Type Diagram

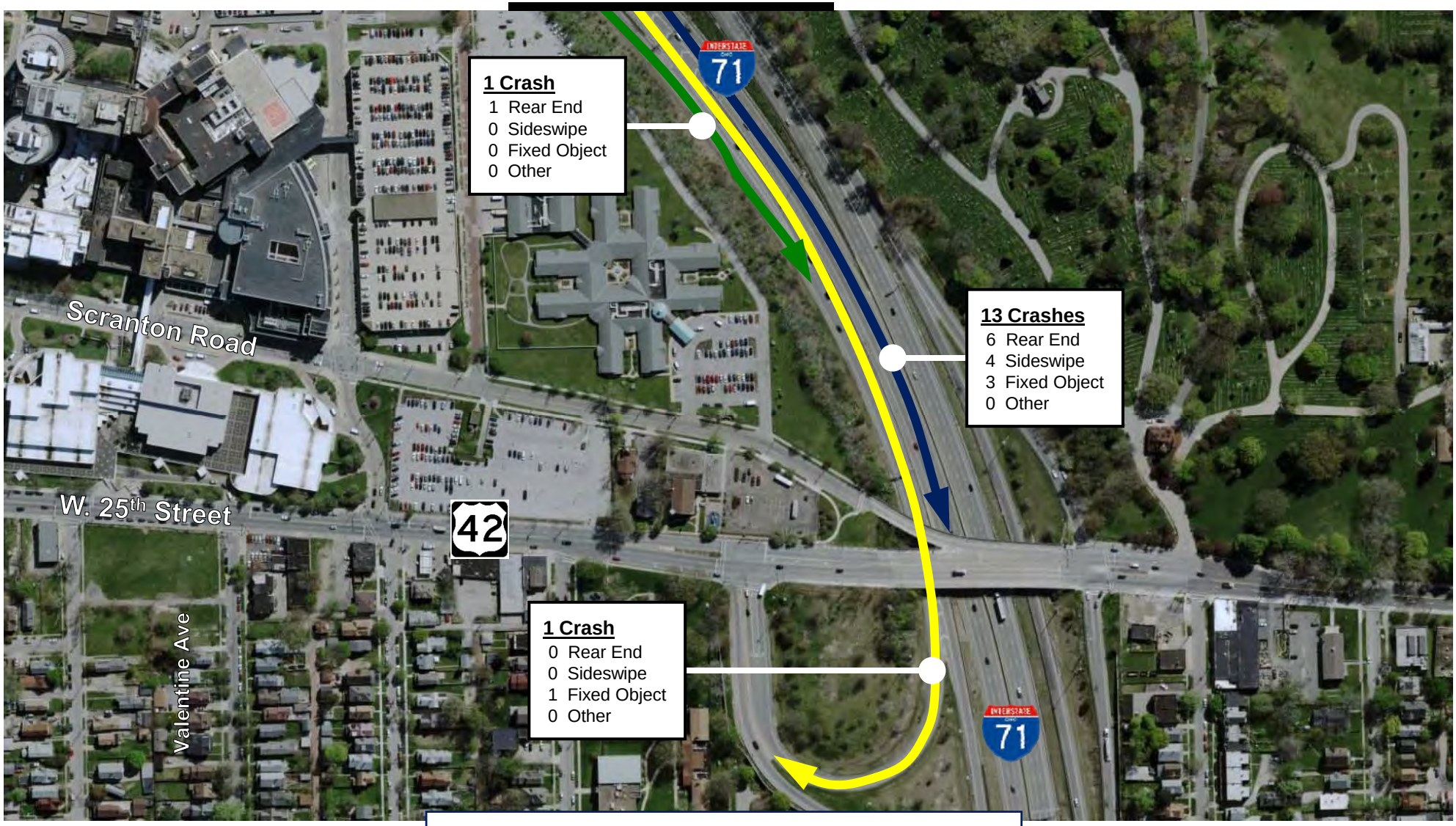
(2015-2017)



Crash Frequency & Crash Type Diagram

(2015-2017)

MATCHLINE B



LEGEND

- I-71 (SB): SLM 18.00 – 18.26
- I-71 (NB) to I-71 (SB): SLM 17.61 – 18.27
- I-71 (SB) to W. 25th St: SLM 17.50 – 17.84

2016-2018 Crash Analysis (EB I-90 only)

	Number
Total	**256**

CRASH_SEVERITY	Number	%
Injury Crash	**90**	35.2%
Property Damage Crash	**166**	64.8%
Grand Total	**256**	**100.0%**

TRAFFIC_CRASH_YEAR	Number	%
2016	**135**	52.7%
2017	**81**	31.6%
2018	**40**	15.6%
Grand Total	**256**	**100.0%**

DAY_OF_WEEK	Number	%
Tuesday	**57**	22.3%
Wednesday	**48**	18.8%
Thursday	**47**	18.4%
Friday	**43**	16.8%
Monday	**37**	14.5%
Sunday	**17**	6.6%
Saturday	**7**	2.7%
Grand Total	**256**	**100.0%**

HOUR_OF_DAY	Number	%
00	**3**	1.2%
01	**4**	1.6%
02	**2**	0.8%
03	**2**	0.8%
04	**1**	0.4%
05	**1**	0.4%
06	**14**	5.5%
07	**36**	14.1%
08	**38**	14.8%
09	**23**	9.0%
10	**3**	1.2%
11	**11**	4.3%
12	**6**	2.3%
13	**3**	1.2%
14	**4**	1.6%
15	**11**	4.3%
16	**39**	15.2%
17	**30**	11.7%
18	**14**	5.5%
19	**1**	0.4%
20	**4**	1.6%
21	**3**	1.2%
22	**2**	0.8%
23	**1**	0.4%
Grand Total	**256**	**100.0%**

TYPE_OF_CRASH	Number	%
Rear End	**171**	66.8%
Sideswipe - Passing	**54**	21.1%
Fixed Object	**24**	9.4%
Other Object	**2**	0.8%
Unknown	**2**	0.8%
Backing	**1**	0.4%
Other Non-Collision	**1**	0.4%
Animal	**1**	0.4%
Grand Total	**256**	**100.0%**

2016-2018 Crash Analysis (EB I-90 only)

WEATHER_CONDITION	Number	%
Clear	144	56.3%
Cloudy	65	25.4%
Rain	21	8.2%
Snow	14	5.5%
Other/Unknown	12	4.7%
Grand Total	**256**	**100.0%**

ROAD_CONDITION	Number	%
Dry	185	72.3%
Wet	57	22.3%
Snow	9	3.5%
Unknown	3	1.2%
Slush	1	0.4%
Ice	1	0.4%
Grand Total	**256**	**100.0%**

LIGHT_CONDITION	Number	%
Daylight	195	76.2%
Dark - Lighted Roadway	32	12.5%
Dawn	15	5.9%
Unknown	8	3.1%
Dusk	3	1.2%
Dark - Roadway Not Lighted	3	1.2%
Grand Total	**256**	**100.0%**

NUMBER_OF_VEHICLES	Number	%
1	28	10.9%
2	167	65.2%
3	46	18.0%
4	10	3.9%
5	4	1.6%
7	1	0.4%
Grand Total	**256**	**100.0%**

LOCATION	Number	%
Not An Intersection	235	91.8%
Off Ramp	10	3.9%
On Ramp	6	2.3%
Unknown	2	0.8%
Y-Intersection	1	0.4%
Crossover	1	0.4%
Four-Way Intersection	1	0.4%
Grand Total	**256**	**100.0%**

CRASH_MONTH_NBR	Number	%
1	19	7.4%
2	32	12.5%
3	17	6.6%
4	20	7.8%
5	28	10.9%
6	34	13.3%
7	23	9.0%
8	27	10.5%
9	16	6.3%
10	22	8.6%
11	8	3.1%
12	10	3.9%
Grand Total	**256**	**100.0%**

ROAD_CONTOUR	Number	%
Straight Level	193	75.4%
Straight Grade	51	19.9%
Curve Grade	9	3.5%
Curve Level	2	0.8%
Unknown	1	0.4%
Grand Total	**256**	**100.0%**

SPECIAL_AREA	Number	%
(blank)	256	100.0%
Grand Total	**256**	**100.0%**

ANIMAL_TYPE	Number	%
(blank)	256	100.0%
Grand Total	**256**	**100.0%**

2016-2018 Crash Analysis (EB I-90 only)

ACTION1	Number	%
Straight Ahead	170	66.4%
Changing Lanes	32	12.5%
Unknown	25	9.8%
Slowing Or Stopped In Traffic	22	8.6%
Negotiating A Curve	4	1.6%
Leaving Traffic Lane	2	0.8%
Backing	1	0.4%
Grand Total	**256**	**100.0%**

CONTRIBUTING_FACTOR1	Number	%
Followed To Closely/ACDA	125	48.8%
Failure To Control	47	18.4%
Unknown	25	9.8%
None-Motorist	19	7.4%
Improper Lane Change/Passing/Offroad	14	5.5%
Unsafe Speed	6	2.3%
Operating Vehicle In Negligent Manner	4	1.6%
Failure To Yield	4	1.6%
Swerving To Avoid	3	1.2%
Other Improper Action	2	0.8%
Load Shifting/Falling/Spilling	2	0.8%
Operating Defective Equipment	2	0.8%
Improper Backing	1	0.4%
Inattentive	1	0.4%
Vision Obstruction	1	0.4%
Grand Total	**256**	**100.0%**

	Number	%
Total	**256**	**100.0%**

TRAFFIC_CONTROL1	Number	%
No Controls	209	81.6%
Pavement Markings	44	17.2%
Not Reported	2	0.8%
Traffic Signal	1	0.4%
Grand Total	**256**	**100.0%**

DRIVER_ALCOHOL1	Number	%
No	250	97.7%
Yes	6	2.3%
Grand Total	**256**	**100.0%**

DRIVER_DRUGS1	Number	%
No	256	100.0%
Grand Total	**256**	**100.0%**

2016-2018 Crash Analysis (EB I-90 only)

DIRECTION_FROM1	Number	%
West	**236**	92.2%
Unknown	**9**	3.5%
East	**5**	2.0%
North	**3**	1.2%
Southeast	**1**	0.4%
South	**1**	0.4%
Southwest	**1**	0.4%
Grand Total	**256**	**100.0%**

DIRECTION_TO1	Number	%
East	**233**	91.0%
Unknown	**10**	3.9%
West	**6**	2.3%
South	**3**	1.2%
Northeast	**2**	0.8%
Northwest	**1**	0.4%
North	**1**	0.4%
Grand Total	**256**	**100.0%**

POSTED_SPEED1	Number	%
60	**210**	82.0%
50	**18**	7.0%
55	**10**	3.9%
	6	2.3%
65	**4**	1.6%
35	**3**	1.2%
40	**2**	0.8%
45	**1**	0.4%
70	**1**	0.4%
25	**1**	0.4%
Grand Total	**256**	**100.0%**

ESTIMATED_SPEED1	Number	%
20	**1**	100.0%
Grand Total	**1**	**100.0%**

VEHICLE_TYPE1	Number	%
Mid Size	**81**	31.6%
Sport Utility Vehicle	**53**	20.7%
Compact	**38**	14.8%
Unknown Or Hit/Skip	**20**	7.8%
Pickup	**18**	7.0%
Full Size	**17**	6.6%
Van	**9**	3.5%
Motorcycle	**3**	1.2%
Sub-Compact	**3**	1.2%
Tractor/Semi-Trailer	**3**	1.2%
Single Unit Truck/Trailer	**3**	1.2%
Other Passenger Vehicle	**2**	0.8%
Minivan	**2**	0.8%
Single Unit Truck; 3+ Axles	**2**	0.8%
Single Unit Truck Or Van 2 Axle, 6 Tires	**1**	0.4%
Bus/Van (9-15 Seats Inc Driver)	**1**	0.4%
Grand Total	**256**	**100.0%**

VEHICLE_TYPE2	Number	%
Mid Size	**87**	34.0%
Sport Utility Vehicle	**60**	23.4%
	28	10.9%
Compact	**26**	10.2%
Pickup	**13**	5.1%
Full Size	**11**	4.3%
Unknown Or Hit/Skip	**6**	2.3%
Van	**5**	2.0%
Single Unit Truck Or Van 2 Axle, 6 Tires	**4**	1.6%
Minivan	**4**	1.6%
Sub-Compact	**4**	1.6%
Other Med/Heavy Vehicle	**2**	0.8%
Tractor/Semi-Trailer	**2**	0.8%
Single Unit Truck; 3+ Axles	**2**	0.8%
Other Passenger Vehicle	**1**	0.4%
Bus/Van (9-15 Seats Inc Driver)	**1**	0.4%
Grand Total	**256**	**100.0%**

2016-2018 Crash Analysis (EB I-90 only)

ACTION2	Number	%
Slowing Or Stopped In Traffic	**139**	54.3%
Straight Ahead	**76**	29.7%
	28	10.9%
Unknown	**7**	2.7%
Changing Lanes	**4**	1.6%
Entering Traffic Lane	**1**	0.4%
Overtaking/Passing	**1**	0.4%
Grand Total	**256**	**100.0%**

CONTRIBUTING_FACTOR2	Number	%
None-Motorist	**206**	80.5%
	28	10.9%
Unknown	**12**	4.7%
Failure To Control	**3**	1.2%
Followed To Closely/ACDA	**3**	1.2%
Improper Lane Change/Passing/Offroad	**2**	0.8%
Swerving To Avoid	**2**	0.8%
Grand Total	**256**	**100.0%**

DIRECTION_FROM2	Number	%
West	**225**	87.9%
	28	10.9%
Unknown	**2**	0.8%
North	**1**	0.4%
Grand Total	**256**	**100.0%**

DIRECTION_TO2	Number	%
East	**224**	87.5%
	28	10.9%
Unknown	**2**	0.8%
Northeast	**1**	0.4%
South	**1**	0.4%
Grand Total	**256**	**100.0%**

DRIVER_ALCOHOL2	Number	%
(blank)	**256**	100.0%
Grand Total	**256**	**100.0%**

DRIVER_DRUGS2	Number	%
(blank)	**256**	100.0%
Grand Total	**256**	**100.0%**

2016-2018 Crash Analysis (EB I-90 only)

SEVERITY	CRASH_SEVERITY	
TRAFFIC_CRASH_YEAR	Property Damage Crash	Injury Crash
2016	91	44
2017	48	33
2018	27	13
Grand Total	**166**	**90**

TRAFFIC_CRASH_YEAR	Fatalities	Incapacitating Injuries
2016	0	2
2017	0	0
2018	0	1
Grand Total	**0**	**3**

TRAFFIC_CRASH_YEAR	INJ_TYPE2_SERIOUS_VISIBLE	INJ_TYPE3_MINOR_VISIBLE	INJ_TYPE4_NO_VISIBLE
2016	2	12	51
2017	0	7	33
2018	1	2	20
Grand Total	**3**	**21**	**104**

CUY-Innerbelt Influence Area 2008-2010

	Number
Total	**582**

CRASH_SEVERITY	Number	%
Fatal Crash	**2**	0.3%
Injury Crash	**188**	32.3%
Property Damage Crash	**392**	67.4%
Grand Total	**582**	**100.0%**

TRAFFIC_CRASH_YEAR	Number	%
2008	**190**	32.6%
2009	**202**	34.7%
2010	**190**	32.6%
Grand Total	**582**	**100.0%**

DAY_OF_WEEK	Number	%
Wednesday	**130**	22.3%
Thursday	**102**	17.5%
Friday	**101**	17.4%
Monday	**90**	15.5%
Tuesday	**85**	14.6%
Sunday	**42**	7.2%
Saturday	**32**	5.5%
Grand Total	**582**	**100.0%**

HOUR_OF_DAY	Number	%
0	**11**	1.9%
1	**15**	2.6%
2	**6**	1.0%
3	**3**	0.5%
4	**5**	0.9%
5	**5**	0.9%
6	**25**	4.3%
7	**85**	14.6%
8	**101**	17.4%
9	**48**	8.2%
10	**15**	2.6%
11	**15**	2.6%
12	**13**	2.2%
13	**10**	1.7%
14	**23**	4.0%
15	**27**	4.6%
16	**31**	5.3%
17	**56**	9.6%
18	**18**	3.1%
19	**14**	2.4%
20	**15**	2.6%
21	**13**	2.2%
22	**11**	1.9%
23	**17**	2.9%
Grand Total	**582**	**100.0%**

TYPE_OF_CRASH	Number	%
Rear End	**303**	52.1%
Sideswipe - Passing	**143**	24.6%
Fixed Object	**86**	14.8%
Parked Vehicle	**16**	2.7%
Overturning	**7**	1.2%
Angle	**7**	1.2%
Other Non-Collision	**6**	1.0%
Other Object	**4**	0.7%
Animal	**3**	0.5%
Backing	**3**	0.5%
Unknown	**2**	0.3%
Pedestrian	**1**	0.2%
Left Turn	**1**	0.2%
Grand Total	**582**	**100.0%**

CUY-Innerbelt Influence Area 2008-2010

WEATHER_CONDITION	Number	%
Clear	**267**	45.9%
Cloudy	**135**	23.2%
Rain	**89**	15.3%
Snow	**62**	10.7%
Other/Unknown	**15**	2.6%
Sleet, Hail	**12**	2.1%
Blowing Sand, Soil, Dirt, Snow	**2**	0.3%
Grand Total	**582**	**100.0%**

ROAD_CONDITION	Number	%
Road - Dry	**326**	56.0%
Road - Wet	**162**	27.8%
Road - Snow	**49**	8.4%
Road - Ice	**35**	6.0%
Road Condition Not Stated	**10**	1.7%
Grand Total	**582**	**100.0%**

LIGHT_CONDITION	Number	%
Daylight	**394**	67.7%
Dark - Lighted	**136**	23.4%
Dawn	**26**	4.5%
Light Not Stated	**14**	2.4%
Dusk	**10**	1.7%
Other	**1**	0.2%
Dark - No Lights	**1**	0.2%
Grand Total	**582**	**100.0%**

NUMBER_OF_VEHICLES	Number	%
(blank)	**582**	100.0%
Grand Total	**582**	**100.0%**

LOCATION	Number	%
Not An Intersection	**481**	82.6%
Four-Way Intersection	**22**	3.8%
Off Ramp	**22**	3.8%
Y-Intersection	**21**	3.6%
On Ramp	**20**	3.4%
Unknown	**8**	1.4%
T-Intersection	**4**	0.7%
Crossover	**3**	0.5%
Shared-Use Paths Or Trails	**1**	0.2%
Grand Total	**582**	**100.0%**

CRASH_MONTH_NBR	Number	%
1	**71**	12.2%
2	**55**	9.5%
3	**46**	7.9%
4	**37**	6.4%
5	**48**	8.2%
6	**33**	5.7%
7	**40**	6.9%
8	**42**	7.2%
9	**48**	8.2%
10	**61**	10.5%
11	**47**	8.1%
12	**54**	9.3%
Grand Total	**582**	**100.0%**

ROAD_CONTOUR	Number	%
Straight - Level	**421**	72.3%
Straight - Grade	**91**	15.6%
Curve - Grade	**41**	7.0%
Curve - Level	**25**	4.3%
Contour Not Stated	**4**	0.7%
Grand Total	**582**	**100.0%**

SPECIAL_AREA	Number	%
Unknown or Not in Work Zone	**578**	99.3%
Advance Warning Area	**2**	0.3%
Transition Area	**1**	0.2%
Activity Area	**1**	0.2%
Grand Total	**582**	**100.0%**

ANIMAL_TYPE	Number	%
Animal Not Stated	**579**	99.5%
Deer Hit	**2**	0.3%
Other Animal	**1**	0.2%
Grand Total	**582**	**100.0%**

CUY-Innerbelt Influence Area 2008-2010

ACTION1	Number	%
Straight Ahead	393	67.5%
Changing Lanes	78	13.4%
Slowing Or Stopped In Traffic	40	6.9%
Unknown	39	6.7%
Other Motorist Action	6	1.0%
Entering Traffic Lane	5	0.9%
Overtaking/Passing	4	0.7%
Leaving Traffic Lane	4	0.7%
Backing	3	0.5%
Making Right Turn	3	0.5%
Parked	2	0.3%
Making Left Turn	2	0.3%
	1	0.2%
Other Non-Motorist Action	1	0.2%
Walking, Running, Jogging, Playing, Cycling	1	0.2%
Grand Total	**582**	**100.0%**

CONTRIBUTING_FACTOR1	Number	%
Failure To Control	131	22.5%
Followed To Closely/ACDA	123	21.1%
Unknown	78	13.4%
Other Improper Action	62	10.7%
None	61	10.5%
Swerving To Avoid	40	6.9%
Improper Lane Change/Passing/Offroad	32	5.5%
Operating Vehicle In Negligent Manner	17	2.9%
Failure To Yield	13	2.2%
Load Shifting/Falling/Spilling	5	0.9%
Operating Defective Equipment	4	0.7%
Unsafe Speed	4	0.7%
Vision Obstruction	2	0.3%
Improper Backing	2	0.3%
Improper Turn	2	0.3%
Other Non-Motorist	1	0.2%
Improper Crossing	1	0.2%
Improper Start From Parked Position	1	0.2%
None Non-Motorist	1	0.2%
Stopped Or Parked Illegally	1	0.2%
	1	0.2%
Grand Total	**582**	**100.0%**

OBJECT_STRUCK1	Number	%
(blank)	582	100.0%
Grand Total	**582**	**100.0%**

TRAFFIC_CONTROL1	Number	%
No Controls	477	82.0%
Pavement Markings	71	12.2%
Not Reported	16	2.7%
Traffic Signal	10	1.7%
Yield Sign	4	0.7%
Stop Sign	3	0.5%
	1	0.2%
Grand Total	**582**	**100.0%**

DRIVER_ALCOHOL1	Number	%
None	442	75.9%
0	132	22.7%
Yes - Alcohol Suspected	6	1.0%
	1	0.2%
Yes - Alcohol And Drugs Suspected	1	0.2%
Grand Total	**582**	**100.0%**

DRIVER_DRUGS1	Number	%
(blank)	582	100.0%
Grand Total	**582**	**100.0%**

CUY-Innerbelt Influence Area 2008-2010

DIRECTION_FROM1	Number	%
West	**398**	68.4%
North	**95**	16.3%
East	**64**	11.0%
Unknown	**19**	3.3%
South	**4**	0.7%
	1	0.2%
Northeast	**1**	0.2%
Grand Total	**582**	**100.0%**

DIRECTION_TO1	Number	%
East	**385**	66.2%
South	**106**	18.2%
West	**63**	10.8%
Unknown	**18**	3.1%
North	**7**	1.2%
Southwest	**1**	0.2%
	1	0.2%
Southeast	**1**	0.2%
Grand Total	**582**	**100.0%**

POSTED_SPEED1	Number	%
Posted Speed 56-60	**346**	59.5%
Posted Speed 46-50	**80**	13.7%
Posted Speed 51-55	**77**	13.2%
Posted Speed Not Stated	**25**	4.3%
Posted Speed 21-25	**18**	3.1%
Posted Speed 61-65	**15**	2.6%
Posted Speed 31-35	**10**	1.7%
Posted Speed 41-45	**6**	1.0%
Posted Speed 20 and Under	**2**	0.3%
Posted Speed 36-40	**2**	0.3%
	1	0.2%
Grand Total	**582**	**100.0%**

ESTIMATED_SPEED1	Number	%
Unit Speed 20 and Under	**117**	20.1%
Unit Speed 56-60	**88**	15.1%
Unit Speed Not Stated	**69**	11.9%
Unit Speed 46-50	**69**	11.9%
Unit Speed 41-45	**44**	7.6%
Unit Speed 51-55	**38**	6.5%
Unit Speed 36-40	**37**	6.4%
Unit Speed 31-35	**37**	6.4%
Unit Speed 21-25	**36**	6.2%
Unit Speed 26-30	**19**	3.3%
Unit Speed Over 65	**15**	2.6%
Unit Speed 61-65	**12**	2.1%
	1	0.2%
Grand Total	**582**	**100.0%**

VEHICLE_TYPE1	Number	%
Mid Size	**229**	39.3%
Sport Utility Vehicle	**96**	16.5%
Compact	**81**	13.9%
Full Size	**64**	11.0%
Pickup	**34**	5.8%
Unknown Or Hit/Skip	**29**	5.0%
Minivan	**17**	2.9%
Van	**10**	1.7%
Single Unit Truck Or Van 2 Axle, 6 Tires	**6**	1.0%
Tractor/Semi-Trailer	**4**	0.7%
Single Unit Truck/Trailer	**4**	0.7%
Sub-Compact	**3**	0.5%
Tractor/Triples	**1**	0.2%
	1	0.2%
Pedestrian/Skater	**1**	0.2%
Motorcycle	**1**	0.2%
Other Passenger Vehicle	**1**	0.2%
Grand Total	**582**	**100.0%**

VEHICLE_TYPE2	Number	%
Mid Size	**183**	31.4%
	96	16.5%
Sport Utility Vehicle	**91**	15.6%
Compact	**61**	10.5%
Full Size	**40**	6.9%
Pickup	**39**	6.7%
Minivan	**30**	5.2%
Van	**13**	2.2%
Unknown Or Hit/Skip	**11**	1.9%
Tractor/Semi-Trailer	**4**	0.7%
Single Unit Truck Or Van 2 Axle, 6 Tires	**4**	0.7%
Motorcycle	**3**	0.5%
Other Passenger Vehicle	**2**	0.3%
Other Med/Heavy Vehicle	**2**	0.3%
Single Unit Truck/Trailer	**1**	0.2%
Bus (16+ Seats, Inc Driver)	**1**	0.2%
Sub-Compact	**1**	0.2%
Grand Total	**582**	**100.0%**

CUY-Innerbelt Influence Area 2008-2010

ACTION2	Number	%
Straight Ahead	**273**	46.9%
Slowing Or Stopped In Traffic	**170**	29.2%
	96	16.5%
Unknown	**13**	2.2%
Parked	**11**	1.9%
Changing Lanes	**11**	1.9%
Making Left Turn	**2**	0.3%
Leaving Traffic Lane	**1**	0.2%
Backing	**1**	0.2%
Making Right Turn	**1**	0.2%
Driverless	**1**	0.2%
Entering Traffic Lane	**1**	0.2%
Other Motorist Action	**1**	0.2%
Grand Total	**582**	**100.0%**

CONTRIBUTING_FACTOR2	Number	%
None	**397**	68.2%
	96	16.5%
Unknown	**37**	6.4%
Followed To Closely/ACDA	**16**	2.7%
Swerving To Avoid	**14**	2.4%
Failure To Control	**9**	1.5%
Failure To Yield	**4**	0.7%
Other Improper Action	**3**	0.5%
Improper Lane Change/Passing/Offroad	**3**	0.5%
Operating Defective Equipment	**1**	0.2%
None Non-Motorist	**1**	0.2%
Operating Vehicle In Negligent Manner	**1**	0.2%
Grand Total	**582**	**100.0%**

DIRECTION_FROM2	Number	%
West	**357**	61.3%
	96	16.5%
North	**70**	12.0%
East	**46**	7.9%
South	**9**	1.5%
Unknown	**4**	0.7%
Grand Total	**582**	**100.0%**

DIRECTION_TO2	Number	%
East	**349**	60.0%
	96	16.5%
South	**80**	13.7%
West	**46**	7.9%
North	**7**	1.2%
Unknown	**4**	0.7%
Grand Total	**582**	**100.0%**

DRIVER_ALCOHOL2	Number	%
None	**408**	70.1%
	96	16.5%
0	**78**	13.4%
Grand Total	**582**	**100.0%**

DRIVER_DRUGS2	Number	%
(blank)	**582**	100.0%
Grand Total	**582**	**100.0%**

CUY-Innerbelt Influence Area 2008-2010

SEVERITY	CRASH_SEVERITY		
TRAFFIC_CRASH_YEAR	Injury Crash	Property Damage Crash	Fatal Crash
2008	64	125	1
2009	65	137	0
2010	59	130	1
Grand Total	**188**	**392**	**2**

TRAFFIC_CRASH_YEAR	Fatalities	Incapacitating Injuries
2008	1	4
2009	0	1
2010	1	3
Grand Total	**2**	**8**

TRAFFIC_CRASH_YEAR	INJ_TYPE2_SERIOUS_VISIBLE	INJ_TYPE3_MINOR_VISIBLE	INJ_TYPE4_NO_VISIBLE
2008	4	27	73
2009	1	12	84
2010	3	26	69
Grand Total	**8**	**65**	**226**

Ramp Crash Frequency & Crash Type Diagram

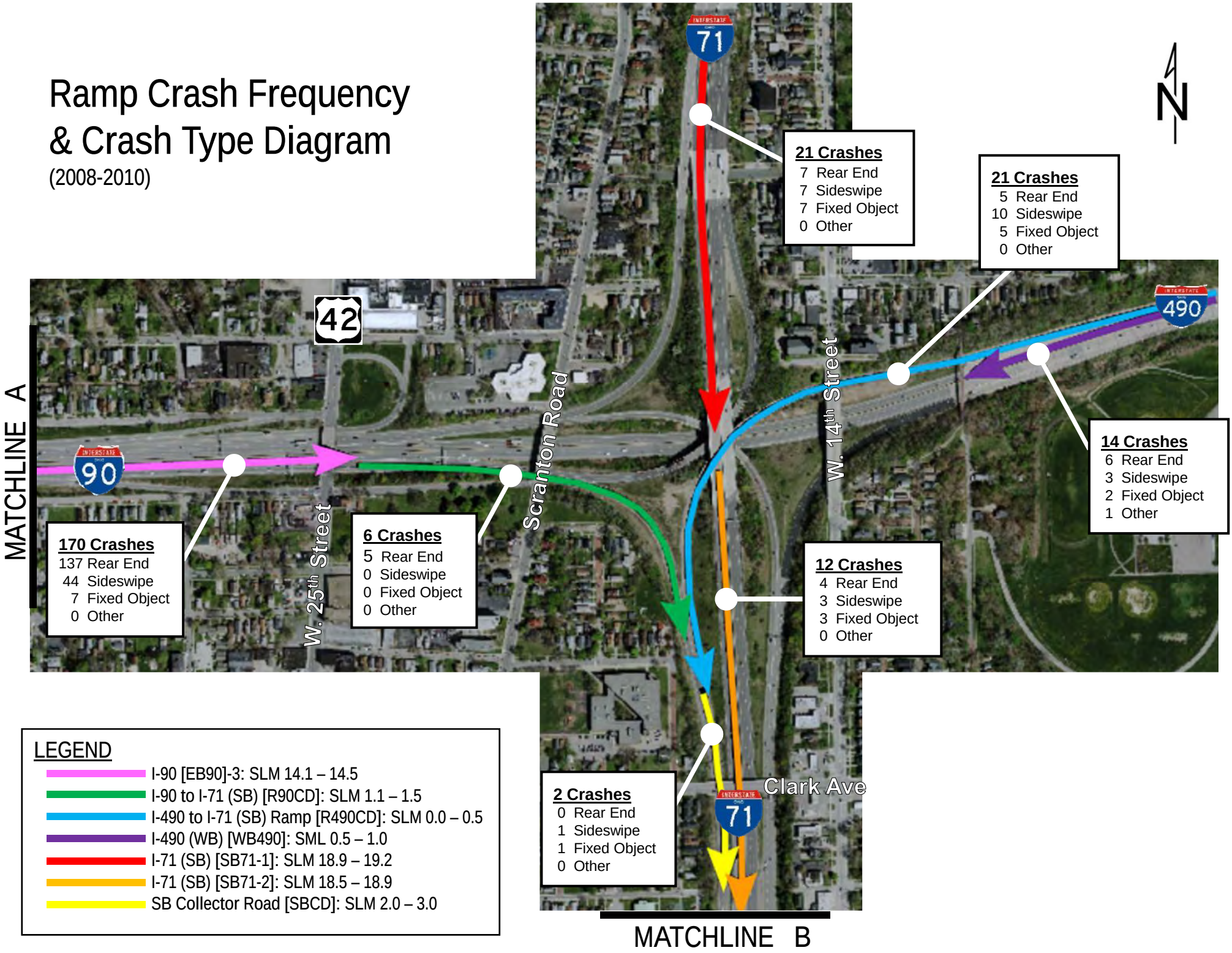
(2008-2010)

LEGEND

- I-90 [EB90-1]: SLM 13.1 – 13.8
- I-90 [EB90-2]: SLM 13.8 – 14.1

Ramp Crash Frequency & Crash Type Diagram

(2008-2010)



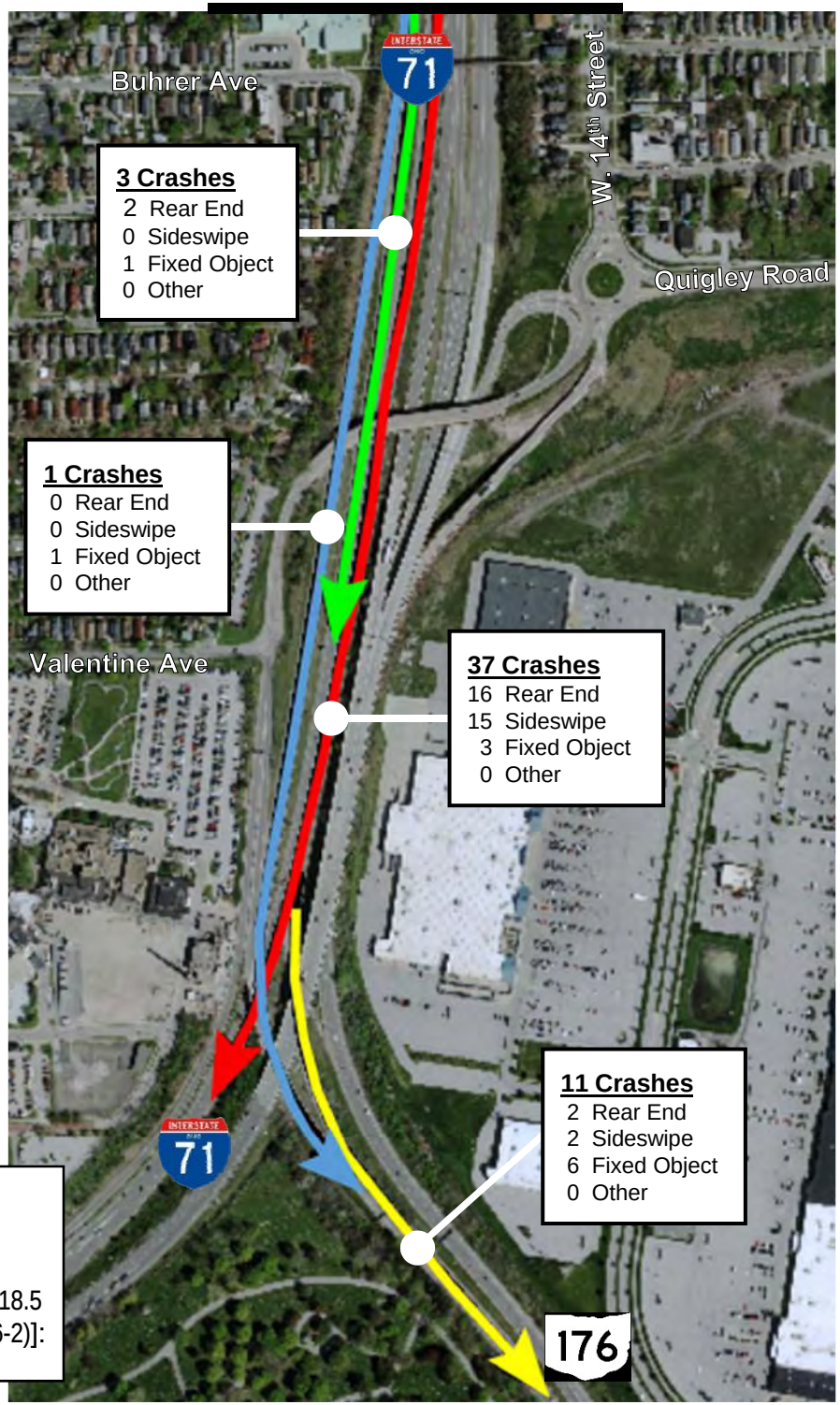
LEGEND

- I-90 [EB90]-3: SLM 14.1 – 14.5
- I-90 to I-71 (SB) [R90CD]: SLM 1.1 – 1.5
- I-490 to I-71 (SB) Ramp [R490CD]: SLM 0.0 – 0.5
- I-490 (WB) [WB490]: SML 0.5 – 1.0
- I-71 (SB) [SB71-1]: SLM 18.9 – 19.2
- I-71 (SB) [SB71-2]: SLM 18.5 – 18.9
- SB Collector Road [SBCD]: SLM 2.0 – 3.0

Ramp Crash Frequency & Crash Type Diagram

(2008-2010)

MATCHLINE B



LEGEND

- I-176 (SB) Ramp [RCD176-1]: SLM 4.0 – 5.0]
- I-71 (SB) Ramp [RCD71]: SLM 3.0 – 4.0
- I-71 (SB) [SB71-3/SB71-4 (CURVE)]: SLM 17.9 – 18.5
- I-71 to I-176 (SB) Ramp [SR176 CURVE (RCD176-2)]: SML 5.0 – 6.0

CUY-71-18.29 SAFETY STUDY

APPENDIX F: COST ESTIMATES

Estimate: CUY-IR 71 SAFETY STUDY (Figure 15) SINGH + Associates, Inc.

Line #	Item Number	Description	Quantity	Units	Unit Price	Extension
0001	202E 38000	GUARDRAIL REMOVAL	300.000	FT	$5.00	$1,500.00
0002	202E 23000	PAVEMENT REMOVED	200.000	SY	$20.00	$4,000.00
0003	202E 32000	CURB REMOVED	550.000	FT	$15.00	$8,250.00
0004	203E 10000	EXCAVATION	700.000	CY	$40.00	$28,000.00
0005	204E 13000	EXCAVATION OF SUBGRADE	450.000	CY	$40.00	$18,000.00
0006	204E 35110	GRANULAR MATERIAL, TYPE B	450.000	CY	$50.00	$22,500.00
0007	254E 01000	PAVEMENT PLANING, ASPHALT (1.5")	6,150.000	SY	$3.00	$18,450.00
0008	255E 20000	FULL DEPTH PAVEMENT SAWING	1,500.000	FT	$3.00	$4,500.00
0009	301E 46020	ASPHALT CONCRETE BASE, PG64-22	350.000	CY	$175.00	$61,250.00
0010	304E 20000	AGGREGATE BASE	250.000	CY	$90.00	$22,500.00
0011	441E 50100	ASPHALT CONCRETE SURFACE COURSE, TYPE 1 (448), PG70-22M	300.000	CY	$220.00	$66,000.00
0012	441E 50300	ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE 2, (448)	100.000	CY	$190.00	$19,000.00
0013	606E 15550	GUARDRAIL, BARRIER DESIGN, TYPE MGS	25.000	FT	$50.00	$1,250.00
0014	606E 26000	ANCHOR ASSEMBLY, TYPE E	1.000	EACH	$3,000.00	$3,000.00
0015	618E 40600	RUMBLE STRIPS, (ASPHALT CONCRETE)	0.200	MILE	$50,000.00	$10,000.00
0016	622E 24000	CONCRETE BARRIER, TYPE B	1,200.000	FT	$250.00	$300,000.00
0017	622E 24000	CONCRETE BARRIER, TYPE D	610.000	FT	$200.00	$122,000.00
0018	630	OVERHEAD TRUSS SIGN	1.000	EACH	$25,000.00	$25,000.00
0019	644E 00104	EDGE LINE, 6"	0.800	MILE	$6,000.00	$4,800.00
0020	644E 00404	CHANNELIZING LINE, 12"	1,500.000	FT	$3.00	$4,500.00
0021	644E	DOTTED LINE, 8"	700.000	FT	$3.00	$2,100.00
0022	659E 10000	SEEDING AND MULCHING	4,500.000	SY	$3.00	$13,500.00
0023	832E 30000	EROSION CONTROL	15,000.000	EACH	$1.00	$15,000.00
0024	614E 11011	MAINTAINING TRAFFIC, AS PER PLAN	1.000	LS	$39,000.00	$39,000.00
0025	619E 10000	FIELD OFFICE, TYPE B	6.000	MONTH	$1,600.00	$9,600.00
0026	623E 10000	CONSTRUCTION LAYOUT STAKES AND SURVEYING	1.000	LS	$12,000.00	$12,000.00
0027	624E 10000	MOBILIZATION	1.000	LS	$30,000.00	$30,000.00

Estimated Sub-Total:	$866,000.00
Engineering Design, Enviro and Construction Eng (30%)	$259,800.00
Contigency (35%):	$303,100.00
Inflation to 2021 Construction (7.5%)	$107,200.00
Estimated Total:	**$1,536,100.00**

COST ESTIMATE DOES NOT INCLUDE

RIGHT-OF-WAY
UTILITY RELOCATION

FIGURE #14:
Proposed Improvements include the placement of concrete barrier on the outside SB I-71 lane with the addition of rumble strips to deter drivers from a three-lane weave. In addition, minor pavement widening, and restriping are required.

REMOVAL OF GUARDRAIL N & S OF W. 14TH STREET OVERPASS PIER/ LANE CLOSURE REQUIRED
1' REMOVAL FOR WIDENING
CURB REMOVAL AT GORE AREA
EXCAVATION FOR PAVEMENT WIDENING (7.33 FT WIDTH x 1.5 FT DEPTH x 1,500 FT LENGTH) AND LEVELING SOLID ADJACENT TO PR PAVEMENT TYING INTO EXISTING GRADE
ASSUME 12" EXCAVATION AND REPLACEMENT FOR FOUNDATION IMPROVEMENT
ASSUME 12" EXCAVATION AND REPLACEMENT FOR FOUNDATION IMPROVEMENT
RAMP TO I-71
SAWING ON EX PVMT ALONG PR PAVEMENT FOR CLEAN EDGE TO BEGIN WIDENING
USE 8 INCH OF ASPHALT BASE (0.75 FT x 6.5 FT WIDTH x 1500 FT LENGTH) + BASE WIDENING FOR BARRIER IN GORE
USE 6 INCH OF AGGREGATE UNDER PAVEMENT (0.5 FT x 7.33 FT WIDTH x 1500 FT LENGTH) + BASE WIDENING FOR BARRIER IN GORE
USE 1.5 INCH OF SURFACE COURSE (0.125 FT x 6 FT WIDTH x 1500 FT LENGTH) + MILL/OVERLAY AREA
USE 2.5 INCH OF INTERMEDIATE BASE (0.208 FT x 6 FT WIDTH x 1500 FT LENGTH)
SHORT GUARDRAIL LENGTH AT OVERPASS PIER
TERMINAL AT OVERPASS PIER
RUMBLE STRIPS AT C-D ROAD TO I-71 SB ENTRANCE RAMP
CONCRETE BARRIER FROM GORE TO BEGINNING OF RUMBLE STRIP
CONCRETE BARRIER FROM PEDESTRIAN BRIDGE TO GORE, PLUS RIGHT SIDE OF RAMP
ONE OVERHEAD SIGN ON MAINLINE I-71
RUMBLE STRIPS AT C-D ROAD TO I-71 SB ENTRANCE RAMP
SOLID PAVEMENT MARKINGS AT RAMPS PER ODOT TC DETAIL
SOLID PAVEMENT MARKINGS AT RAMPS PER ODOT TC DETAIL
EX GRASSED AREAS THAT MAY BE USED TO TEMPORARILY STORE MATERIAL OR EQUIPMENT (40,000 SQ FT)
TEMPORARY EROSION CONTROL OF GRASSED AREAS AND INLET PROTECTION
5% OF ROADWAY SUB-TOTAL
ASSUME 6 MONTHS
1.5% OF ROADWAY SUB-TOTAL
PER CMS

Estimate: CUY-IR 71 SAFETY STUDY (Figure 16) SINGH + Associates, Inc.

Line #	Item Number	Quantity	Units	Unit Price	Extension
	Description				
0001	202E 38000	625.000	FT	$5.00	$3,125.00
	GUARDRAIL REMOVAL				
0002	202E 23000	100.000	SY	$20.00	$2,000.00
	PAVEMENT REMOVED				
0003	203E 10000	300.000	CY	$40.00	$12,000.00
	EXCAVATION				
0004	204E 13000	200.000	CY	$40.00	$8,000.00
	EXCAVATION OF SUBGRADE				
0005	204E 35110	200.000	CY	$50.00	$10,000.00
	GRANULAR MATERIAL, TYPE B				
0006	254E 01000	25,800.000	SY	$3.00	$77,400.00
	PAVEMENT PLANING, ASPHALT (1.5")				
0007	255E 20000	800.000	FT	$3.00	$2,400.00
	FULL DEPTH PAVEMENT SAWING				
0008	301E 46020	150.000	CY	$175.00	$26,250.00
	ASPHALT CONCRETE BASE, PG64-22				
0009	304E 20000	100.000	CY	$90.00	$9,000.00
	AGGREGATE BASE				
0010	441E 50100	1,100.000	CY	$220.00	$242,000.00
	ASPHALT CONCRETE SURFACE COURSE, TYPE 1 (448), PG70-22M				
0011	441E 50300	50.000	CY	$190.00	$9,500.00
	ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE 2, (448)				
0012	606E 15550	75.000	FT	$50.00	$3,750.00
	GUARDRAIL, BARRIER DESIGN, TYPE MGS				
0013	606E 26000	3.000	EACH	$3,000.00	$9,000.00
	ANCHOR ASSEMBLY, TYPE E				
0014	606E 35002	4.000	EACH	$2,100.00	$8,400.00
	MGS BRIDGE TERMINAL ASSEMBLY				
0015	606E	3,500.000	SF	$25.00	$87,500.00
	SPECIAL - VISUAL BARRIER WALL				
0016	611E 07400	1,000.000	FT	$100.00	$100,000.00
	18" CONDUIT, TYPE B				
0017	611E 99114	2.000	EACH	$10,000.00	$20,000.00
	INLET, NO. 3 FOR SINGLE SLOPE BARRIER, TYPE D				
0018	622E 10020	175.000	FT	$200.00	$35,000.00
	CONCRETE BARRIER, TYPE D				
0019	622E 24000	1,000.000	FT	$350.00	$350,000.00
	CONCRETE BARRIER, TYPE D, AS PER PLAN (REINFORCED W/ FOOTING)				
0020	630E	2.000	EACH	$25,000.00	$50,000.00
	OVERHEAD TRUSS SIGNS				
0021	630E	1.000	EACH	$10,000.00	$10,000.00
	CANTILEVER SIGN				
0022	644E 00104	2.900	MILE	$6,000.00	$17,400.00
	EDGE LINE, 6"				
0023	644E 00204	1.100	MILE	$3,500.00	$3,850.00
	LANE LINE, 6"				
0024	646 10620	350.000	FT	$10.00	$3,500.00
	CHEVRON MARKING				
0025	644E	1,500.000	FT	$3.00	$4,500.00
	DOTTED LINE, 8"				
0026	659E 10000	6,300.000	SY	$3.00	$18,900.00
	SEEDING AND MULCHING				
0027	832E 30000	25,000.000	EACH	$1.00	$25,000.00
	EROSION CONTROL				
0028	614E 11011	1.000	LS	$58,000.00	$58,000.00
	MAINTAINING TRAFFIC, AS PER PLAN				
0029	623E 10000	1.000	LS	$18,000.00	$18,000.00
	CONSTRUCTION LAYOUT STAKES AND SURVEYING				
0030	624E 10000	1.000	LS	$40,000.00	$40,000.00
	MOBILIZATION				

Estimated Sub-Total:	$1,265,000.00
Engineering Design, Enviro and Construction Eng (30%)	$379,500.00
Contigency (35%):	$442,800.00
Inflation to 2021 Construction (7.5%)	$156,600.00
Estimated Total:	**$2,243,900.00**

COST ESTIMATE DOES NOT INCLUDE

RIGHT-OF-WAY

UTILITY RELOCATION

FIGURE #15: **Proposed Improvements include the placement of concrete barrier on the outside SB I-71 lane with the addition of rumble strips to detur drivers from a three-lane weave. In addition, minor pavement widening along the C-D road, and significant restriping are required along the C-D Road all the way to CR 176.**
REMOVAL OF GUARDRAIL N & S OF W. 14TH STREET OVERPASS PIER + REMOVAL AT NORTHERN PAVEMENT WIDENING.
1' REMOVAL FOR WIDENING
EXCAVATION FOR PAVEMENT WIDENING (6.33 FT WIDTH x 1.5 FT DEPTH x 800 FT LENGTH) AND LEVELING SOLID ADJACENT TO PR PAVEMENT TYING INTO EXISTING GRADE AT BOTH LOCATIONS
ASSUME 12" EXCAVATION AND REPLACEMENT FOR FOUNDATION IMPROVEMENT
ASSUME 12" EXCAVATION AND REPLACEMENT FOR FOUNDATION IMPROVEMENT
CD ROAD AND RAMP TO SR 176
SAWING ON EX PVMT FOR CLEAN EDGE TO BEGIN WIDENING
USE 8 INCH OF ASPHALT BASE (0.75 FT x 5.5 FT WIDTH x 800 FT LENGTH) FOR WIDENING AREA
USE 6 INCH OF AGGREGATE UNDER PAVEMENT (0.5 FT x 6.33 FT WIDTH x 800 FT LENGTH) FOR WIDENING AREA
USE 1.5 INCH OF SURFACE COURSE (0.125 FT x 5 FT WIDTH x 800 FT LENGTH) FOR WIDENING AREA + MILL AND OVERLAY
USE 2.5 INCH OF INTERMEDIATE BASE (0.208 FT x 5 FT WIDTH x 800 FT LENGTH)
SHORT GUARDRAIL LENGTH AT OVERPASS PIER + AT NORTH NEAR NEW SIGN TRUSS STRUCTURE
TERMINAL AT OVERPASS PIER + TWO AT NEW SIGN TRUSS STRUCTURE
TERMINAL AT OVERPASS PIER + TWO AT NEW SIGN TRUSS STRUCTURE
CLARK ST TO PED BRIDGE; SHIELD MAINLINE SIGNAGE FROM CD ROAD
DRAINAGE PIPE FOR PROPOSED DRAINAGE IMPROVEMENTS AT NORTHERN PAVEMENT WIDENING.
INLETS AT NORTHERN WIDENING TO IMPROVE EXISTING DRIANANGE CONCERNS
THREE LOCATIONS (TWO 50' LENGTH AT NORTH SIGN TRUSS & JUST NORTH OF PEDESTRIAN BRIDGE)
CONCRETE BARRIER AT NORTHERN PAVEMENT WIDENING AT DRAINAGE IMPROVEMENTS
THREE PROPOSED OVERHEAD SIGN TRUSS STRUCTURES + ONE CANTILEAVER. COMBINED TO SIMPLIFY ESTIMATE.
THREE PROPOSED OVERHEAD SIGN TRUSS STRUCTURES + ONE CANTILEAVER. COMBINED TO SIMPLIFY ESTIMATE.
SOLID (15,000 FT)
SKIP-DASH (6,000 FT) + DOTTED (1,200)
SOLID PAVEMENT MARKINGS AT RAMPS PER ODOT TC DETAIL
SOLID PAVEMENT MARKINGS AT RAMPS PER ODOT TC DETAIL
EX GRASSED AREAS THAT MAY BE USED TO TEMPORARILY STORE MATERIAL OR EQUIPMENT (60,000 SQ FT)
TEMPORARY EROSION CONTROL OF GRASSED AREAS AND INLET PROTECTION
5% OF ROADWAY SUB-TOTAL
1.5% OF ROADWAY SUB-TOTAL
PER CMS

Estimate: CUY-IR 71 SAFETY STUDY (Figure 18) SINGH + Associates, Inc.

Line #	Item Number	Description	Quantity	Units	Unit Price	Extension
0001	202E 38000	GUARDRAIL REMOVAL	870.000	FT	$5.00	$4,350.00
0002	202E 23000	PAVEMENT REMOVED	4,500.000	SY	$12.00	$54,000.00
0003	203E 10000	EXCAVATION	1,990.000	CY	$30.00	$59,700.00
0004	203E 20000	EMBANKMENT	995.000	CY	$35.00	$34,825.00
0005	255E 20000	FULL DEPTH PAVEMENT SAWING	900.000	FT	$3.00	$2,700.00
0006	301E 46000	ASPHALT CONCRETE BASE, PG64-22	1,500.000	CY	$175.00	$262,500.00
0007	304E 20000	AGGREGATE BASE	1,000.000	CY	$65.00	$65,000.00
0008	442E 10000	ASPHALT CONCRETE SURFACE COURSE, 12.5 MM, TYPE A (446)	250.000	CY	$220.00	$55,000.00
0009	442E 10100	ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE 2, (448)	450.000	CY	$190.00	$85,500.00
0010	606E 15550	GUARDRAIL, BARRIER DESIGN, TYPE MGS	325.000	FT	$30.00	$9,750.00
0011	606E 26150	ANCHOR ASSEMBLY, TYPE E	2.000	EACH	$2,500.00	$5,000.00
0012	606E 35002	MGS BRIDGE TERMINAL ASSEMBLY, TYPE 1	1.000	EACH	$2,500.00	$2,500.00
0013	609E 70000	4" CONCRETE MEDIAN	80.000	SY	$80.00	$6,400.00
0014	611E 98010	CONCRETE BARRIER (TYPE D) INLET	3.000	EACH	$4,000.00	$12,000.00
0015	622E 24000	CONCRETE BARRIER, TYPE D	420.000	FT	$200.00	$84,000.00
0016	622E 24001	CONCRETE BARRIER, TYPE D, AS PER PLAN (REINFORCED W/ FOOTING)	190.000	FT	$350.00	$66,500.00
0017	630E 00000	OVERHEAD SIGN SUPPORT AND SIGN SHEET	1.000	LS	$90,000.00	$90,000.00
0018	630E 89702	REMOVAL OF OVERHEAD SIGN SUPPORT AND DISPOSAL	1.000	EACH	$5,000.00	$5,000.00
0019	644E 30030	REMOVAL OF PAVEMENT MARKING	1.500	MILE	$9,000.00	$13,500.00
0020	644E 00104	EDGE LINE, 6"	1.100	MILE	$4,500.00	$4,950.00
0021	644E 00204	LANE LINE, 6"	0.400	MILE	$2,500.00	$1,000.00
0022	644E 00404	CHANNELIZING LINE, 12"	450.000	FT	$3.00	$1,350.00
0023	644E 00700	TRANSVERSE/DIAGONAL LINE	410.000	FT	$6.00	$2,460.00
0024	653E 10000	TOPSOIL FURNISHED AND PLACED	530.000	CY	$40.00	$21,200.00
0025	659E 10000	SEEDING AND MULCHING	3,200.000	SY	$3.00	$9,600.00
0026	611E 00000	DRAINAGE	1.000	LS	$90,000.00	$90,000.00
0027	832E 30000	EROSION CONTROL	30,000.000	EACH	$1.00	$30,000.00
0028	614E 11011	MAINTAINING TRAFFIC, AS PER PLAN	1.000	LS	$44,000.00	$44,000.00
0029	623E 10000	CONSTRUCTION LAYOUT STAKES AND SURVEYING	1.000	LS	$27,000.00	$27,000.00
0030	624E 10000	MOBILIZATION	1.000	LS	$54,000.00	$54,000.00

Estimated Sub-Total:	$1,204,000.00
Engineering Design, Enviro and Construction Eng (30%)	$361,200.00
Contigency (35%):	$421,400.00
Inflation to 2021 Construction (7.5%)	$149,000.00
Estimated Total:	**$2,135,600.00**

COST ESTIMATE DOES NOT INCLUDE

RIGHT-OF-WAY
UTILITY RELOCATION

FIGURE #16:
Proposed Improvements include the reconstruction of the W. 14th Street connection to the C-D Ramp to CR 176. To do so, reconfiguration of the vertical and horzontal alignment of W. 14th Street, Valentine Road, and the adjacent ramps.

REMOVAL OF GUARDRAIL on W. 14TH STREET TO CR 176 + REMOVAL AT RAMP TO W. 25TH STREET

REMOVAL OF EXISTING PAVEMENT FROM 14TH ST OVERPASS TO 17TH ST AT VALENTINE INTERSECTION TO RAMP TO CR 176 OVERPASS.

EXCAVATION FOR VERTICAL ALIGNMENT REVISIONS (2 FT DEPTH x 65,000 SF AREA)

SAWING ON EX PVMT ALONG BOTH PR PAVEMENT WIDENING LOCATIONS FOR CLEAN EDGE TO BEGIN WIDENING

USE 8 INCH OF AGGREGATE BASE (0.75 FT x 65,000 SF AREA) FOR PAVEMENT RECONSTRUCTION AREA

USE 6 INCH OF AGGREGATE UNDER PAVEMENT (0.5 FT x 65,000 SF AREA) FOR PAVEMENT RECONSTRUCTION AREA

USE 1.5 INCH OF SURFACE COURSE (0.125 FT x 65,000 SF AREA) FOR PAVEMENT RECONSTRUCTION AREA. ADDITIONAL SIGNAGE AREA ADDED FOR SMALLER SIGNS NEAR VALENTINE AVE

USE 2.5 INCH OF INTERMEDIATE BASE (0.208 FT x 65,000 SF AREA) FOR PAVEMENT RECONSTRUCTION AREA

SHORT GUARDRAIL LENGTH AT RAMP TO CR 176

TERMINAL AT OVERPASS PIER + TWO AT NEW SIGN TRUSS STRUCTURE

PROPOSED MEDIAN AT VALENTINE AVE INTERSECTION

INLETS AT CONCRETE BARRIER IN CASE OF DRAINAGE BOUNDARY REVISIONS

COMPLEX CONCRETE BARRIER SERVING AS A MINOR RETAINING WALL. COMBINED TO SIMPLIFY THE COST ESTIMATE

REGULAR CONCRETE BARRIER

ONE PROPOSED OVERHEAD SIGN TRUSS STRUCTURES

ONE EXISTING OVERHEAD TRUSS ON THE SOUTH SIDE OF THE IMPROVEMENTS

REMOVAL OF PAVEMENT MARKINGS ON SB IR-71 AND C-D ROAD TO CR 176. ESTIMATED JUST SHY OF PROPOSED PAVEMENT MARKINGS

SOLID (6,500 FT)

SKIP-DASH (2,000 FT) + DOTTED (300) + SOLID (600)

SOLID PAVEMENT MARKINGS AT RAMPS PER ODOT TC DETAIL

EXISTING AND PROPOSED GRASSED AREAS WITHIN THE PAVEMENT IMPROVEMENTS WILL BE AFFECTED (65,000 SQ FT)

DRAINAGE PIPE FOR PROPOSED DRAINAGE IMPROVEMENTS AT NORTHERN PAVEMENT WIDENING.

TEMPORARY EROSION CONTROL OF GRASSED AREAS AND INLET PROTECTION

2% OF ROADWAY SUB-TOTAL

3% OF ROADWAY SUB-TOTAL

1.5% OF ROADWAY SUB-TOTAL

CUY-71-18.29 SAFETY STUDY

APPENDIX G: CAPACITY ANALYSIS

HCS7 Freeway Weaving Report

Project Information

Analyst	BSE	Date	3/18/2018
Agency	CMT	Analysis Year	2018
Jurisdiction	ODOT	Time Period Analyzed	Peak
Project Description	I-490 / I-71 / 176 SB CD Road Proposed Weaving Segment (CUY-71-18.29)		

Geometric Data

Number of Lanes (N), ln	2	Segment Type	Highway/CD Roadway
Short Length (L_s), ft	1000	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.80	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Volume (V_i), veh/h	1100	110	1720	910
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.952	0.952	0.952	0.952
Flow Rate (v_i), pc/h	1284	128	2007	1062

Weaving Flow Rate (v_w), pc/h	1190	Freeway Max Capacity (c_{IFL}), pc/h/ln	2250
Non-Weaving Flow Rate (v_{NW}), pc/h	3291	Density-Based Capacity (c_{IWL}), pc/h/ln	1927
Total Flow Rate (v), pc/h	4481	Demand Flow-Based Capacity (c_{IW}), pc/h	9023
Volume Ratio (VR)	0.266	Weaving Segment Capacity (c_W), veh/h	3669
Minimum Lane Change Rate (LC_{MIN}), lc/h	0	Adjusted Weaving Area Capacity (c_{wa}), veh/h	3669
Maximum Weaving Length (L_{MAX}), ft	5222	Volume-to-Capacity Ratio (v/c)	1.16

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Total Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

HCS7 Freeway Weaving Report

Project Information

Analyst	BSE	Date	3/18/2018
Agency	CMT	Analysis Year	2018
Jurisdiction	ODOT	Time Period Analyzed	Peak
Project Description	I-490 / I-71 / 176 SB CD Road Proposed Weaving Segment (CUY-71-18.29)		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Highway/CD Roadway
Short Length (L_s), ft	1250	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.50	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Volume (V_i), veh/h	1100	110	1720	910
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	8.00	8.00	8.00	8.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.926	0.926	0.926	0.926
Flow Rate (v_i), pc/h	1320	132	2064	1092

Weaving Flow Rate (v_w), pc/h	1224	Freeway Max Capacity (c_{IFL}), pc/h/ln	2250
Non-Weaving Flow Rate (v_{NW}), pc/h	3384	Density-Based Capacity (c_{IWL}), pc/h/ln	1946
Total Flow Rate (v), pc/h	4608	Demand Flow-Based Capacity (c_{IW}), pc/h	9023
Volume Ratio (VR)	0.266	Weaving Segment Capacity (c_W), veh/h	5406
Minimum Lane Change Rate (LC_{MIN}), lc/h	132	Adjusted Weaving Area Capacity (c_{wa}), veh/h	5406
Maximum Weaving Length (L_{MAX}), ft	5222	Volume-to-Capacity Ratio (v/c)	0.79

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	212	Average Weaving Speed (S_W), mi/h	48.3
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	797	Average Non-Weaving Speed (S_{NW}), mi/h	46.7
Weaving Lane Change Rate (LC_W), lc/h	282	Average Speed (S), mi/h	47.1
Total Lane Change Rate (LC_{All}), lc/h	1079	Density (D), pc/mi/ln	32.6
Weaving Intensity Factor (W)	0.201	Level of Service (LOS)	D

HCS7 Freeway Merge Report

Project Information

Analyst	BSE	Date	3/18/2018
Agency	CMT	Analysis Year	2018
Jurisdiction	ODOT	Time Period Analyzed	Peak
Project Description	Merge-14		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	55.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	250
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	All Familiar	All Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Volume (V_i), veh/h	2630	940
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	4.00	5.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.962	0.952
Flow Rate (v_i), pc/h	3038	1097
Capacity (c), pc/h	6750	2000
Volume-to-Capacity Ratio (v/c)	0.61	0.55

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	25.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.372
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	1264
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	50.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	0.584	Outer Lanes Freeway Speed (S_O), mi/h	52.2
Flow in Lanes 1 and 2 (v_{12}), pc/h	1774	Ramp Junction Speed (S), mi/h	50.8
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	2871	Average Density (D), pc/mi/ln	27.1
Level of Service (LOS)	C		

CUY-71-18.29 SAFETY STUDY

APPENDIX H: ECAT ANALYSIS

Project Information

General Information

Project Name	CUY-71-CCG7A	Contact Email	kmiller@cmtengr.com
Project Description	I-71 at I-90/I-490/SR-176	Contact Phone	(937) 701-8561
Reference Number	CUY-71-CCG7A	Date Performed	3/5/2019
Analyst	Kevin Miller	Analysis Year	2018
Agency/Company	Crawford, Murphy & Tilly		
Perform Benefit Cost Analysis?	Yes		

Do the proposed improvements fundamentally change the conditions of the base safety performance function (SPF), Or is crash data unavailable for the analysis condition, Or is only predicted (and not expected) analysis needed for the existing or proposed condition?	**No**

(Examples: unsignalized to signalized, undivided to divided, increase or decrease in the number of lanes, change the number of approaches to an intersection, significant realignment of the roadway)

Project Elements Description Table

Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name
IR71; 17.98-18.35	Freeway Segment		SCUYIR00071**C	17.98	18.35	0.37		I-71 SB from I-90 CD Gore to SR176
IR71; 18.36-18.87	Freeway Segment		SCUYIR00071**C	18.36	18.87	0.51		I-71 SB from I-90 to I-90 CD Gore
IR90; 13.86-14.38	Freeway Segment		SCUYIR00090**C	13.86	14.38	0.52		I-90 EB from Train Ave. to I490 Gore

Traffic Volume Growth Rate Calculation For Benefit Cost Analysis

	Year	AADT	
Present ADT (PADT)	2017	59,640	veh / day
Future ADT (FADT)	2035	63,000	veh / day
Annual Linear Growth Rate		0.0031	

Project Elements Description Table

Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name

Select Other Non-Site Characteristic Based Countermeasures For Entire Project

CMF Nbr	Countermeasure	CMF KA Value	CMF B Value	CMF C Value	CMF O Value	CMF Valid for the Following Site Types
CMF 1	Restrict weaving movement from I-90 CD road to SR-176 exit ramp	0.7	0.7	0.7	0.7	8
CMF 2	Install changeable "Queue Ahead" warning signs	By Crash Type	By Crash Type	By Crash Type	By Crash Type	8 / 10
CMF 3						
CMF 4						
CMF 5						
CMF 6						
CMF 7						
CMF 8						
CMF 9						
CMF 10						

Project Cost Estimate

Project Name	CUY-71-CCG7A	Contact Email	kmiller@cmtengr.com
Project Description	I-71 at I-90/I-490/SR-176	Contact Phone	(937) 701-8561
Reference Number	CUY-71-CCG7A	Date Performed	3/5/2019
Analyst	Kevin Miller	Analysis Year	2018
Agency/Company	Crawford, Murphy & Tilly		

Engineering Design %	30%
Contingency %	35%

Countermeasures	Construction Costs	Right of Way Costs	Engineering Design Costs	Contingency Amount	Total Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value
Site Characteristic Improvements (i.e. Lane widening)			$0.00	$0.00	**$0.00**		
Site Characteristic Improvements (i.e. Lighting)			$0.00	$0.00	**$0.00**		
Site Characteristic Improvements (i.e. Signal Phasing)			$0.00	$0.00	**$0.00**		
Site Characteristic Improvements (i.e. Added Right Turn Lane)			$0.00	$0.00	**$0.00**		
CMF 1 - Restrict weaving movement from I-90 CD road to SR-176 exit ramp	$2,131,000.00	$0.00	$639,300.00	$745,850.00	**$3,516,150.00**		
CMF 2 - Install changeable "Queue Ahead" warning signs	$1,204,000.00	$0.00	$361,200.00	$421,400.00	**$1,986,600.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
Totals	**$3,335,000.00**	**$0.00**	**$1,000,500.00**	**$1,167,250.00**	**$5,502,750.00**	**$0.00**	**$0.00**

Inflation %	8%

Final Costruction Cost:	**$5,915,456.25**

*Final construction cost should match the Project Cost Estimate

Safety Benefit - Cost Analysis

General Information

Project Name	CUY-71-CCG7A	Contact Email	kmiller@cmtengr.com
Project Description	I-71 at I-90/I-490/SR-176	Contact Phone	(937) 701-8561
Reference Number	CUY-71-CCG7A	Date Performed	3/5/2019
Analyst	Kevin Miller	Analysis Year	2018
Agency/Company	Crawford, Murphy & Tilly		

Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Comments:

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Site Characteristic Improvements (i.e. Lane widening)		$0.00			$0.00	$0.00	-10.133	$1,605,465
Site Characteristic Improvements (i.e. Lighting)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		$0.00			$0.00	$0.00		
CMF 1 - Restrict weaving movement from I-90 CD road to SR-176 exit ramp	20	$3,516,150.00			$3,516,150.00	$3,516,150.00	-5.142	$2,182,611
CMF 2 - Install changeable "Queue Ahead" warning signs	20	$1,986,600.00			$1,986,600.00	$1,986,600.00	-0.506	$91,205
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
Totals		**$5,502,750.00**	**$0.00**	**$0.00**	**$5,502,750.00**	**$5,502,750.00**	**-15.780**	**$3,879,280**

Safety Benefit - Cost Analysis

General Information

Project Name	CUY-71-CCG7A	Contact Email	kmiller@cmtengr.com
Project Description	I-71 at I-90/I-490/SR-176	Contact Phone	(937) 701-8561
Reference Number	CUY-71-CCG7A	Date Performed	3/5/2019
Analyst	Kevin Miller	Analysis Year	2018
Agency/Company	Crawford, Murphy & Tilly		

Benefit - Cost Calculator

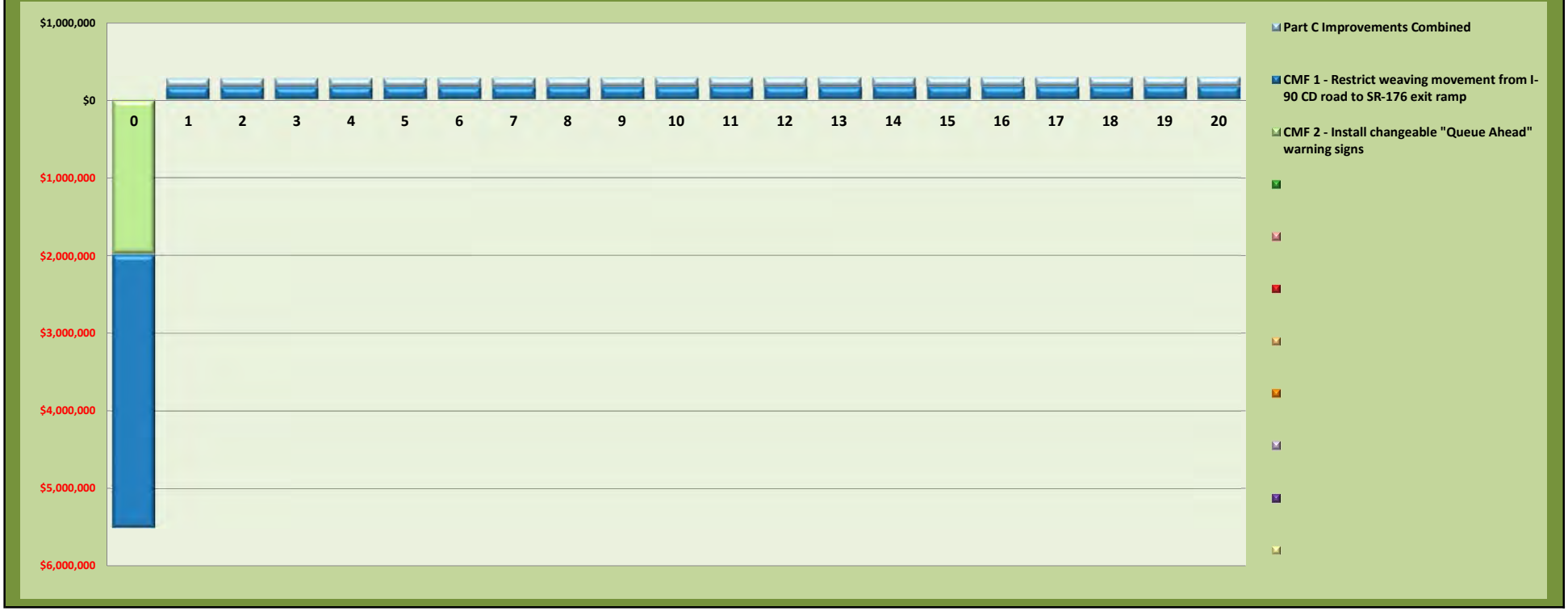
Net Present Value of Project	$5,502,750.00
Net Present Value of Safety Benefits	$3,879,280.24
Net Benefit	($1,623,469.76)
Benefit / Cost Ratio	0.70

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.109
Number of Injury Crashes	-2.752
Number of Total Crashes	-15.780

Comments:

Safety Benefits and Project Costs Combined Cash Flows By Countermeasure Per Year

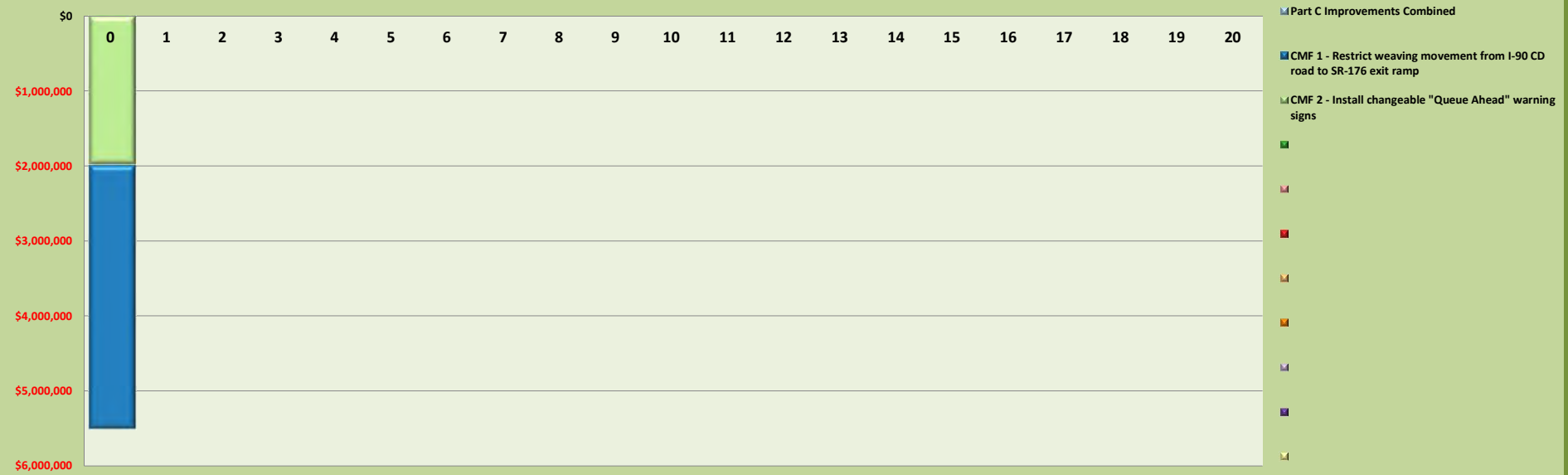


Safety Benefit - Cost Analysis

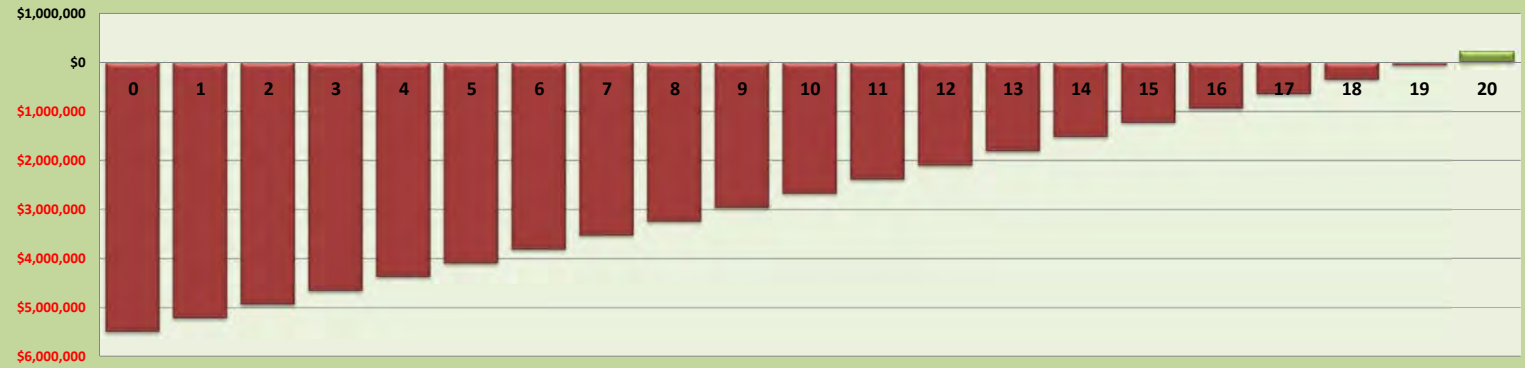
General Information

Project Name	CUY-71-CCG7A	Contact Email	kmiller@cmtengr.com
Project Description	I-71 at I-90/I-490/SR-176	Contact Phone	(937) 701-8561
Reference Number	CUY-71-CCG7A	Date Performed	3/5/2019
Analyst	Kevin Miller	Analysis Year	2018
Agency/Company	Crawford, Murphy & Tilly		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



First year to observe a positive return on investiment: 2038 (20 years)

Percentage of Service Life to observe a continuous Positive Return on Investment: 05.00%

OHIO DEPARTMENT OF TRANSPORTATION

Safety Funding Application

General Project Information

Project Sponsoring Agency	ODOT District 12
Project Name	CUY-71-18.29
PID	98063
Project Manager	Keri Welch, PE
Contact Phone	216.584.2166
Contact Email	keri.welch@dot.ohio.gov

Location Information

ODOT District	12	**County**	Cuyahoga
Route Number	71	**Road Name**	Medina Freeway
Begin Logpoint	18.000	**End Logpoint**	18.800
Begin Latitude	41.462	**Begin Longitude**	-81.695
End Latitude	41.473	**End Longitude**	-81.694

Project Description

Summary of Crash Patterns

A total of 132 crashes occurred within a study area that included SB I-71 and related ramps and CD roadway between the I-90/I490 interchange and the SR176 interchange. A subset of these crashes involve vehicles that avoid queues on the Collector Distributor (CD) roadway destine to SB SR176 by performing a 3-lane weave across SB I-71 to access a left side exit ramp to SB SR176. 25 crashes are directly attributed to this weave maneuver over a distance of 800-1500 feet; an additional 25 rear end crashes have occurred within the merge/diverge area of both ramps. Origin-destination analysis using Streetlight data suggests as many as 500 vehicles attempt the 3-lane weave maneuver during the PM peak hour. 25.8% of the 132 crashes resulted in injuries which is higher than the 24.1% average of similar type interstates.

The CD roadway formed by the EB I-90 and WB I-490 ramps also operates over capacity (V/C of 1.16 in the PM peak hour). Queues extend from the 2-lane CD roadway onto EB I-90. Three segments on I-90 rank in the top 10 Urban Freeway segments within 0.4 miles of the exit ramp to the CD roadway destine to SB I-71: #1 (14.25 to 14.35 which includes the W. 25th Street interchange), #4 (14.35 to 14.45 which includes the EB I-90 ramp gore to SB I-71), and #8 (13.98 to 14.08). Three crash types common when queues form on interstates comprise 97.5% of all crashes on the EB I-90 segment (2016-2018 data): rear-ends (68.1%), sideswipe-passing (20.2%), and fixed object (9.2%). 34.5% of the 238 crashes resulted in injuries which is higher than the 24.1% average of similar type interstates.

Summary of Recommended Countermeasures

1.Extend a concrete barrier between I-71 and the C-D ramp from the Buhrer Avenue pedestrian bridge to a point 100 feet south of the W. 14th Street bridge (1,200 feet total length).
2.Extend longitudinal rumble strip between the C-D ramp and I-71 from the end of the concrete barrier to the painted merge of the C-D ramp (650 feet).
3.Extend longitudinal rumble strip between the SB SR176 diverge ramp and I-71 from the ramp gore (400 feet).
4. Add concrete barrier to protect the west piers at W. 14th Street adjacent to the C-D entrance ramp – shifting the ramp on existing pavement is proposed to maximize the width between the C-D ramp and mainline I-71
5.Add regulatory sign prohibiting exit to SB SR176 from the C-D ramp to SB I-71
6. Convert the ramp merge for the EB I-90 movement by adding a 3rd lane to the CD roadway (LOS improved from F to D)
7. Increase weaving distance on CD roadway from 600 feet to 1,250 feet. Minor pavement widening to extend weaving distance.
8. An option lane is proposed for the center lane of the 3-lane section to reduce the workload of drivers by distributing the decision points over a longer distance. A driver from EB I-90 destine to SB I-71 in the proposed condition is required to weave a single lane within a distance of 1,250 feet. A lane drop follows the weave segment on both ramps to SB I-71 and to SB SR176.
9. A visual screen is proposed between the C-D roadway and mainline I-71 (350 ft length) to reduce visibility of overhead guide signs on I-71.
10. Convert SB SR176 ramp over I-71 to a 2-lane ramp to reduce queue lengths that extend to EB I-90
11. Convert Valentine/W. 14th Street entrance ramp to a merge from an add lane to SB SR176

Project Priority Information

Three segments on I-90 rank in the top 10 Urban Freeway segments within 0.4 miles of the exit ramp to the CD roadway destined to SB I-71: #1 (14.25 to 14.35 which includes the W. 25th Street interchange), #4 (14.35 to 14.45 which includes the EB I-90 ramp gore to SB I-71), and #8 (13.98 to 14.08).

Safety Funding Application

Crash Data

Crash Totals

	Fatal & Serious Injury (KA)	Visible Injury (B)	Non-Visible (C)	Property Damage Only (O)	Total
Existing Conditions: Predicted Crash Frequency	0.5802	2.0382	2.1947	11.0588	15.87
Existing Conditions: Expected Crash Frequency	0.5847	2.4432	4.3115	26.7214	34.06
Potential for Safety Improvement	0.0045	0.4050	2.1168	15.6626	18.19
Proposed Conditions: Expected Crash Frequency	0.4760	1.7310	2.3800	13.6934	18.28
Observed Crashes	0.7500	5.5000	19.7500	55.0000	81.00

Observed People Injury Totals

	Fatal Injury (K)	Serious Injury (A)	Visible Injury (B)	Non-Visible (C)	Total
Observed People Injury Totals	0.0000	1.0000	7.2500	32.2500	40.50

Application Scoring

Category	Scoring Value	Points Awarded	Points Possible
Expected Crash Frequency	34.06	10	10
Ratio of Observed Fatal and Serious Injuries to Observed Total Crashes	0.01	1	5
% of the Potential for Safety Improvement to Total Expected Crashes	53.41%	20	20
Relative Severity Index	$30,950	6	10
Equivalent Property Damage Only Index	2.49	2	5
Volume to Capacity Ratio	1.30	10	10
Benefit Cost Ratio	0.70	0	30
Safety Funding Request Percentage	88.40%	2	10
Total		51	100

Strategic Highway Safety Plan

Functional Class	Interstates
Major Route AADT	94,285 (2017) on I-71; 143,262 (2017) on I-90
Ohio Emphasis Area	Emphasis Area V - Incident and Congestion Related Crashes
Ohio Emphasis Area Subcategory	Rear End Crashes
FHWA Emphasis Area	Curbing aggressive driving
FHWA Improvement Category	Interchange design
FHWA Improvement Subcategory	Interchange design - other

Work Locations

NLFID	Begin Logpoint	End Logpoint	Begin Latitude	Begin Longitude	Location Termini (i.e. from Street 1 to Street 2)
SCUYIR00071**C	17.980	18.120	41.462	-81.6950	I-71 SB and C-D Road from I-90 to SR-176

OHIO DEPARTMENT OF TRANSPORTATION

Safety Funding Application

Project Funding

Project Phase	Safety Study	Interchange Mod. Study	PE - Environmental	PE - Detailed Design	Right of Way /Utilities	Construction	Total
Fiscal Year	2018	2019	2020	2021		2022	
Project Phase Completed	☐	☐	☐	☐	☐	N/A	
Previous Safety	$94,273.00	$22,306.00					$116,579.00
New Safety			$700,000.00	$300,500.00	$0.00	$4,214,956.00	$5,215,456.00
Sponsor Funding						$700,000.00	$700,000.00
Total	$94,273.00	$22,306.00	$700,000.00	$300,500.00	$0.00	$4,914,956.00	$6,032,035.00

Additional Funding Detail

The CCG7A project is a committed project receiving $6.5 million of TRAC funding in 2018. Safety improvements to the CD ramp to SB I-71 are being incorporated into the scope of the CCG7A project. New safety funding is limited to improvements to the CD roadway between I-90/I490 and Valentine Road ramp.

Applicant Information

Name	Title	Phone Number
	Planning Engineer	216.584.2166
Signature		**Date**
		March 12, 2019

Version: 20150917

The following information should be included in submission of the safety project application:

1. An electronic copy of the Safety Engineering Study
2. All Excel Analysis Files
   May include Crash Analysis Module (CAM) Tool, Economic Crash Analysis Tool (ECAT), HSIP Application and Scoring Tool.
3. Benefit-Cost Results (Economic Analysis)
4. DSRT approval signatures

Project Scoring Summary

General Project Information

Project Name	CUY-71-CCG7A	Contact Email	kmiller@cmtengr.com
Project Description	I-71 at I-90/I-490/SR-176	Contact Phone	(937) 701-8561
Reference Number	CUY-71-CCG7A	Date Performed	3/5/2019
Analyst	Kevin Miller	Analysis Year	2018
Agency/Company	Crawford, Murphy & Tilly	Analysis Type Performed	ECAT - No Change in base SPF

Category	Value	Points Awarded
Expected Crash Frequency	34.06	10
Ratio of Observed Fatal and Serious Injuries to Observed Total Crashes	0.01	1
% of the Potential for Safety Improvement to Total Expected Crashes	53.41%	20
Relative Severity Index	$30,950.22	6
Equivalent Property Damage Only Index	2.49	2
Volume to Capacity Ratio	130.00%	10
Benefit Cost Ratio	0.70	0
Safety Funding Request Percentage	0.88	2

Safety Application Score	51

Submit to the Office of Systems Planning and Program Management

OHIO DEPARTMENT OF TRANSPORTATION