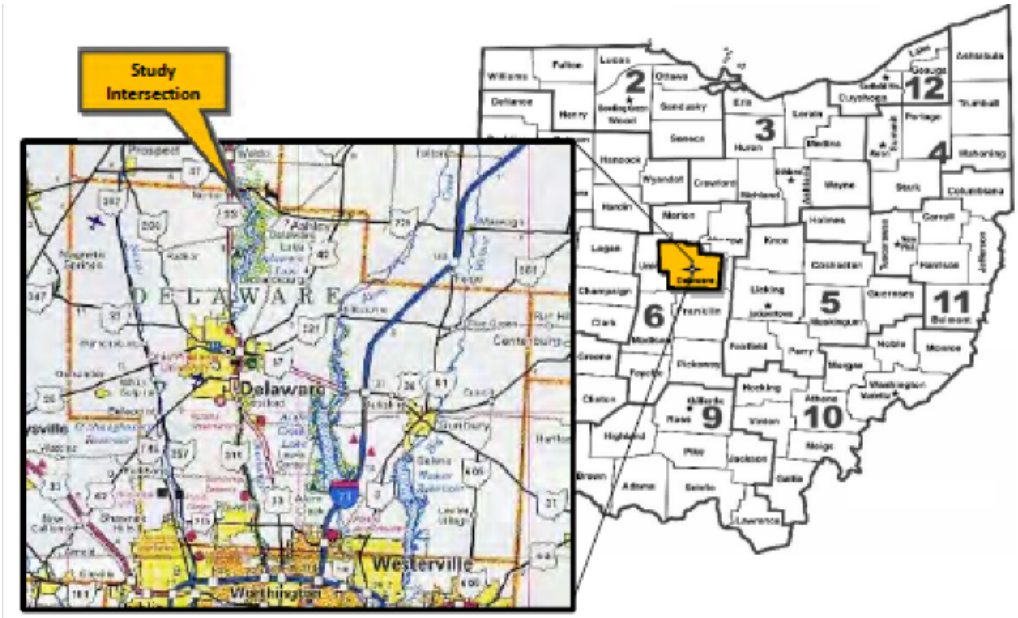

OHIO DEPARTMENT OF TRANSPORTATION

SAFETY STUDY

DEL-23-21.33
US 23 at SR 229

2020 Rural Segment
Rank #177,274,276

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Purpose and Need

This study analyzes the intersection of US 23 and SR 229 in Delaware County. This portion of US 23 is ranked 177, 274, and 276 on ODOT's 2020 rural non-freeway segment list, and has ranked as high as 22 in recent years. It should also be noted that there were crashes resulting in fatalities at this intersection in 2014 and 2015.

The purpose of this report is to study this location and analyze the crashes to determine what, if any, actions can be taken to reduce the high percentage of left turn, rear end and angle crashes that have occurred in the study area.

In addition, ODOT is seeking to proactively implement improvements along the US 23 corridor north of the City of Delaware that will eliminate existing signals by constructing interchanges and innovative intersections. This intersection has been identified as a priority location in the US 23 Corridor Study in order to create a free-flowing connection between the Columbus and Toledo regions.

Existing Conditions

The intersection of US 23 and SR 229 is a rural 4-legged isolated signalized intersection located in northern Delaware County approximately 10 miles north of Delaware and 12 miles south of Marion. This section of US 23 is a 4-lane, divided controlled access roadway classified as a rural principal arterial with a 60 mph speed limit. North of the intersection, US 23 becomes a rural freeway with a 65 mph speed limit. SR 229 (Norton Road) is a 2-lane undivided roadway classified as a rural major collector east and west of US 23 with both legs having a 55 mph speed limit. Current daily traffic volumes are approximately 26,000 (16% trucks) on US 23 south of the intersection, 28,000 (14% trucks) on US 23 north of the intersection, 3,320 (13% trucks) on SR 229 east of US 23, and 1,580 (9% trucks) west of US 23. A 2022 turning movement count is also available in the **Appendix A** for reference.

The signalized intersection has backplates and advanced radar dilemma zone detection. There are left turn lanes for the northbound and southbound approaches, which operate as permissive only movements. Lighting for the intersection is located at the southwest and northeast corners of the intersection. Signal ahead signs are provided on the north, south and eastbound approaches and the southbound approach includes dual signal ahead signs with one having flashing LED's. In addition, there is a southbound slip ramp from US 23 to SR 229 located approximately 2550 feet north of the intersection and the speed limit reduces from 65 mph to 60 mph for southbound traffic just north of this ramp.

The study area is predominantly rural with undeveloped land, farms, cemeteries and low-density single-family residences. Undeveloped, wooded land is located in the adjacent northwest, northeast and southeast corners of the intersection. Adjacent to the southwest corner is Cox Road which provides access to two (2) single family residences. In addition, a sporting goods store is located approximately 500 feet west of the intersection on the north side of SR 229 (Norton Rd). The intersection of SR 229/Norton Waldo Road and Norton Road is located 600 feet west of the intersection where SR 229 continues to the north. The two (2) cemeteries are on the southside of SR 229 located 500 feet and 1300 feet east of US 23

respectively. The intersection of SR 229 and Brundage Road/Weiser Road is located approximately 700 feet to the east of US 23.

Recent improvements at this intersection include the removal of the prepare to stop when flashing signs, installation of advanced radar dilemma zone detection, supplementary signal heads, signal head reflective backplates, advanced LED flashing signal ahead sign for southbound traffic on US 23, and upgrading the intersection lighting to LED. In addition, yellow and all red clearance times have been evaluated and updated as needed and red light running settings were recently implemented to extend the red when vehicles do not stop.

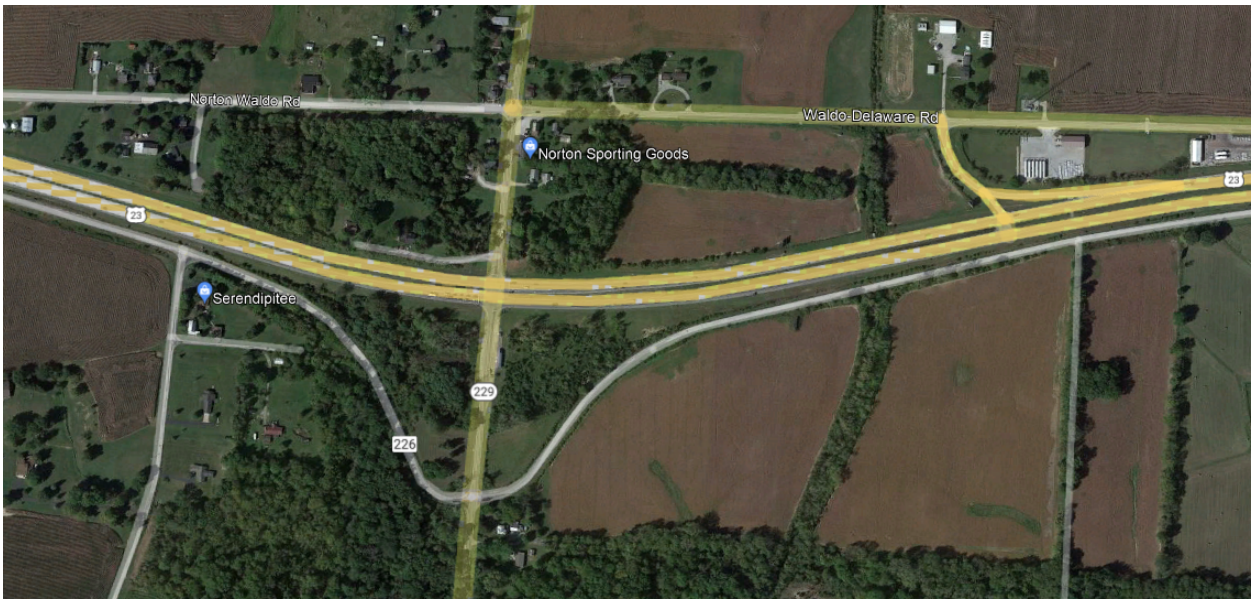


FIGURE 1 AERIAL VIEW

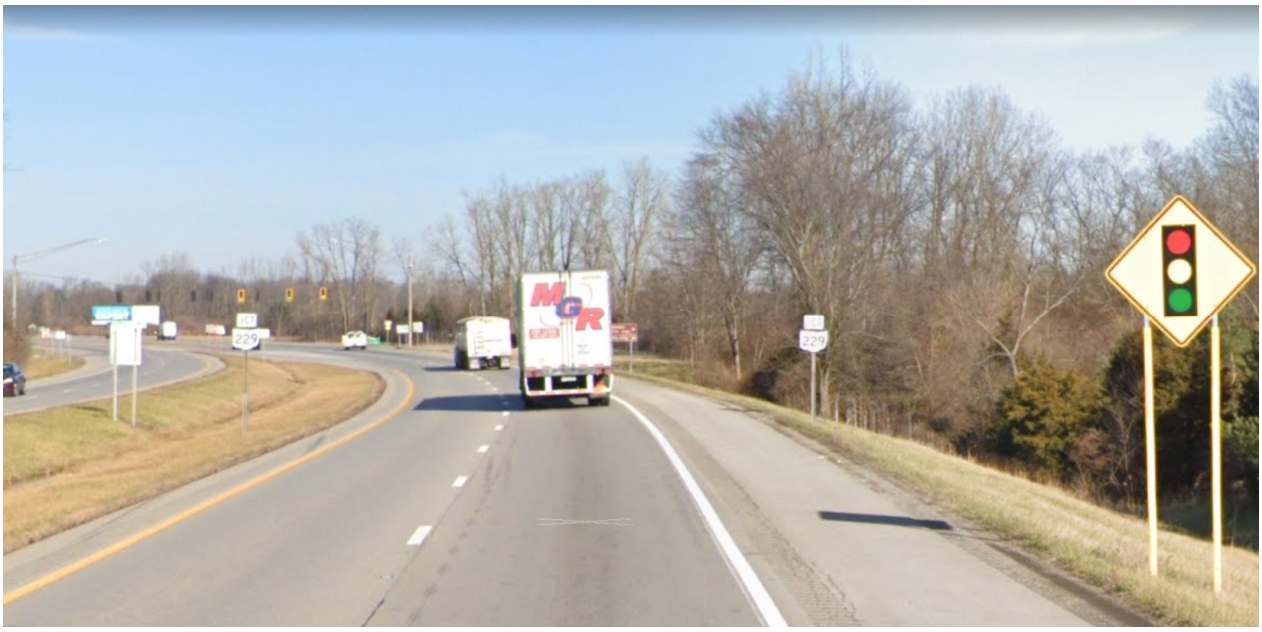


FIGURE 2 NORTHBOUND APPROACH

FIGURE 3 SOUTHBOUND APPROACH

FIGURE 4 EASTBOUND APPROACH

FIGURE 5 WESTBOUND APPROACH

Data Collection

Updated traffic counts were obtained by ODOT. The counts were collected on June 9, 2022 from 6AM to 6PM. The peak hour turning movement counts, which were used to develop future volumes used for the capacity analysis, can be found in the **Appendix A**.

Crash Trends

A total of 36 crashes were reported at this intersection from 2019 to 2021, 13 (36%) resulted in injuries with 3 having serious injuries. Of these crashes, 12 (33%) were rear end, 9 (25%) were left turn, 5 (14%) were angle, and 2 (8%) were side swipe crashes. The remaining crashes include run off the road (2), right turn (1) and other (3).

Of the 12 rear end crashes, 6 occurred in the northbound direction and 6 occurred in the southbound direction. Most of the rear-end crashes occurred during the day on dry pavement under no adverse weather conditions.

Of the 9 left turn crashes, 6 crashes were as a result of southbound US 23 drivers turning left in front of northbound traffic and 3 were due to a northbound left vehicles turning in front of southbound traffic. Of the southbound crashes, 3 serious injuries were reported.

Of the 5 angle crashes, 4 were as a result of drivers on US 23 running the red light. Of these 4 crashes, 3 were in the southbound direction and 1 was in the northbound direction.

The crashes have occurred throughout the day, with an increase in the afternoon hours. Almost all of the crashes (78%) occurred in the daylight. The crashes spiked in October (22%), with the remaining crashes spread throughout the year.

The high percentage of rear end crashes indicates that the high-speed traffic on US 23 is having difficulty stopping in time for traffic that is stopped at the signalized intersection. Especially coming from the north, the US 23 and SR 229 intersection is the first signalized intersection for miles, so drivers may not expect to see a signal on this high-speed, freeway like roadway.

The crash diagram can be found below and the full crash data is available in the **Appendix B**. Also, the ECAT analysis for existing and build conditions can be found in **Appendices C and D** respectively.

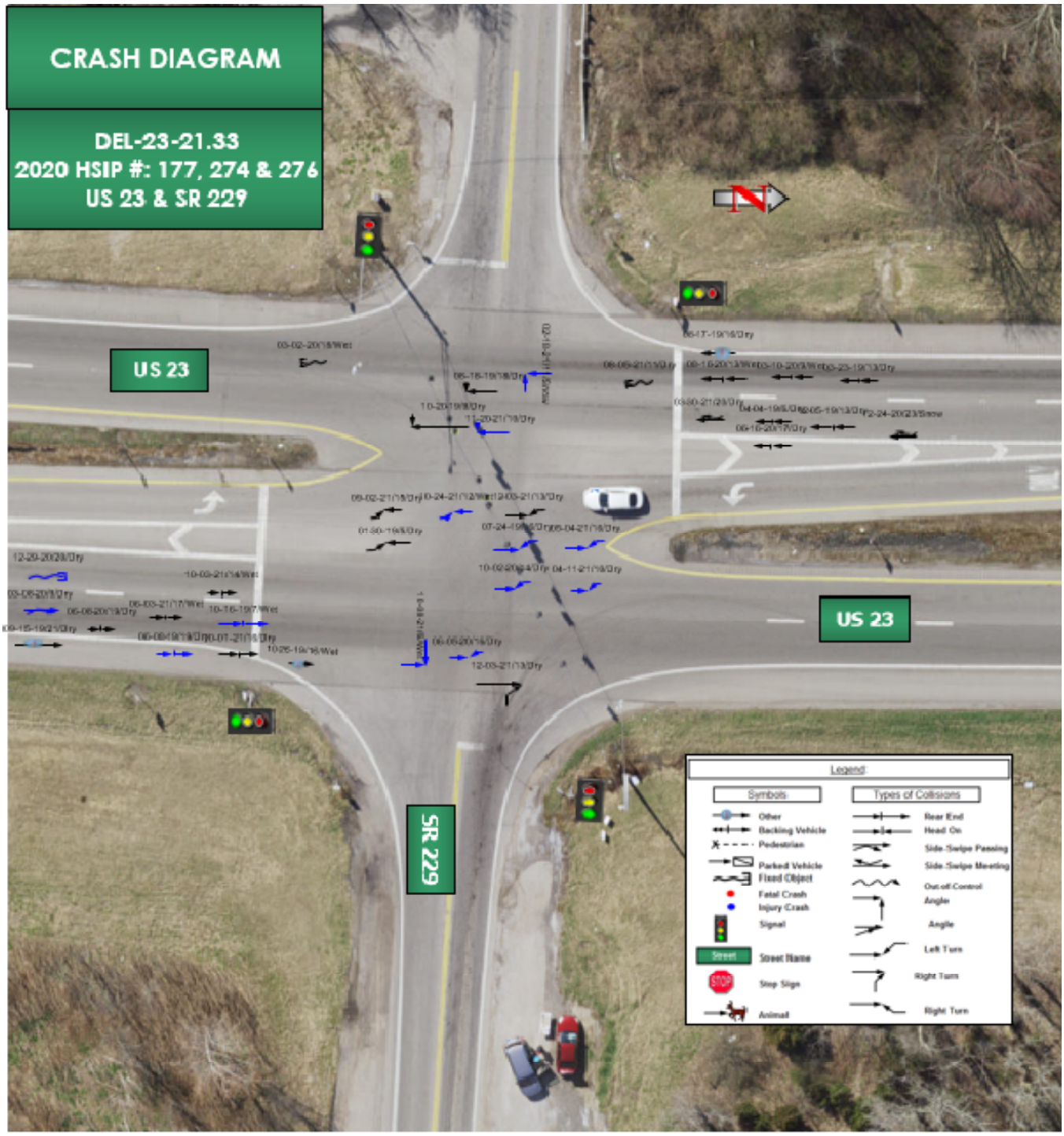


FIGURE 6 COLLISION DIAGRAM

Traffic Operations

Traffic volumes for opening year 2026 and design year 2046 were obtained from ODOT's Traffic Forecast Management System (TFMS). These volumes can be found in **Appendix E**.

A preliminary operational analysis was performed utilizing these volumes for the No Build and a Restricted Crossing U-Turn (RCUT) alternative using Highway Capacity Software (HCS). All HCS printouts can be found in **Appendix F**.

Based on the preliminary operational analysis, it was determined that the RCUT alternative would still need to be signalized to operate at an acceptable Level of Service (LOS). Therefore, an interchange type solution would be required in order to obtain acceptable LOS for design year 2046 volumes.

Conclusion and Recommendations

US 23 and SR 229 is an intersection that has a history of rear-end, left turn and angle crashes which have resulted in serious injuries and even fatalities in past years. This intersection has already had several low-cost countermeasures performed, which have been present for almost 10-years. Another short term countermeasure that could be considered is converting the northbound and southbound left turn movements from permissive to protected only movements, but this would only address the left turn crashes. Given that the same crash patterns remain and the fact that traffic volumes will continue to increase, a more long term countermeasure is needed. Based on the predicted crash reduction, corresponding safety benefit and preliminary operational analysis performed, it is recommended that the interchange alternative described under the long term countermeasures below be further analyzed, developed, designed and constructed.

Potential Short Term Countermeasures

- Convert northbound and southbound left turn movements from permissive to protected only movements.

Potential Long Term Countermeasures

- Remove existing traffic signal and construct overpass to grade separate US 23 over SR 229. Construct new ramps to the east of US 23 to provided access to/from SR 229 to northbound US 23. Modify existing ramps on the westside of US 23 to provide access to/from SR 229 to southbound US 23.
- Remove existing traffic signal and construct overpass to grade separate US 23 over SR 229. Construct right-in, right-out to the east of US 23 to provide access to/from SR 229 to northbound US 23. Modify existing ramps on the westside of US 23 to provide access to/from SR 229 to southbound US 23.

Appendices

Appendix A: Traffic Counts

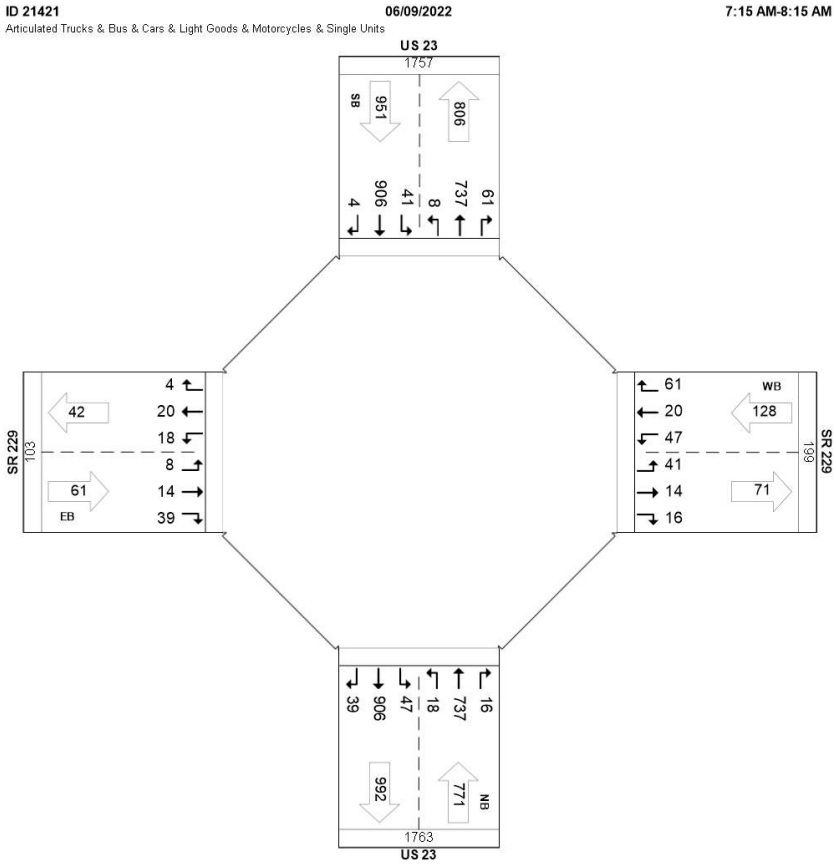
Peak Hour Data for Intersection

Int ID: 21421
Community: -
Zone: N/A
Road 1: US 23
Road 2: SR 229
Road 3: US 23
Road 4: SR 229

AM Peak Hour (06/09/2022)

☑ Articulated Trucks ☑ Bus ☑ Cars & Light Goods ☑ Motorcycles ☑ Single Units

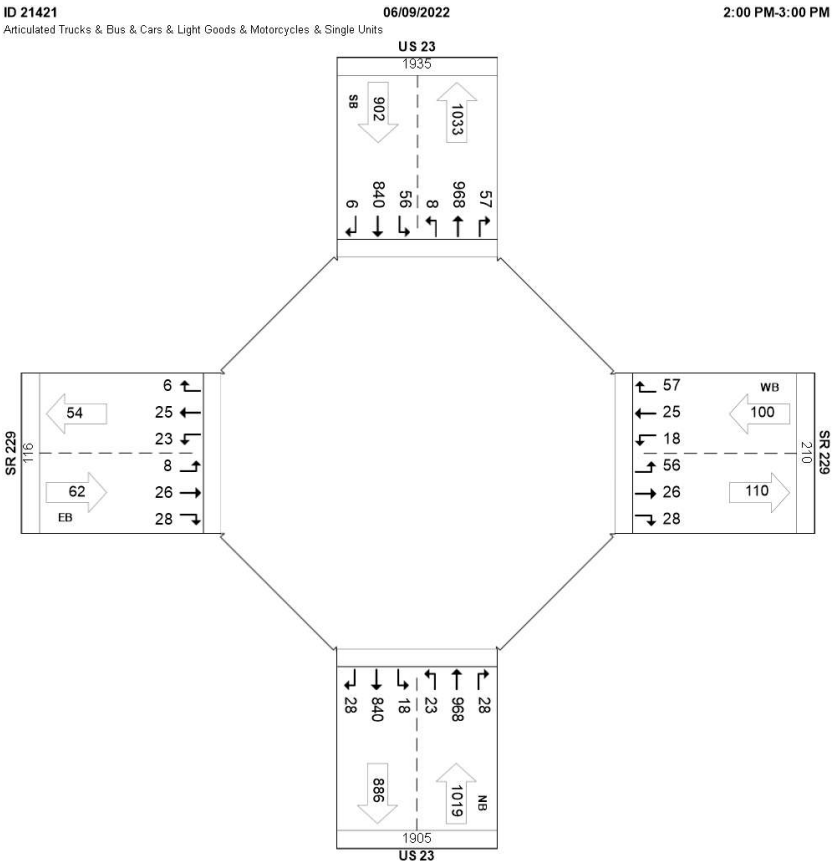
	NB				EB				SB				WB			
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total
7:15 AM	4	165	2	**171**	0	3	10	**13**	8	223	1	**232**	19	4	13	**36**
7:30 AM	6	207	5	**218**	2	2	10	**14**	15	255	1	**271**	9	2	22	**33**
7:45 AM	2	176	2	**180**	3	5	7	**15**	6	213	1	**220**	11	10	17	**38**
8:00 AM	6	189	7	**202**	3	4	12	**19**	12	215	1	**228**	8	4	9	**21**
Total	18	737	16	**771**	8	14	39	**61**	41	906	4	**951**	47	20	61	**128**
App %	2%	96%	2%		13%	23%	64%		4%	95%	0%		37%	16%	48%	
PHF	0.75	0.89	0.57	**0.88**	0.67	0.70	0.81	**0.80**	0.68	0.89	1.00	**0.88**	0.62	0.50	0.69	**0.84**
HV %	11%	16%	38%	**16%**	13%	21%	3%	**8%**	22%	17%		**17%**	2%	10%	18%	**11%**
Total %	1%	39%	1%	**40%**	0%	1%	2%	**3%**	2%	47%	0%	**50%**	2%	1%	3%	**7%**



Midday Peak Hour (06/09/2022)

☑ Articulated Trucks ☑ Bus ☑ Cars & Light Goods ☑ Motorcycles ☑ Single Units

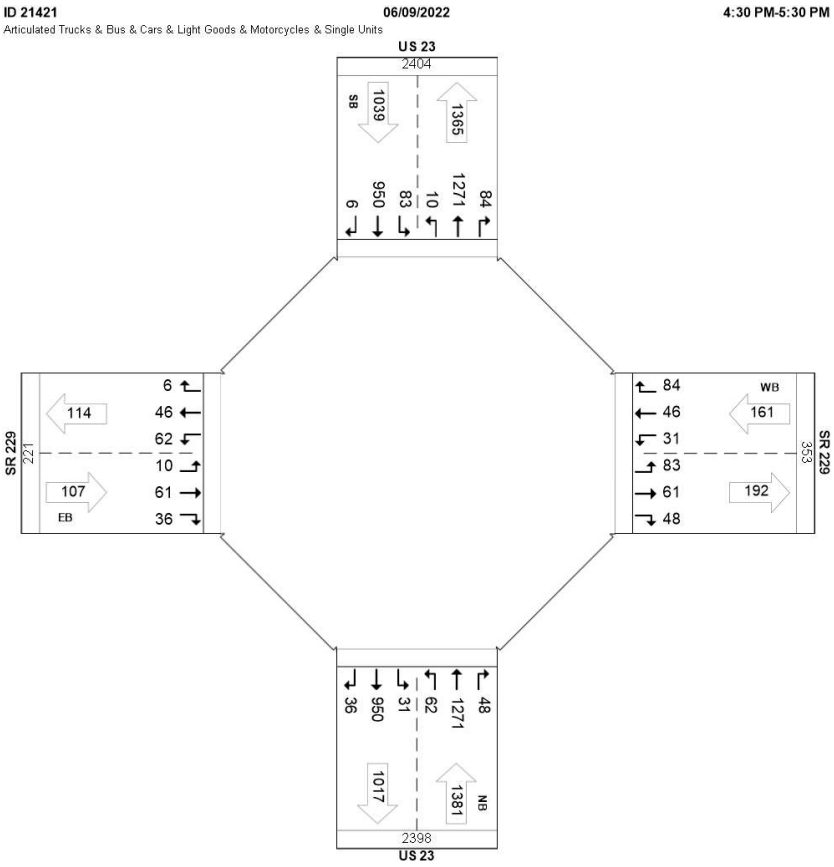
	NB				EB				SB				WB			
Start Time	**Left**	**Thru**	**Right**	**Total**	**Left**	**Thru**	**Right**	**Total**	**Left**	**Thru**	**Right**	**Total**	**Left**	**Thru**	**Right**	**Total**
2:00 PM	5	237	6	**248**	1	3	12	**16**	14	199	0	**213**	3	9	14	**26**
2:15 PM	6	196	7	**209**	3	5	5	**13**	16	234	1	**251**	7	4	15	**26**
2:30 PM	4	252	8	**264**	3	6	5	**14**	12	209	2	**223**	4	6	10	**20**
2:45 PM	8	283	7	**298**	1	12	6	**19**	14	198	3	**215**	4	6	18	**28**
Total	23	968	28	**1,019**	8	26	28	**62**	56	840	6	**902**	18	25	57	**100**
App %	2%	95%	3%		13%	42%	45%		6%	93%	1%		18%	25%	57%	
PHF	0.72	0.86	0.88	**0.85**	0.67	0.54	0.58	**0.82**	0.88	0.90	0.50	**0.90**	0.64	0.69	0.79	**0.89**
HV %	9%	15%	7%	**15%**	13%	8%	4%	**6%**	23%	18%	17%	**18%**	11%	16%	19%	**17%**
Total %	1%	46%	1%	**49%**	0%	1%	1%	**3%**	3%	40%	0%	**43%**	1%	1%	3%	**5%**



PM Peak Hour (06/09/2022)

☑ Articulated Trucks ☑ Bus ☑ Cars & Light Goods ☑ Motorcycles ☑ Single Units

	NB				EB				SB				WB			
Start Time	**Left**	**Thru**	**Right**	**Total**	**Left**	**Thru**	**Right**	**Total**	**Left**	**Thru**	**Right**	**Total**	**Left**	**Thru**	**Right**	**Total**
4:30 PM	10	275	11	**296**	2	17	8	**27**	18	242	3	**263**	9	9	31	**49**
4:45 PM	23	322	13	**358**	3	14	10	**27**	24	236	1	**261**	5	14	14	**33**
5:00 PM	19	321	11	**351**	3	17	9	**29**	13	230	1	**244**	11	10	21	**42**
5:15 PM	10	353	13	**376**	2	13	9	**24**	28	242	1	**271**	6	13	18	**37**
Total	62	1,271	48	**1,381**	10	61	36	**107**	83	950	6	**1,039**	31	46	84	**161**
App %	4%	92%	3%		9%	57%	34%		8%	91%	1%		19%	29%	52%	
PHF	0.67	0.90	0.92	**0.92**	0.83	0.90	0.90	**0.92**	0.74	0.98	0.50	**0.96**	0.70	0.82	0.68	**0.82**
HV %		8%	2%	**8%**	10%	2%	6%	**4%**	13%	12%	17%	**12%**	3%		6%	**4%**
Total %	2%	47%	2%	**51%**	0%	2%	1%	**4%**	3%	35%	0%	**39%**	1%	2%	3%	**6%**

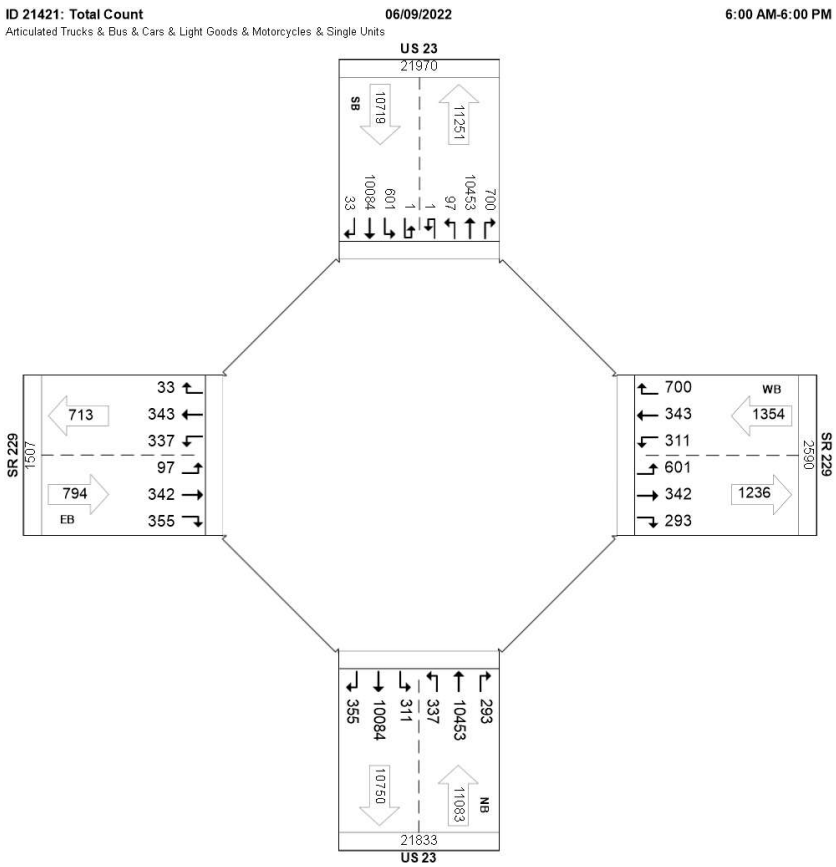


AllDay (06/09/2022)

☑ Articulated Trucks ☑ Bus ☑ Cars & Light Goods ☑ Motorcycles ☑ Single Units

	NB					EB					SB					WB				
Start Time	Left	Thru	Right	U-Turn	Total	Left	Thru	Right	U-Turn	Total	Left	Thru	Right	U-Turn	Total	Left	Thru	Right	U-Turn	Total
6:00 AM	2	90	0	0	**92**	0	2	8	0	**10**	4	187	0	0	**191**	5	3	9	0	**17**
6:15 AM	2	87	1	0	**90**	2	9	13	0	**24**	12	184	0	0	**196**	3	2	9	0	**14**
6:30 AM	3	111	1	0	**115**	1	4	16	0	**21**	8	219	0	0	**227**	8	4	10	0	**22**
6:45 AM	3	140	0	0	**143**	0	5	6	0	**11**	16	198	0	0	**214**	12	4	8	0	**24**
7:00 AM	3	126	0	0	**129**	3	2	9	0	**14**	16	221	0	0	**237**	12	4	13	0	**29**
7:15 AM	4	165	2	0	**171**	0	3	10	0	**13**	8	223	1	0	**232**	19	4	13	0	**36**
7:30 AM	6	207	5	0	**218**	2	2	10	0	**14**	15	255	1	0	**271**	9	2	22	0	**33**
7:45 AM	2	176	2	0	**180**	3	5	7	0	**15**	6	213	1	0	**220**	11	10	17	0	**38**
8:00 AM	6	189	7	0	**202**	3	4	12	0	**19**	12	215	1	0	**228**	8	4	9	0	**21**
8:15 AM	3	188	2	0	**193**	3	6	6	0	**15**	11	198	1	0	**210**	5	7	18	0	**30**
8:30 AM	4	182	3	0	**189**	2	4	6	0	**12**	6	212	1	0	**219**	3	10	14	0	**27**
8:45 AM	4	185	3	0	**192**	1	7	5	0	**13**	12	182	0	1	**195**	7	2	9	0	**18**
9:00 AM	3	176	7	0	**186**	3	2	5	0	**10**	12	223	1	0	**236**	2	5	10	0	**17**
9:15 AM	2	187	4	0	**193**	1	7	5	0	**13**	17	193	0	0	**210**	5	6	9	0	**20**
9:30 AM	3	180	2	0	**185**	0	6	9	0	**15**	13	200	2	0	**215**	5	9	13	0	**27**
9:45 AM	2	182	4	0	**188**	1	3	10	0	**14**	12	200	0	0	**212**	8	8	13	0	**29**
10:00 AM	4	199	6	0	**209**	0	3	1	0	**4**	10	180	0	0	**190**	8	5	19	0	**32**
10:15 AM	5	204	5	0	**214**	2	5	6	0	**13**	13	170	1	0	**184**	9	3	10	0	**22**
10:30 AM	6	156	6	0	**168**	4	5	2	0	**11**	7	202	1	0	**210**	9	5	16	0	**30**
10:45 AM	4	199	3	0	**206**	2	5	10	0	**17**	10	180	1	0	**191**	6	9	14	0	**29**
11:00 AM	9	210	7	0	**226**	0	8	2	0	**10**	7	184	1	0	**192**	3	4	8	0	**15**
11:15 AM	8	254	7	0	**269**	2	5	9	0	**16**	10	180	0	0	**190**	3	1	13	0	**17**
11:30 AM	9	196	4	0	**209**	1	8	6	0	**15**	9	201	0	0	**210**	4	1	15	0	**20**
11:45 AM	4	206	5	0	**215**	1	5	10	0	**16**	15	171	0	0	**186**	5	14	7	0	**26**
12:00 PM	8	188	13	0	**209**	1	8	6	0	**15**	11	198	1	0	**210**	4	3	13	0	**20**
12:15 PM	9	187	3	0	**199**	4	3	11	0	**18**	13	183	1	0	**197**	2	6	24	0	**32**
12:30 PM	7	187	15	0	**209**	4	9	5	0	**18**	6	213	2	0	**221**	4	9	17	0	**30**
12:45 PM	4	203	3	0	**210**	2	8	7	0	**17**	12	198	0	0	**210**	9	6	16	0	**31**
1:00 PM	7	207	8	0	**222**	1	4	6	0	**11**	6	194	1	0	**201**	5	12	10	0	**27**
1:15 PM	2	183	5	0	**190**	0	5	8	0	**13**	11	212	1	0	**224**	2	4	16	0	**22**
1:30 PM	4	223	8	0	**235**	2	7	5	0	**14**	17	213	0	0	**230**	7	12	13	0	**32**
1:45 PM	11	222	2	0	**235**	2	8	6	0	**16**	10	245	0	0	**255**	3	4	14	0	**21**
2:00 PM	5	237	6	0	**248**	1	3	12	0	**16**	14	199	0	0	**213**	3	9	14	0	**26**
2:15 PM	6	196	7	0	**209**	3	5	5	0	**13**	16	234	1	0	**251**	7	4	15	0	**26**
2:30 PM	4	252	8	0	**264**	3	6	5	0	**14**	12	209	2	0	**223**	4	6	10	0	**20**
2:45 PM	8	283	7	0	**298**	1	12	6	0	**19**	14	198	3	0	**215**	4	6	18	0	**28**
3:00 PM	9	230	8	0	**247**	0	11	7	0	**18**	16	196	0	0	**212**	6	16	13	0	**35**
3:15 PM	17	328	4	0	**349**	4	13	9	0	**26**	15	226	0	0	**241**	3	15	19	0	**37**
3:30 PM	14	345	11	0	**370**	4	8	3	0	**15**	13	229	0	0	**242**	7	9	24	0	**40**

	NB					EB					SB					WB				
Start Time	Left	Thru	Right	U-Turn	Total	Left	Thru	Right	U-Turn	Total	Left	Thru	Right	U-Turn	Total	Left	Thru	Right	U-Turn	Total
3:45 PM	15	302	10	0	**327**	2	14	4	0	**20**	8	258	1	0	**267**	3	8	23	0	**34**
4:00 PM	10	334	13	0	**357**	5	11	10	0	**26**	10	238	1	0	**249**	10	13	14	0	**37**
4:15 PM	7	333	11	0	**351**	4	12	7	0	**23**	19	250	0	0	**269**	4	13	17	0	**34**
4:30 PM	10	275	11	0	**296**	2	17	8	0	**27**	18	242	3	0	**263**	9	9	31	0	**49**
4:45 PM	23	322	13	0	**358**	3	14	10	0	**27**	24	236	1	0	**261**	5	14	14	0	**33**
5:00 PM	19	321	11	0	**351**	3	17	9	0	**29**	13	230	1	0	**244**	11	10	21	0	**42**
5:15 PM	10	353	13	0	**376**	2	13	9	0	**24**	28	242	1	0	**271**	6	13	18	0	**37**
5:30 PM	19	286	7	0	**312**	4	12	8	0	**24**	17	251	0	0	**268**	11	11	9	0	**31**
5:45 PM	8	261	10	0	**279**	3	7	6	0	**16**	17	199	0	0	**216**	13	5	19	0	**37**
Total	337	10,453	293	0	**11,083**	97	342	355	0	**794**	601	10,084	33	1	**10,719**	311	343	700	0	**1,354**
App %	3%	94%	3%	0%		12%	43%	45%	0%		6%	94%	0%	0%		23%	25%	52%	0%	
PHF	0.31	0.62	0.41		**0.61**	0.40	0.42	0.46		**0.57**	0.45	0.81	0.23	0.02	**0.82**	0.34	0.45	0.47		**0.58**
HV %	4%	16%	9%		**16%**	18%	9%	6%		**8%**	21%	17%	12%	100%	**17%**	9%	11%	17%		**14%**
Total %	1%	44%	1%	0%	**46%**	0%	1%	1%	0%	**3%**	3%	42%	0%	0%	**45%**	1%	1%	3%	0%	**6%**



Appendix B: 2019-2021 CAM Tool

DEL-23 at 229 (2019-21)

Crash Summary Sheet

Fatalities	0
Serious Injuries	3
Other Injuries	23

Crashes Per Year	12.00
Fatal and All Injury Crashes	13
Percent Injury	36.1%
Equivalent PDO Index Value	5.48

Crash Severity	Crashes	%
(2) Serious Injury Suspected	2	5.56%
(3) Minor Injury Suspected	6	16.67%
(4) Injury Possible	5	13.89%
(5) PDO/No Injury	23	63.89%
Grand Total	36	100.00%

Year	Crashes	%
2019	12	33.33%
2020	10	27.78%
2021	14	38.89%
Grand Total	36	100.00%

Day of Week	Crashes	%
(1) Sunday	8	22.22%
(2) Monday	2	5.56%
(3) Tuesday	5	13.89%
(4) Wednesday	3	8.33%
(5) Thursday	7	19.44%
(6) Friday	6	16.67%
(7) Saturday	5	13.89%
Grand Total	36	100.00%

Crash Type	Crashes	%
Rear End	12	33.33%
Left Turn	9	25.00%
Angle	5	13.89%
Fixed Object	3	8.33%
Sideswipe - Passing	3	8.33%
Other Non-Collision	3	8.33%
Right Turn	1	2.78%
Grand Total	36	100.00%

Hour of Day	Crashes	%
5	1	2.78%
6	2	5.56%
7	1	2.78%
9	3	8.33%
10	2	5.56%
11	2	5.56%
12	1	2.78%
13	5	13.89%
14	2	5.56%
15	1	2.78%
16	6	16.67%
17	2	5.56%
18	2	5.56%
19	2	5.56%
20	2	5.56%
21	1	2.78%
23	1	2.78%
Grand Total	36	100.00%

Month	Crashes	%
1	1	2.78%
2	1	2.78%
3	5	13.89%
4	2	5.56%
5	1	2.78%
6	5	13.89%
7	1	2.78%
8	4	11.11%
9	2	5.56%
10	8	22.22%
11	1	2.78%
12	5	13.89%
Grand Total	36	100.00%

DEL-23 at 229 (2019-21)

Crash Summary Sheet

Weather Condition	Crashes	%
Clear	19	52.78%
Cloudy	11	30.56%
Rain	4	11.11%
Snow	2	5.56%
Grand Total	36	100.00%

Road Condition	Crashes	%
Dry	25	69.44%
Wet	9	25.00%
Snow	2	5.56%
Grand Total	36	100.00%

Light Condition	Crashes	%
Daylight	28	77.78%
Dark - Roadway Not Lighted	6	16.67%
Dawn/Dusk	2	5.56%
Grand Total	36	100.00%

Number of Units	Crashes	%
2	26	72.22%
1	6	16.67%
3	4	11.11%
Grand Total	36	100.00%

ODOT Location	Crashes	%
Four-Way Intersection	26	72.22%
Not An Intersection	7	19.44%
5 Or More Point Intersection	2	5.56%
T-Intersection	1	2.78%
Grand Total	36	100.00%

Work Zone Related	Crashes	%
No	36	100.00%
Grand Total	36	100.00%

Alcohol Related	Crashes	%
No	35	97.22%
Yes	1	2.78%
Grand Total	36	100.00%

Drug Related (Inc. Marijuana)	Crashes	%
No	36	100.00%
Grand Total	36	100.00%

Contour	Crashes	%
Straight Grade	1	2.78%
Straight Level	35	97.22%
Grand Total	36	100.00%

Marijuana Related	Crashes	%
No	36	100.00%
Grand Total	36	100.00%

Roadway Departure	Crashes	%
No	32	88.89%
Yes	4	11.11%
Grand Total	36	100.00%

Older Driver (65+)	Crashes	%
No	29	80.56%
Yes	7	19.44%
Grand Total	36	100.00%

Intersection Related	Crashes	%
Yes	30	83.33%
No	6	16.67%
Grand Total	36	100.00%

Young Driver (15-25)	Crashes	%
No	23	63.89%
Yes	13	36.11%
Grand Total	36	100.00%

Speed Related	Crashes	%
No	32	88.89%
Yes	4	11.11%
Grand Total	36	100.00%

Motorcycle Involved	Crashes	%
No	36	100.00%
Grand Total	36	100.00%

DEL-23 at 229 (2019-21)

Crash Summary Sheet

Unit 1 Summary

Unit 1 Pre-Crash Action	Crashes	%
Straight Ahead	21	58.33%
Making Left Turn	10	27.78%
Slowing or Stopped In Traffic	3	8.33%
Changing Lanes	1	2.78%
Making Right Turn	1	2.78%
Grand Total	36	100.00%

Unit 1 Contributing Factor	Crashes	%
Following Too Closely/ACDA	12	33.33%
Failure to Yield	10	27.78%
Ran Red Light	4	11.11%
Improper Lane Change	2	5.56%
None	2	5.56%
Swerving to Avoid	1	2.78%
Drove off Road	1	2.78%
Unsafe Speed	1	2.78%
Operating Defective Equipment	1	2.78%
Improper Passing	1	2.78%
Not Discernible	1	2.78%
Grand Total	36	100.00%

Unit 1 Object Struck	Crashes	%
Nothing Struck	32	88.89%
Tree	1	2.78%
Traffic Sign Post	1	2.78%
Guardrail Face	1	2.78%
Ditch	1	2.78%
Grand Total	36	100.00%

Unit 1 Traffic Control	Crashes	%
Signal	24	66.67%
No Control	12	33.33%
Grand Total	36	100.00%

Unit 1 Posted Speed	Crashes	%
0	1	2.78%
55	5	13.89%
60	28	77.78%
65	2	5.56%
Grand Total	36	100.00%

Unit 1 Direction From	Crashes	%
North	20	55.56%
South	13	36.11%
East	2	5.56%
West	1	2.78%
Grand Total	36	100.00%

Unit 1 Direction To	Crashes	%
South	12	33.33%
North	11	30.56%
East	8	22.22%
West	3	8.33%
Unknown	2	5.56%
Grand Total	36	100.00%

DEL-23 at 229 (2019-21)

Crash Summary Sheet

Unit 1 Summary

Unit 1 Type	Crashes	%
Passenger Car	15	41.67%
Sport Utility Vehicle	7	19.44%
Semi-Tractor	6	16.67%
Pick up	3	8.33%
Passenger Van (minivan)	2	5.56%
Single Unit Truck	2	5.56%
Unknown or Hit/Skip	1	2.78%
Grand Total	36	100.00%

Unit 1 Special Function	Crashes	%
None	34	94.44%
Other / Unknown	1	2.78%
Farm	1	2.78%
Grand Total	36	100.00%

DEL-23 at 229 (2019-21)
Crash Summary Sheet

Unit 2 Summary

Unit 2 Pre-Crash Action	Crashes	%
Straight Ahead	17	47.22%
Slowing or Stopped In Traffic	13	36.11%
	6	16.67%
Grand Total	36	100.00%

Unit 2 Contributing Factor	Crashes	%
None	28	77.78%
	6	16.67%
Following Too Closely/ACDA	1	2.78%
Not Discernible	1	2.78%
Grand Total	36	100.00%

Unit 2 Direction From	Crashes	%
	6	16.67%
North	12	33.33%
South	15	41.67%
West	3	8.33%
Grand Total	36	100.00%

Unit 2 Direction To	Crashes	%
	8	22.22%
East	2	5.56%
North	15	41.67%
South	11	30.56%
Grand Total	36	100.00%

Unit 2 Type	Crashes	%
Sport Utility Vehicle	16	44.44%
Passenger Car	8	22.22%
	6	16.67%
Pick up	2	5.56%
Passenger Van (minivan)	2	5.56%
Cargo Van	1	2.78%
Semi-Tractor	1	2.78%
Grand Total	36	100.00%

Unit 2 Special Function	Crashes	%
None	30	83.33%
	6	16.67%
Grand Total	36	100.00%

DEL-US 23 & SR 229

	Number
Total	**36**

CRASH_SEVERITY	Number	%
Injury Crash	**13**	36.1%
Property Damage Crash	**23**	63.9%
Grand Total	**36**	**100.0%**

TRAFFIC_CRASH_YEAR	Number	%
2019	**12**	33.3%
2020	**10**	27.8%
2021	**14**	38.9%
Grand Total	**36**	**100.0%**

DAY_OF_WEEK	Number	%
(1) Sunday	**8**	22.2%
(5) Thursday	**7**	19.4%
(6) Friday	**6**	16.7%
(3) Tuesday	**5**	13.9%
(7) Saturday	**5**	13.9%
(4) Wednesday	**3**	8.3%
(2) Monday	**2**	5.6%
Grand Total	**36**	**100.0%**

HOUR_OF_DAY	Number	%
5	**1**	2.8%
6	**2**	5.6%
7	**1**	2.8%
9	**3**	8.3%
10	**2**	5.6%
11	**2**	5.6%
12	**1**	2.8%
13	**5**	13.9%
14	**2**	5.6%
15	**1**	2.8%
16	**6**	16.7%
17	**2**	5.6%
18	**2**	5.6%
19	**2**	5.6%
20	**2**	5.6%
21	**1**	2.8%
23	**1**	2.8%
Grand Total	**36**	**100.0%**

TYPE_OF_CRASH	Number	%
Rear End	**12**	33.3%
Left Turn	**9**	25.0%
Angle	**5**	13.9%
Sideswipe - Passing	**3**	8.3%
Other Non-Collision	**3**	8.3%
Fixed Object	**3**	8.3%
Right Turn	**1**	2.8%
Grand Total	**36**	**100.0%**

DEL-US 23 & SR 229

WEATHER_CONDITION	Number	%
Clear	**19**	52.8%
Cloudy	**11**	30.6%
Rain	**4**	11.1%
Snow	**2**	5.6%
Grand Total	**36**	**100.0%**

ROAD_CONDITION	Number	%
Dry	**25**	69.4%
Wet	**9**	25.0%
Snow	**2**	5.6%
Grand Total	**36**	**100.0%**

LIGHT_CONDITION	Number	%
Daylight	**28**	77.8%
Dark - Roadway Not Lighted	**6**	16.7%
Dawn/Dusk	**2**	5.6%
Grand Total	**36**	**100.0%**

NUMBER_OF_VEHICLES	Number	%
1	**6**	16.7%
2	**26**	72.2%
3	**4**	11.1%
Grand Total	**36**	**100.0%**

LOCATION	Number	%
Four-Way Intersection	**26**	72.2%
Not An Intersection	**7**	19.4%
5 Or More Point Intersection	**2**	5.6%
T-Intersection	**1**	2.8%
Grand Total	**36**	**100.0%**

CRASH_MONTH_NBR	Number	%
1	**1**	2.8%
2	**1**	2.8%
3	**5**	13.9%
4	**2**	5.6%
5	**1**	2.8%
6	**5**	13.9%
7	**1**	2.8%
8	**4**	11.1%
9	**2**	5.6%
10	**8**	22.2%
11	**1**	2.8%
12	**5**	13.9%
Grand Total	**36**	**100.0%**

ROAD_CONTOUR	Number	%
Straight Level	**35**	97.2%
Straight Grade	**1**	2.8%
Grand Total	**36**	**100.0%**

SPECIAL_AREA	Number	%
(blank)	**36**	100.0%
Grand Total	**36**	**100.0%**

ANIMAL_TYPE	Number	%
(blank)	**36**	100.0%
Grand Total	**36**	**100.0%**

DEL-US 23 & SR 229

ACTION1	Number	%
Straight Ahead	21	58.3%
Making Left Turn	10	27.8%
Slowing or Stopped In Traffic	3	8.3%
Making Right Turn	1	2.8%
Changing Lanes	1	2.8%
Grand Total	**36**	**100.0%**

CONTRIBUTING_FACTOR1	Number	%
Following Too Closely/ACDA	12	33.3%
Failure to Yield	10	27.8%
Ran Red Light	4	11.1%
Improper Lane Change	2	5.6%
None	2	5.6%
Swerving to Avoid	1	2.8%
Unsafe Speed	1	2.8%
Operating Defective Equipment	1	2.8%
Drove off Road	1	2.8%
Not Discernible	1	2.8%
Improper Passing	1	2.8%
Grand Total	**36**	**100.0%**

	Number	%
Total	**36**	**100.0%**

TRAFFIC_CONTROL1	Number	%
Signal	24	66.7%
No Control	12	33.3%
Grand Total	**36**	**100.0%**

DRIVER_ALCOHOL1	Number	%
No	35	97.2%
Yes	1	2.8%
Grand Total	**36**	**100.0%**

DRIVER_DRUGS1	Number	%
No	36	100.0%
Grand Total	**36**	**100.0%**

DEL-US 23 & SR 229

DIRECTION_FROM1	Number	%
North	**20**	55.6%
South	**13**	36.1%
East	**2**	5.6%
West	**1**	2.8%
Grand Total	**36**	**100.0%**

DIRECTION_TO1	Number	%
South	**12**	33.3%
North	**11**	30.6%
East	**8**	22.2%
West	**3**	8.3%
Unknown	**2**	5.6%
Grand Total	**36**	**100.0%**

POSTED_SPEED1	Number	%
60	**28**	77.8%
55	**5**	13.9%
65	**2**	5.6%
0	**1**	2.8%
Grand Total	**36**	**100.0%**

ESTIMATED_SPEED1	Number	%
20	**6**	16.7%
60	**5**	13.9%
10	**5**	13.9%
0	**4**	11.1%
45	**2**	5.6%
65	**2**	5.6%
50	**2**	5.6%
5	**2**	5.6%
30	**2**	5.6%
35	**1**	2.8%
25	**1**	2.8%
3	**1**	2.8%
15	**1**	2.8%
55	**1**	2.8%
40	**1**	2.8%
Grand Total	**36**	**100.0%**

VEHICLE_TYPE1	Number	%
Passenger Car	**15**	41.7%
Sport Utility Vehicle	**7**	19.4%
Semi-Tractor	**6**	16.7%
Pick up	**3**	8.3%
Single Unit Truck	**2**	5.6%
Passenger Van (minivan)	**2**	5.6%
Unknown or Hit/Skip	**1**	2.8%
Grand Total	**36**	**100.0%**

VEHICLE_TYPE2	Number	%
Sport Utility Vehicle	**16**	44.4%
Passenger Car	**8**	22.2%
	6	16.7%
Pick up	**2**	5.6%
Passenger Van (minivan)	**2**	5.6%
Semi-Tractor	**1**	2.8%
Cargo Van	**1**	2.8%
Grand Total	**36**	**100.0%**

DEL-US 23 & SR 229

ACTION2	Number	%
Straight Ahead	**17**	47.2%
Slowing or Stopped In Traffic	**13**	36.1%
	6	16.7%
Grand Total	**36**	**100.0%**

CONTRIBUTING_FACTOR2	Number	%
None	**28**	77.8%
	6	16.7%
Following Too Closely/ACDA	**1**	2.8%
Not Discernible	**1**	2.8%
Grand Total	**36**	**100.0%**

DIRECTION_FROM2	Number	%
South	**15**	41.7%
North	**12**	33.3%
	6	16.7%
West	**3**	8.3%
Grand Total	**36**	**100.0%**

DIRECTION_TO2	Number	%
North	**15**	41.7%
South	**11**	30.6%
	8	22.2%
East	**2**	5.6%
Grand Total	**36**	**100.0%**

DRIVER_ALCOHOL2	Number	%
(blank)	**36**	100.0%
Grand Total	**36**	**100.0%**

DRIVER_DRUGS2	Number	%
(blank)	**36**	100.0%
Grand Total	**36**	**100.0%**

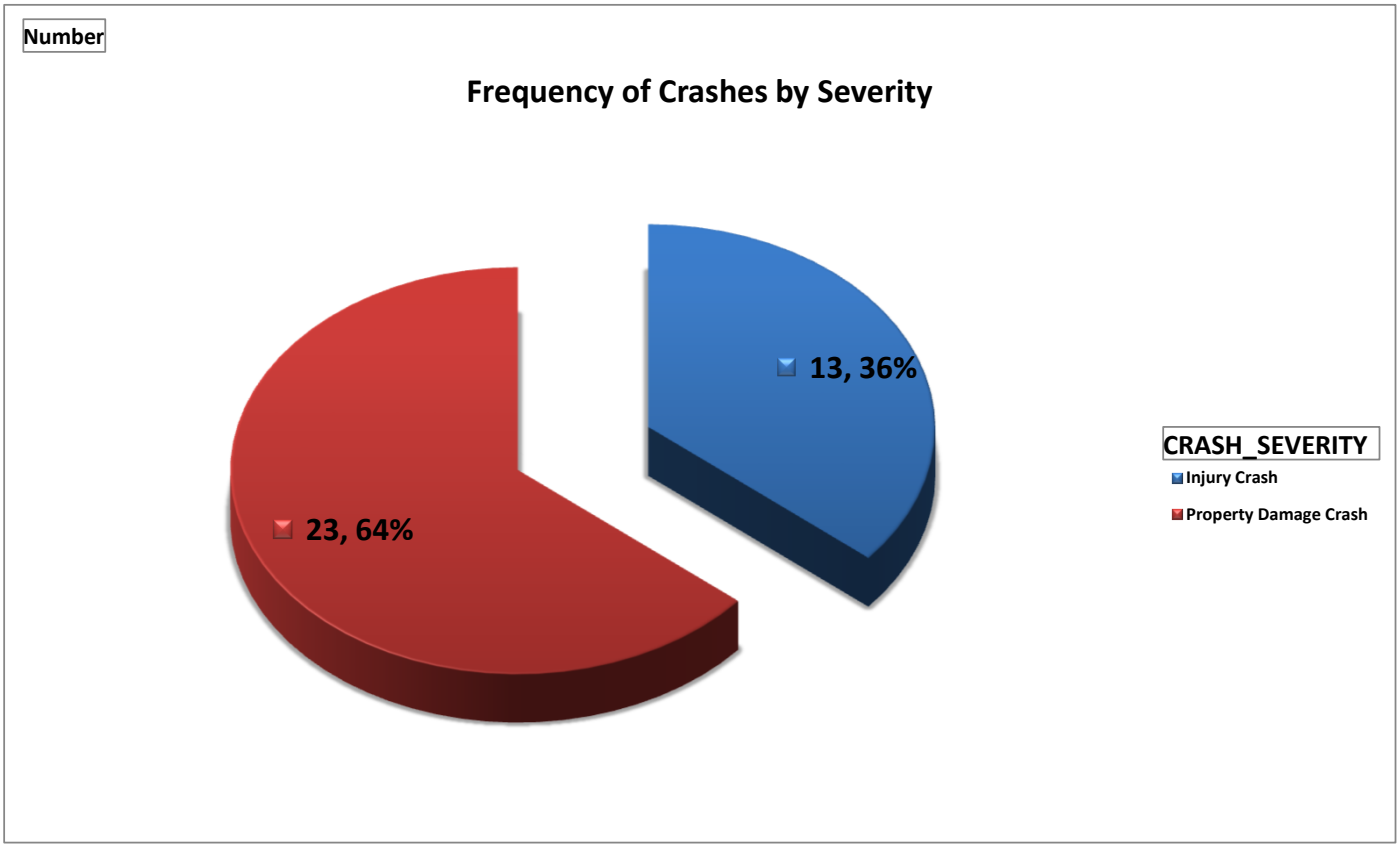
DEL-US 23 & SR 229

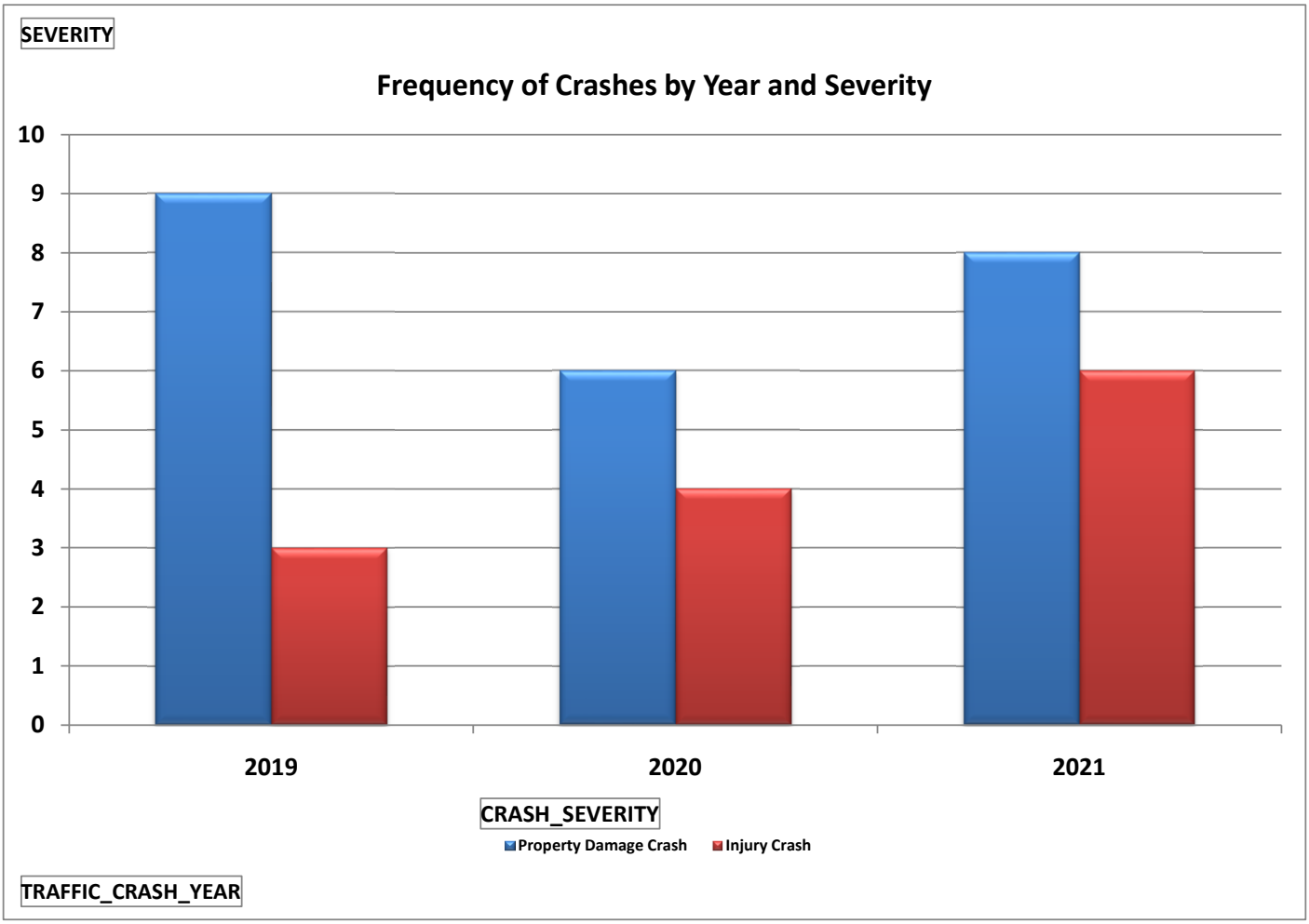
SEVERITY	CRASH_SEVERITY	
TRAFFIC_CRASH_YEAR	Property Damage Crash	Injury Crash
2019	9	3
2020	6	4
2021	8	6
Grand Total	**23**	**13**

TRAFFIC_CRASH_YEAR	Fatalities	Incapacitating Injuries
2019	0	2
2020	0	0
2021	0	1
Grand Total	**0**	**3**

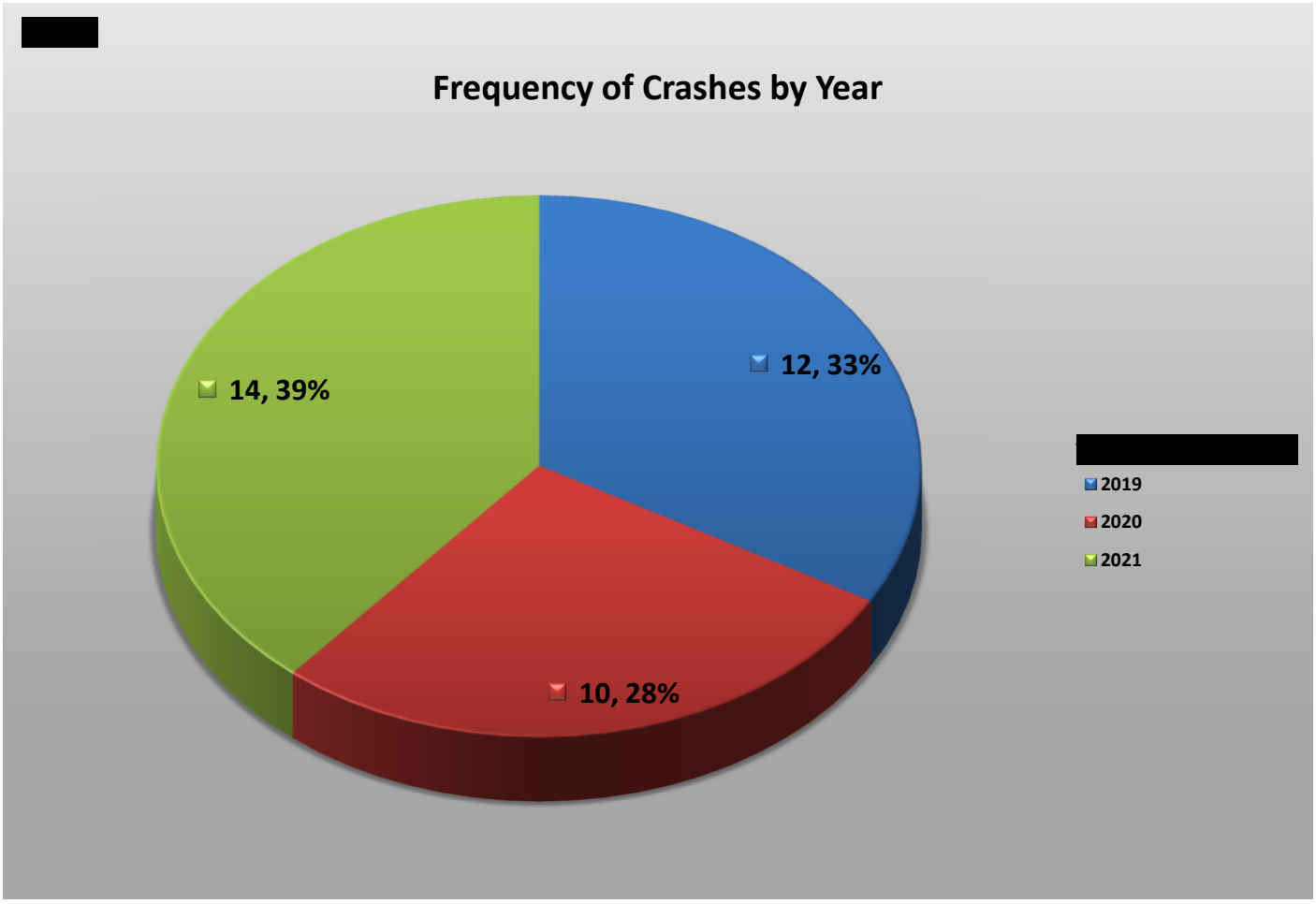
TRAFFIC_CRASH_YEAR	INJ_TYPE2_SERIOUS_VISIBLE	INJ_TYPE3_MINOR_VISIBLE	INJ_TYPE4_NO_VISIBLE
2019	2	3	3
2020	0	3	2
2021	1	7	5
Grand Total	**3**	**13**	**10**

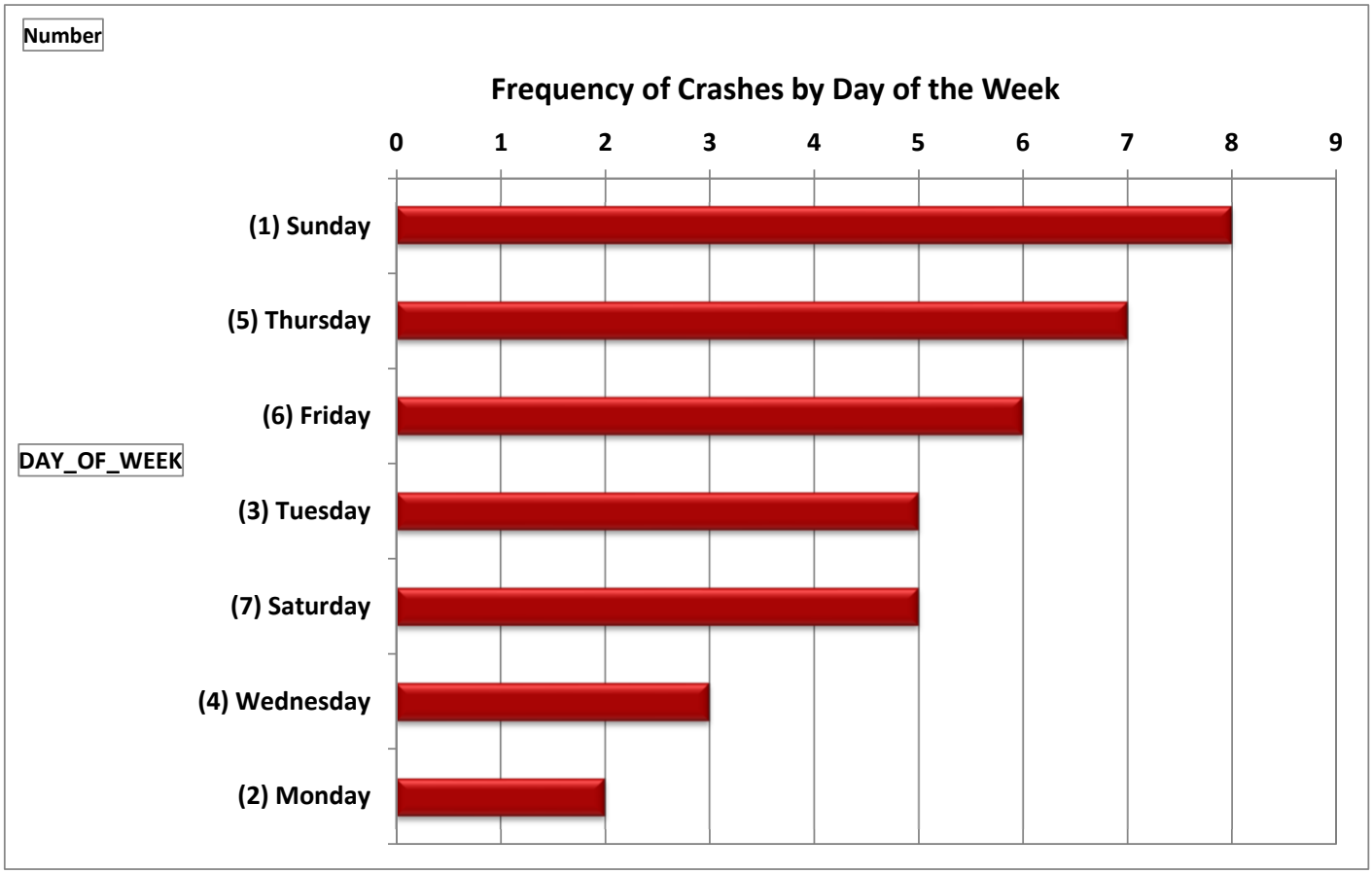
DEL-US 23 & SR 229





DEL-US 23 & SR 229





DEL-US 23 & SR 229

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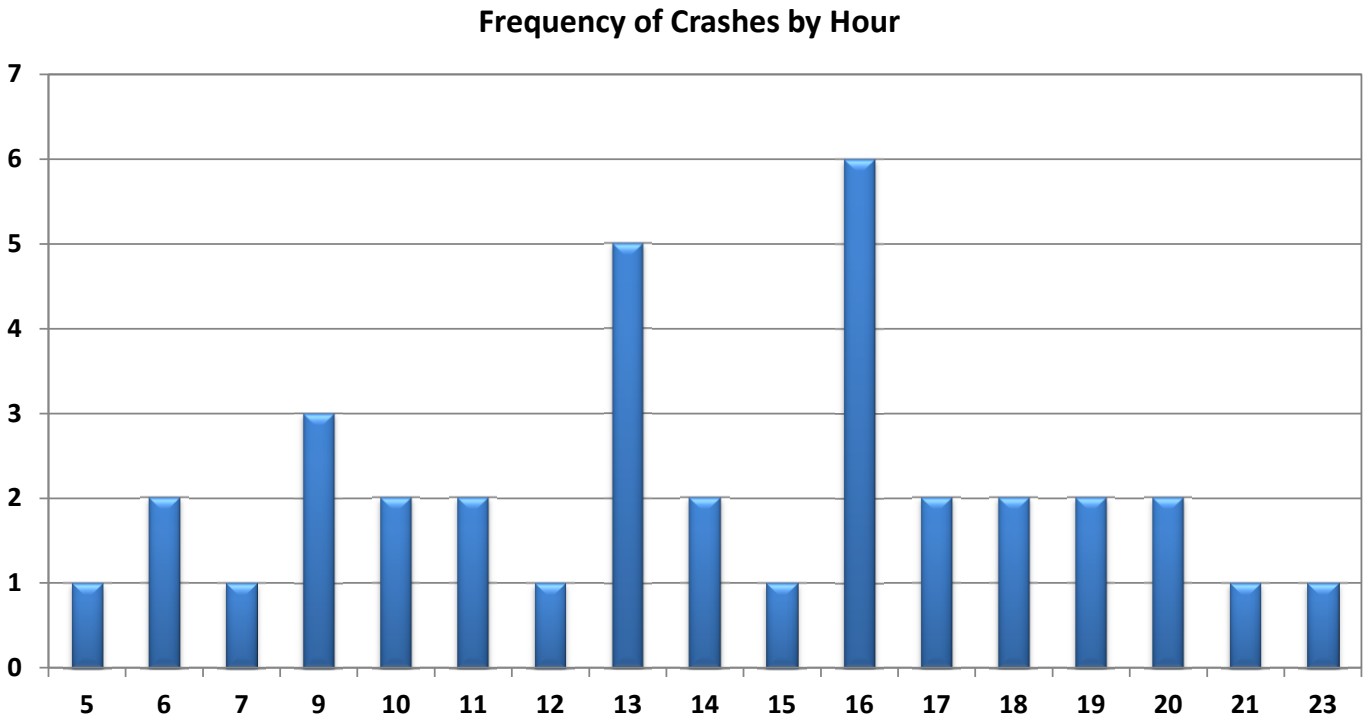

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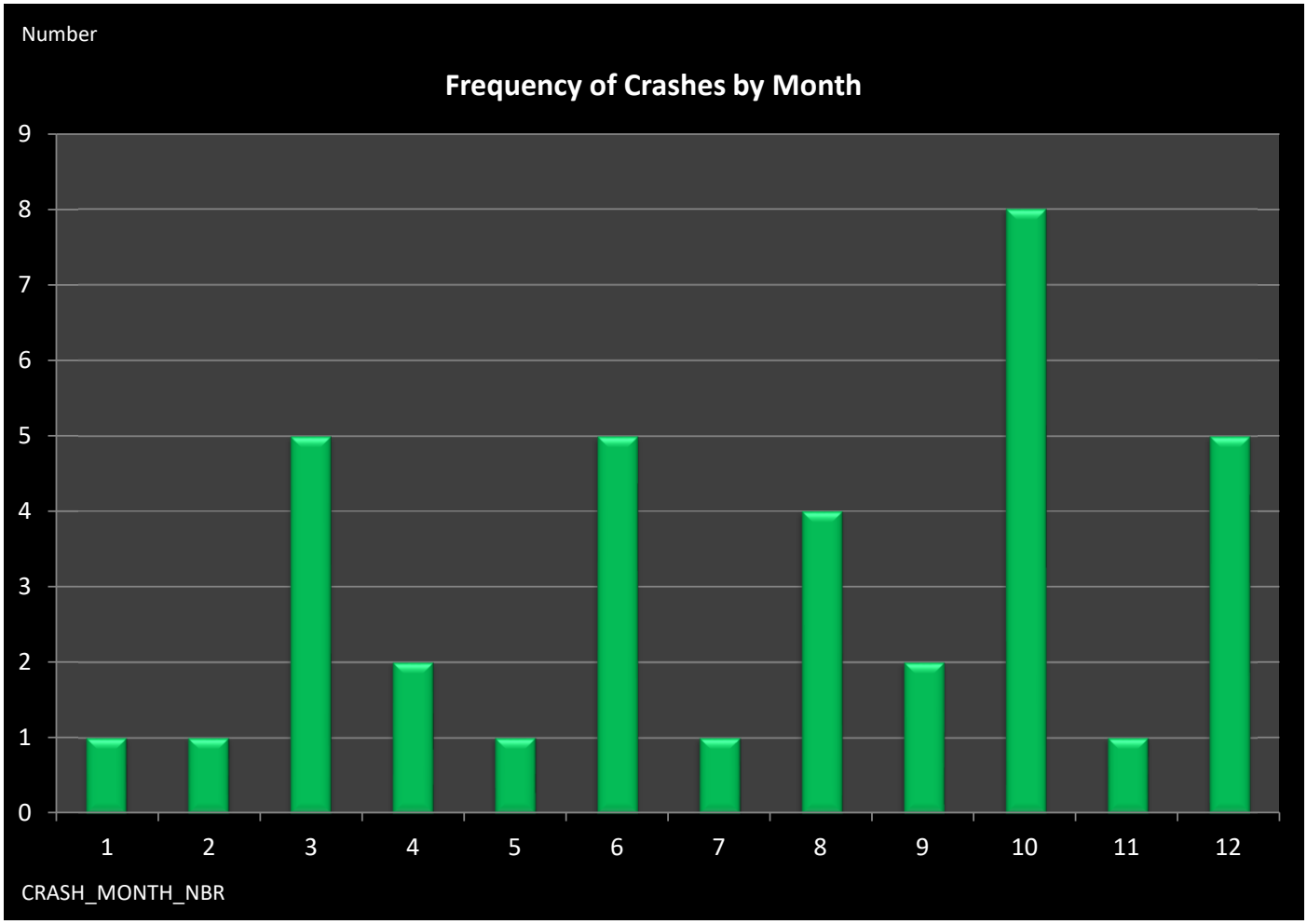
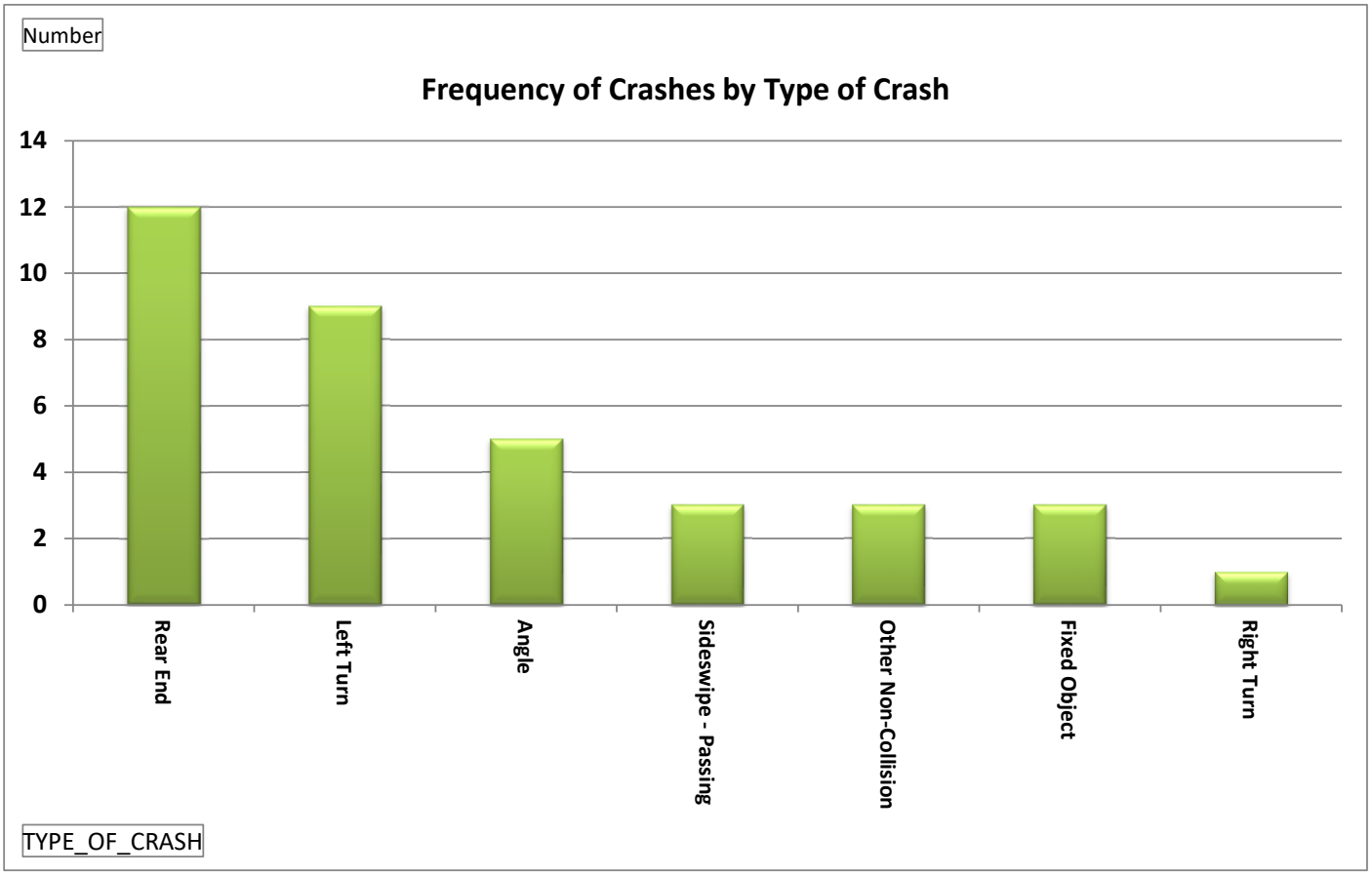
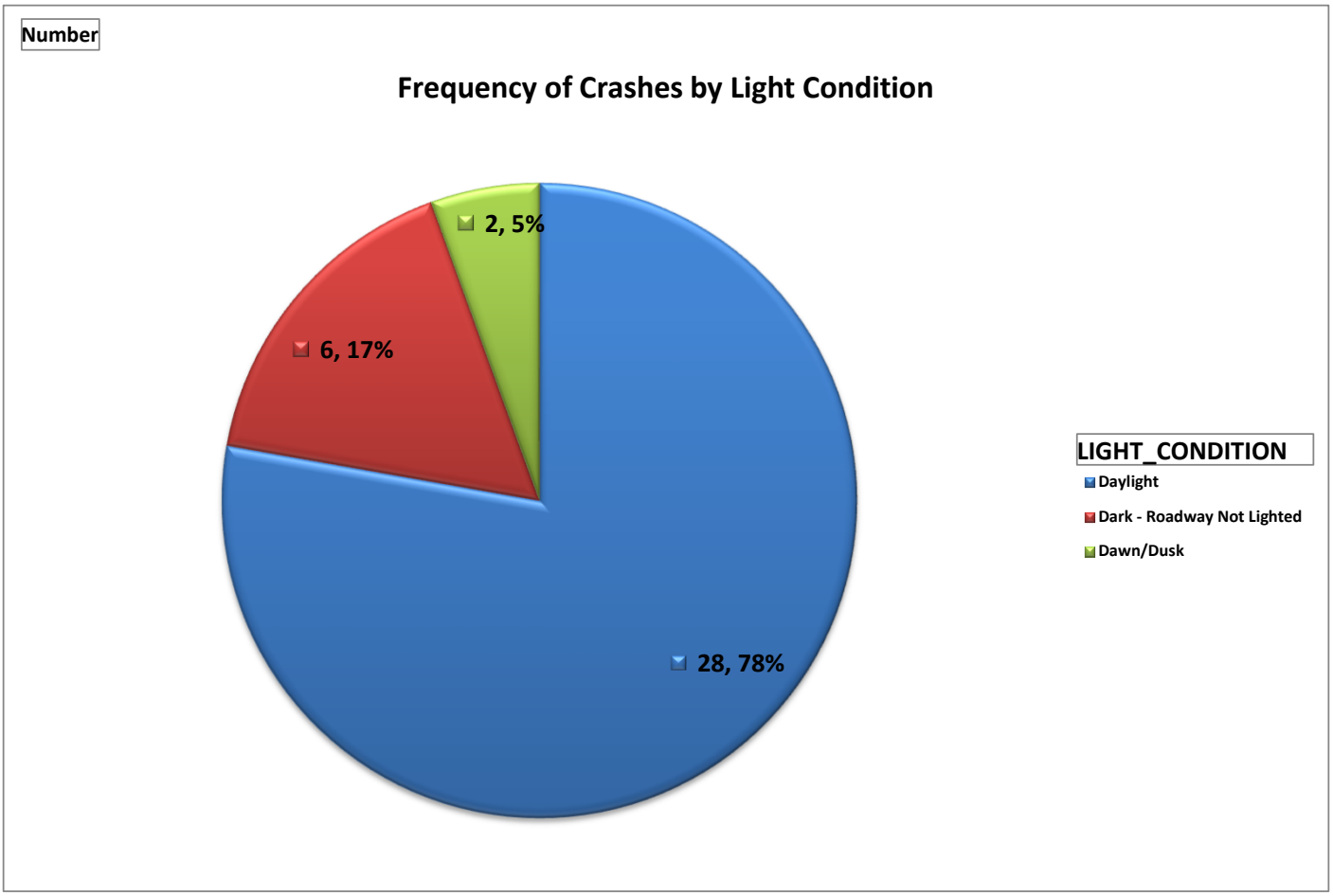
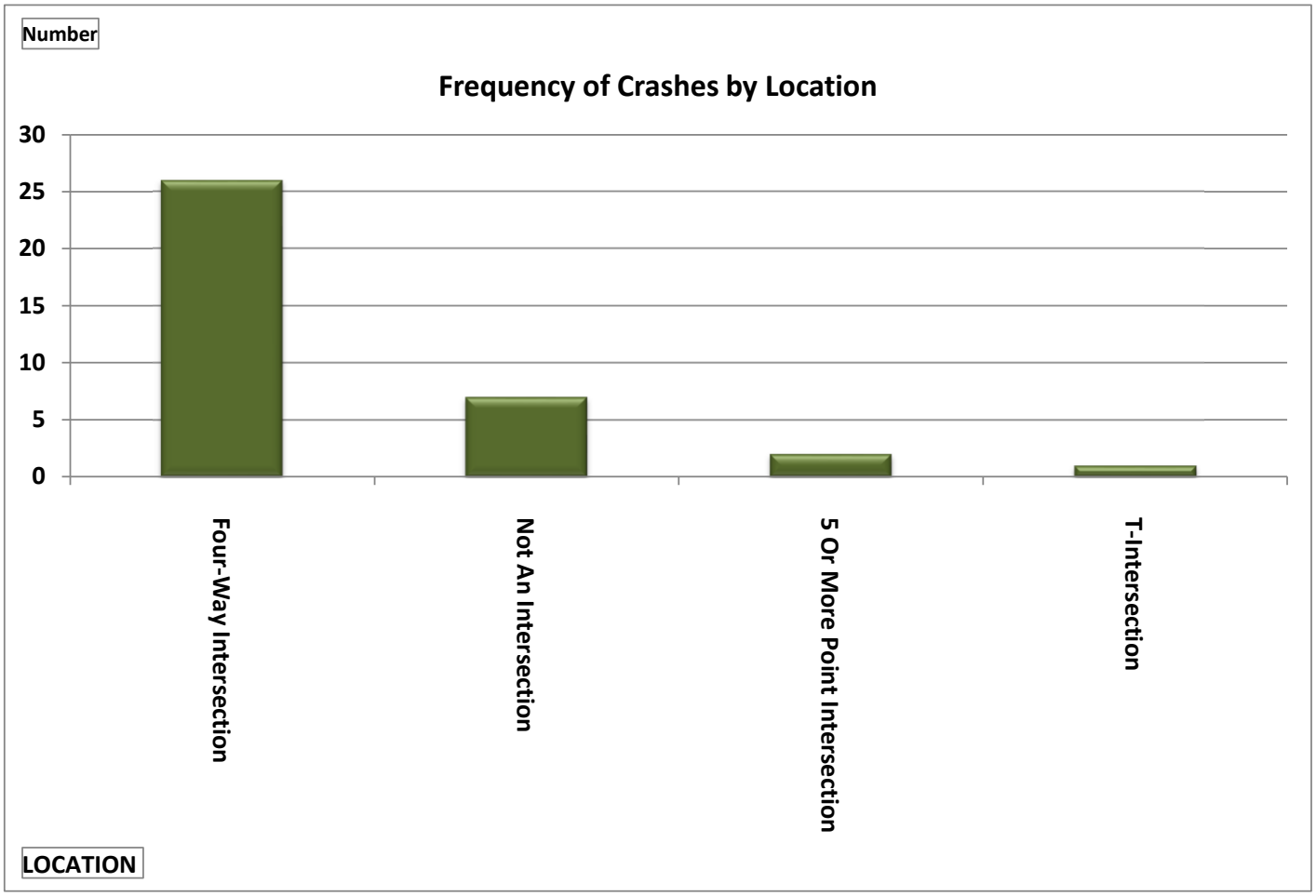


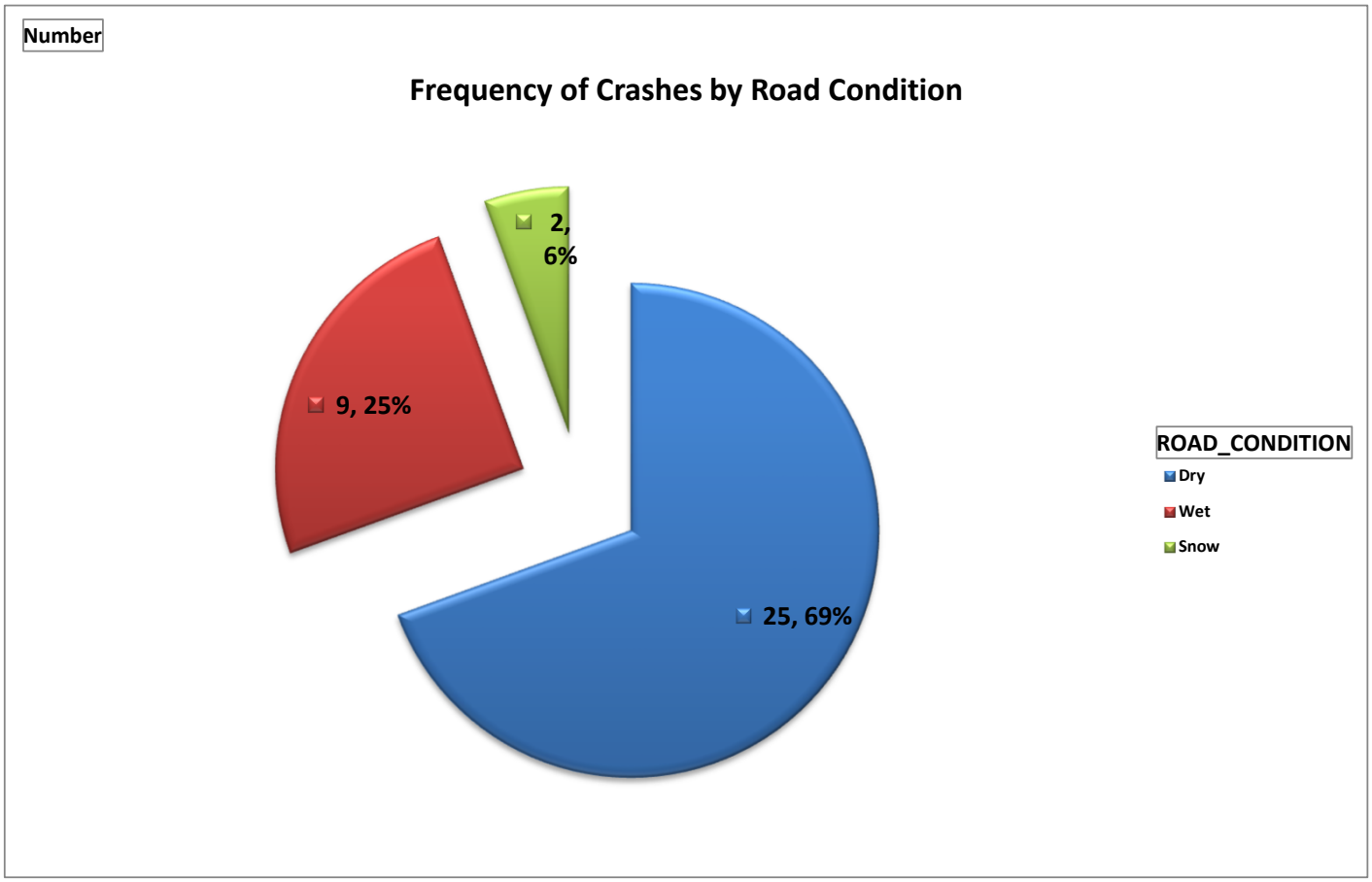
DEL-US 23 & SR 229



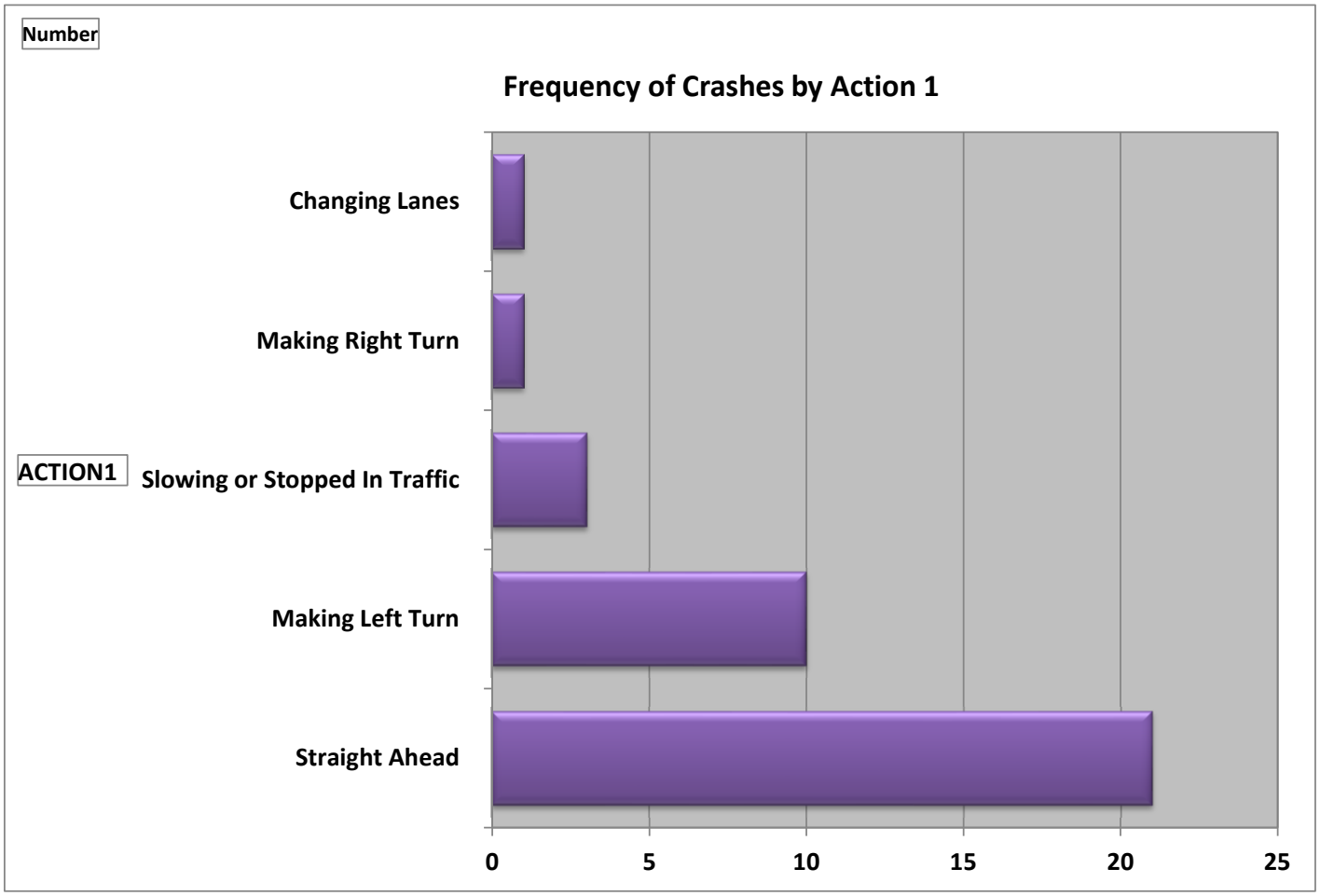


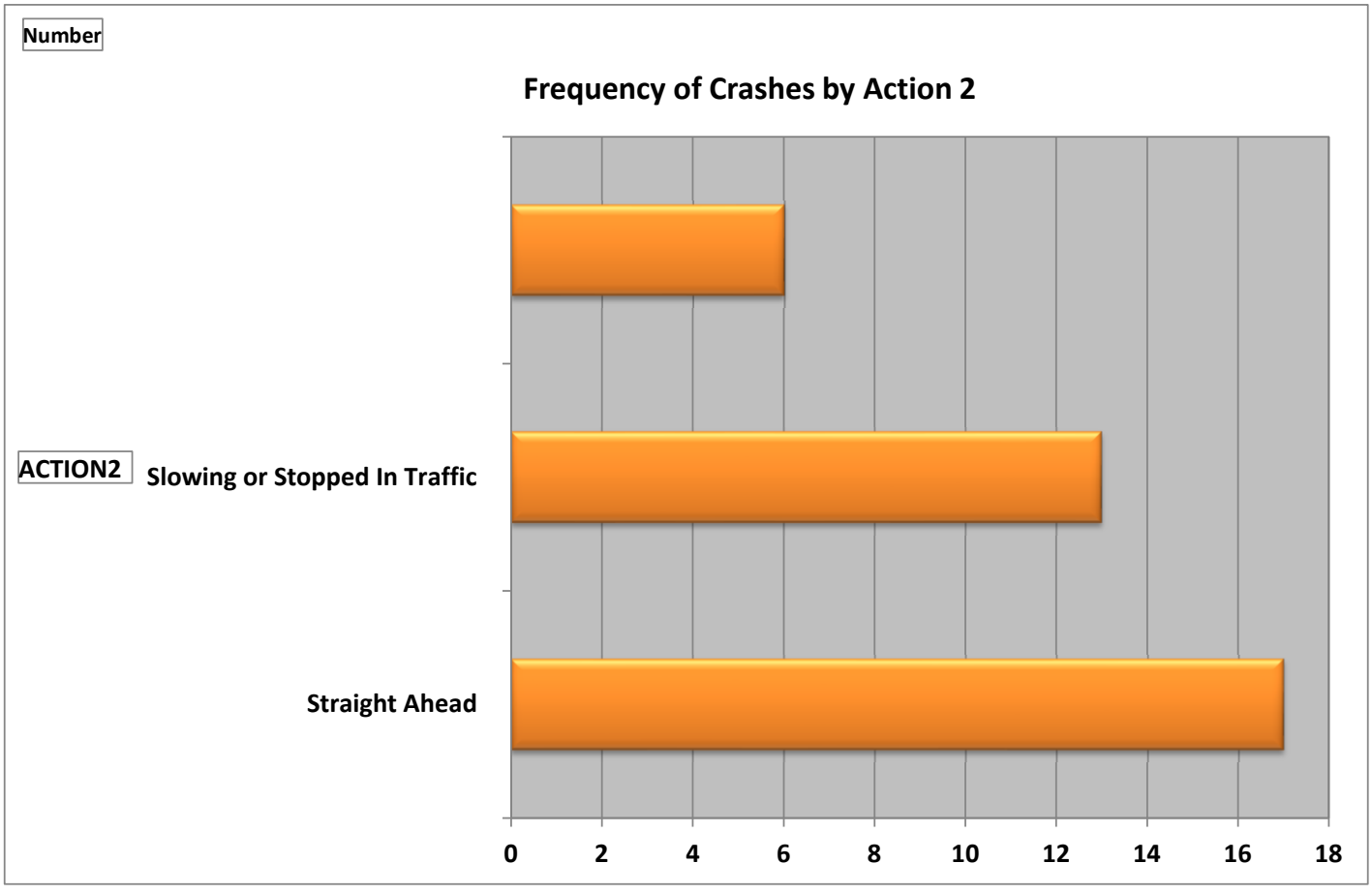
DEL-US 23 & SR 229





DEL-US 23 & SR 229





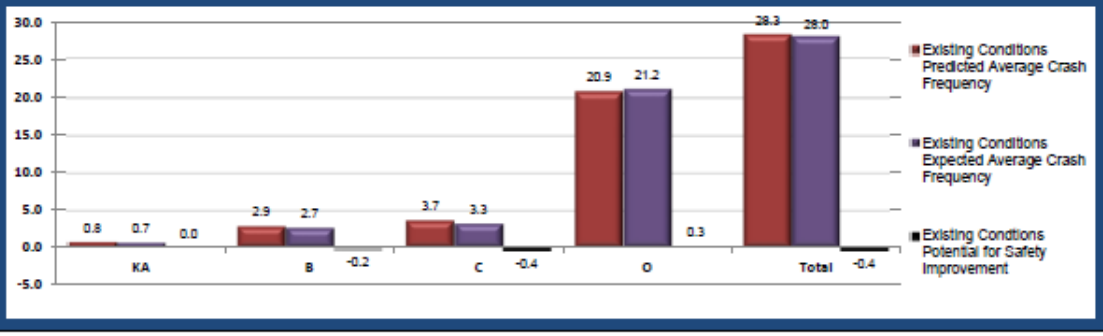
Appendix C: Existing ECAT Analysis

Project Safety Performance Report

General Information

Project Name	DEL-23-21.33 (US 23 at SR 229)	Contact Email	andrew.hurst@dot.ohio.gov
Project Description	Interchange	Contact Phone	740-833-8345
Reference Number		Date Performed	
Analyst	Drew Hurst	Analysis Year	2026
Agency/Company	ODOT District 6		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.7596	2.9030	3.7356	20.9355	28.3337
$N_{expected}$ - Existing Conditions	0.7412	2.7127	3.3088	21.2035	27.9662
$N_{potential\ for\ improvement}$ - Existing Conditions	-0.0184	-0.1903	-0.4268	0.2680	-0.3675

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR229; 0.12-0.25	SR 229 between US 23 and Norton Rd	0.0106	0.0277	0.0131	0.0772	0.1286
SR229; 0.26-0.4	SR 229 between US 23 and Welser Rd/Brunds	0.0071	0.019	0.0095	0.0535	0.0891
US23; 20.78-21.42	US 23 south of SR 229	0.131	0.3362	0.1819	1.6703	2.3194
US23; 21.42-21.55	US 23 north of SR 229	0.0287	0.0739	0.0398	0.3695	0.5119
TR365; 0-0.18	Brundage Rd north of SR 229	0.0001	0.0007	0.0006	0.0021	0.0035
SR229; 0.4	SR 229 and Welser Rd/Brundage Rd Intersect	0.0436	0.1055	0.0706	0.3783	0.598
US23; 21.42	US 23 and SR 229 Intersection	0.5385	2.34	3.4201	18.3846	24.6832

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR229; 0.12-0.25	SR 229 between US 23 and Norton Rd	0.0098	0.0254	0.0119	0.1319	0.179
SR229; 0.26-0.4	SR 229 between US 23 and Welser Rd/Brunds	0.0067	0.0179	0.0086	0.0451	0.0782
US23; 20.78-21.42	US 23 south of SR 229	0.1799	0.4625	0.2505	1.8518	2.7447
US23; 21.42-21.55	US 23 north of SR 229	0.0452	0.1165	0.063	0.3857	0.5104
TR365; 0-0.18	Brundage Rd north of SR 229	0.0001	0.0007	0.0003	0.002	0.0031
SR229; 0.4	SR 229 and Welser Rd/Brundage Rd Intersect	0.0416	0.1004	0.067	0.4024	0.6114
US23; 21.42	US 23 and SR 229 Intersection	0.4579	1.9893	2.9076	18.3846	23.7394

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR229; 0.12-0.25	SR 229 between US 23 and Norton Rd	-0.0008	-0.0023	-0.0012	0.0647	0.0604
SR229; 0.26-0.4	SR 229 between US 23 and Welser Rd/Brunds	-0.0004	-0.0011	-0.001	-0.0084	-0.0109
US23; 20.78-21.42	US 23 south of SR 229	0.0489	0.1263	0.0686	0.1815	0.4253
US23; 21.42-21.55	US 23 north of SR 229	0.0186	0.0426	0.0232	0.0162	0.0886
TR365; 0-0.18	Brundage Rd north of SR 229	0	0	-0.0003	-0.0001	-0.0004
SR229; 0.4	SR 229 and Welser Rd/Brundage Rd Intersect	-0.002	-0.0051	-0.0036	0.0241	0.0134
US23; 21.42	US 23 and SR 229 Intersection	-0.0806	-0.3507	-0.5125	0	-0.9438

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Expected Crash Frequency
Unknown	0.0573	0.0615	0.0042	
Head On	0.1456	0.1372	-0.0084	
Rear End	10.9851	10.7375	-0.2476	
Backing	0.9525	0.9538	0.0013	
Sideswipe - Meeting	0.3796	0.3832	0.0036	
Sideswipe - Passing	3.4997	3.5082	0.0086	
Angle	4.9799	4.8013	-0.1786	
Parked Vehicle	1.0599	1.0545	-0.0054	
Pedestrian	0.3482	0.3092	-0.0390	
Animal	3.3852	3.7886	0.4034	
Train	0.0044	0.0040	-0.0004	
Pedalcycles	0.2207	0.1989	-0.0218	
Other Non-Vehicle	0.0000	0.0000	0.0000	
Fixed Object	2.4046	2.5922	0.1876	
Other Object	0.2030	0.2200	0.0170	
Overturning	0.1776	0.2076	0.0300	
Other Non-Collision	0.2559	0.2758	0.0199	
Left Turn	2.6597	2.5203	-0.1394	
Right Turn	0.0000	0.0000	0.0000	

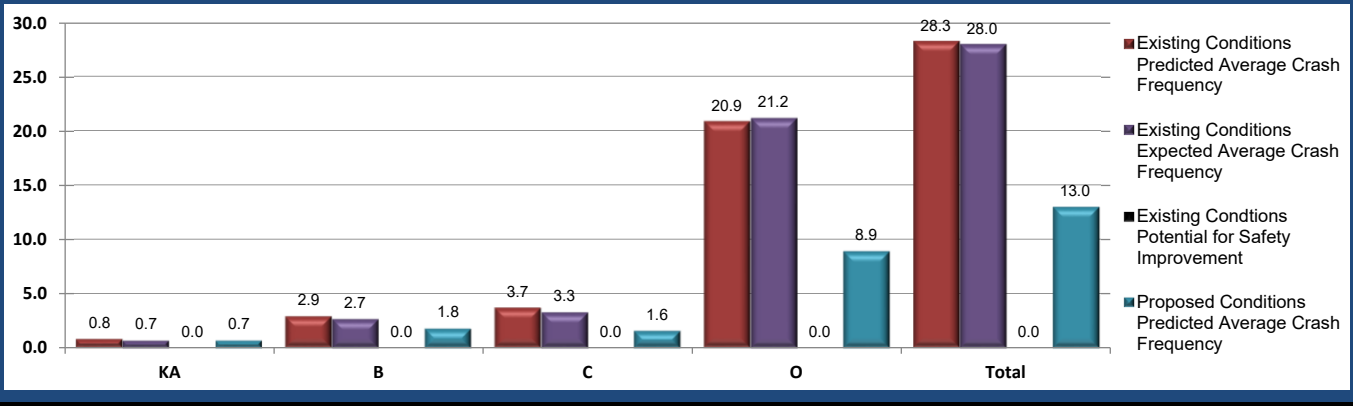
Appendix D: Build Alternative ECAT Analysis

Project Safety Performance Report

General Information

Project Name	DEL-23-21.33 (US 23 at SR 229)	Contact Email	andrew.hurst@dot.ohio.gov
Project Description	Interchange	Contact Phone	740-833-8345
Reference Number		Date Performed	
Analyst	Drew Hurst	Analysis Year	2026
Agency/Company	ODOT District 6		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.7596	2.9030	3.7356	20.9355	28.3337
$N_{expected}$ - Existing Conditions	0.7412	2.7127	3.3088	21.2035	27.9662
$N_{potential\ for\ improvement}$ - Existing Conditions	0.0000	0.0000	0.0000	0.0000	0.0000
$N_{expected}$ - Proposed Conditions	0.6837	1.8196	1.6309	8.8587	12.9929

Project Safety Performance Report

General Information

Project Name	DEL-23-21.33 (US 23 at SR 229)	Contact Email	andrew.hurst@dot.ohio.gov
Project Description	Interchange	Contact Phone	740-833-8345
Reference Number		Date Performed	
Analyst	Drew Hurst	Analysis Year	2026
Agency/Company	ODOT District 6		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR229; 0.12-0.25	SR 229 between US 23 and Norton Rd	0.0106	0.0277	0.0131	0.0772	0.1286
SR229; 0.26-0.4	SR 229 between US 23 and Weiser Rd/Brunda	0.0071	0.019	0.0095	0.0535	0.0891
US23; 20.78-21.42	US 23 south of SR 229	0.131	0.3362	0.1819	1.6703	2.3194
US23; 21.42-21.55	US 23 north of SR 229	0.0287	0.0739	0.0398	0.3695	0.5119
TR366; 0-0.18	Brundage Rd north of SR 229	0.0001	0.0007	0.0006	0.0021	0.0035
SR229; 0.4	SR 229 and Weiser Rd/Brundage Rd intersect	0.0436	0.1055	0.0706	0.3783	0.598
US23; 21.42	US 23 and SR 229 intersection	0.5385	2.34	3.4201	18.3846	24.6832

Project Safety Performance Report

General Information

Project Name	DEL-23-21.33 (US 23 at SR 229)	Contact Email	andrew.hurst@dot.ohio.gov
Project Description	Interchange	Contact Phone	740-833-8345
Reference Number		Date Performed	
Analyst	Drew Hurst	Analysis Year	2026
Agency/Company	ODOT District 6		

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR229; 0.12-0.25	SR 229 between US 23 and Norton Rd	0.0098	0.0254	0.0119	0.1319	0.179
SR229; 0.26-0.4	SR 229 between US 23 and Weiser Rd/Brunda	0.0067	0.0179	0.0085	0.0451	0.0782
US23; 20.78-21.42	US 23 south of SR 229	0.1799	0.4625	0.2505	1.8518	2.7447
US23; 21.42-21.55	US 23 north of SR 229	0.0452	0.1165	0.063	0.3857	0.6104
TR366; 0-0.18	Brundage Rd north of SR 229	0.0001	0.0007	0.0003	0.002	0.0031
SR229; 0.4	SR 229 and Weiser Rd/Brundage Rd intersect	0.0416	0.1004	0.067	0.4024	0.6114
US23; 21.42	US 23 and SR 229 intersection	0.4579	1.9893	2.9076	18.3846	23.7394

Project Safety Performance Report

General Information

Project Name	DEL-23-21.33 (US 23 at SR 229)	Contact Email	andrew.hurst@dot.ohio.gov
Project Description	Interchange	Contact Phone	740-833-8345
Reference Number		Date Performed	
Analyst	Drew Hurst	Analysis Year	2026
Agency/Company	ODOT District 6		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR229; 0.12-0.25	SR 229 between US 23 and Norton Rd	-0.0008	-0.0023	-0.0012	**0.0547**	**0.0504**
SR229; 0.26-0.4	SR 229 between US 23 and Weiser Rd/Brunda	-0.0004	-0.0011	-0.001	-0.0084	-0.0109
US23; 20.78-21.42	US 23 south of SR 229	**0.0489**	**0.1263**	**0.0686**	**0.1815**	**0.4253**
US23; 21.42-21.55	US 23 north of SR 229	**0.0165**	**0.0426**	**0.0232**	**0.0162**	**0.0985**
TR366; 0-0.18	Brundage Rd north of SR 229	0	0	-0.0003	-0.0001	-0.0004
SR229; 0.4	SR 229 and Weiser Rd/Brundage Rd intersect	-0.002	-0.0051	-0.0036	**0.0241**	**0.0134**
US23; 21.42	US 23 and SR 229 intersection	-0.0806	-0.3507	-0.5125	0	-0.9438

Project Safety Performance Report

EDAT Economic Crash Analysis Tool

General Information

Project Name	DEL-23-21.33 (US 23 at SR 229)	Contact Email	andrew.hurst@dot.ohio.gov
Project Description	Interchange	Contact Phone	740-833-8345
Reference Number		Date Performed	
Analyst	Drew Hurst	Analysis Year	2026
Agency/Company	ODOT District 6		

Proposed Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US23; 20.78-21.55	US 23 north of SR 229	0.1574	0.4045	0.2191	2.0095	2.7905
TR366; 0.18-0.23	east side connection to Brundage Rd	0.0017	0.0043	0.0025	0.0127	0.0212
US23; 21.55	US 23 and east side access	0.276	0.7819	0.9954	4.5494	6.6027
SR229; 0.26-0.4	SR 229 between US 23 and Weiser Rd/Brunda	0.0071	0.019	0.0095	0.0535	0.0891
SR229; 0.12-0.25	SR 229 between US 23 and Norton Rd	0.0144	0.0382	0.0183	0.1063	0.1772
TR366; 0-0.18	Brundage Rd north of SR 229	0.0063	0.0165	0.0083	0.0467	0.0778
SR229; 0.4	SR 229 and Weiser Rd/Brundage Rd intersect	0.1778	0.4304	0.2868	1.541	2.436
TR366; 0.18	Brundage Rd and connection to US 23 north	0.043	0.1248	0.091	0.5396	0.7984

Project Safety Performance Report

General Information

Project Name	DEL-23-21.33 (US 23 at SR 229)	Contact Email	andrew.hurst@dot.ohio.gov
Project Description	Interchange	Contact Phone	740-833-8345
Reference Number		Date Performed	
Analyst	Drew Hurst	Analysis Year	2026
Agency/Company	ODOT District 6		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Predicted Crash Frequency
Unknown	0.0573	0.0615		0.0621
Head On	0.1456	0.1372		0.0871
Rear End	10.9851	10.7375		3.3807
Backing	0.9525	0.9538		0.4148
Sideswipe - Meeting	0.3796	0.3832		0.3210
Sideswipe - Passing	3.4997	3.5092		1.3994
Angle	4.9799	4.8013		2.6066
Parked Vehicle	1.0599	1.0545		0.6676
Pedestrian	0.3482	0.3092		0.1328
Animal	3.3852	3.7886		3.4369
Train	0.0044	0.0040		0.0006
Pedalcycles	0.2207	0.1989		0.1040
Other Non-Vehicle	0.0000	0.0000		0.0003
Fixed Object	2.4046	2.5922		2.6495
Other Object	0.2030	0.2200		0.1927
Overturning	0.1776	0.2076		0.2026
Other Non-Collision	0.2559	0.2758		0.2851
Left Turn	2.6597	2.5203		0.4860
Right Turn	0.0000	0.0000		0.0000

Safety Benefit - Cost Analysis

ECAT Economic Crash Analysis Tool

General Information

Project Name	DEL-23-21.33 (US 23 at SR 229)	Contact Email	andrew.hurst@dot.ohio.gov
Project Description	Interchange	Contact Phone	740-833-8345
Reference Number		Date Performed	
Analyst	Drew Hurst	Analysis Year	2026
Agency/Company	ODOT District 6		

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 (Please add description about improvements i.e. Lane widening)	20	$1.00			$1.00	$1.00	-15.341	$2,671,950
Site Characteristic Improvements (Please add description about improvements i.e. Lighting)					$0.00	$0.00		
Site Characteristic Improvements (Please add description about improvements i.e. Signal Phasing)					$0.00	$0.00		
Site Characteristic Improvements (Please add description about improvements i.e. Added Right Turn Lane)					$0.00	$0.00		
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
Totals		**$1.00**	**$0.00**	**$0.00**	**$1.00**	**$1.00**	**-15.341**	**$2,671,950**

Safety Benefit - Cost Analysis

ECAT Economic Crash Analysis Tool

General Information

Project Name	DEL-23-21.33 (US 23 at SR 229)	Contact Email	andrew.hurst@dot.ohio.gov
Project Description	Interchange	Contact Phone	740-833-8345
Reference Number		Date Performed	
Analyst	Drew Hurst	Analysis Year	2026
Agency/Company	ODOT District 6		

Benefit - Cost Calculator

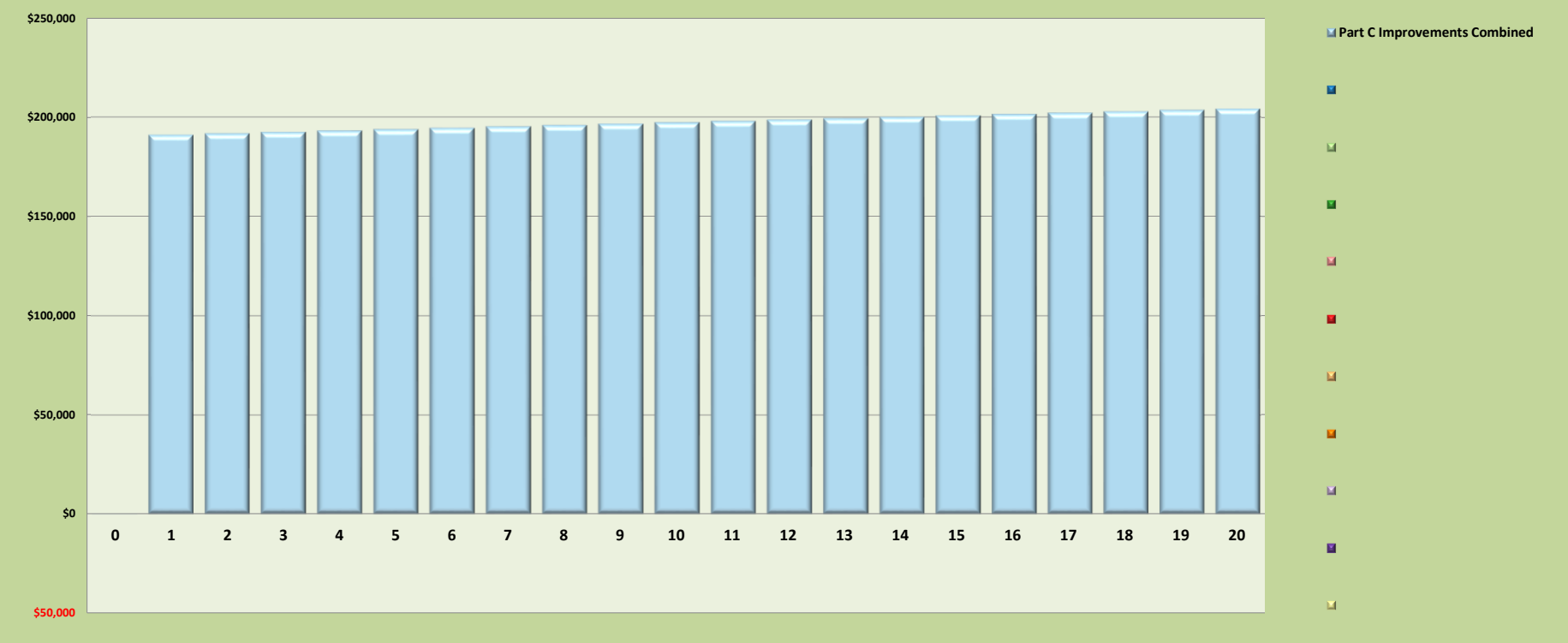
Net Present Value of Project	$1.00
Net Present Value of Safety Benefits	$2,671,949.87
Net Benefit	$2,671,948.87
Benefit / Cost Ratio	2671949.87

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.076
Number of Injury Crashes	-3.264
Number of Total Crashes	-15.341

Comments:

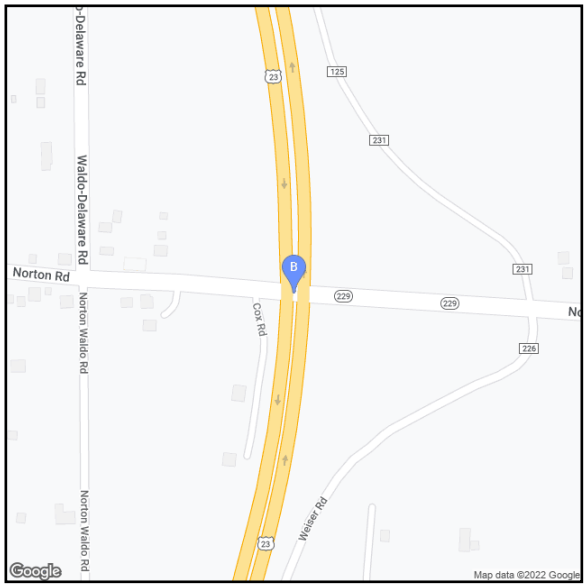
Safety Benefits and Project Costs Combined Cash Flows By Countermeasure Per Year



Appendix E: Traffic Volume Forecasts

TFMS - Intersection Forecast Report

Forecast Summary



Project Id	Project Name

Project Description

Model Version	Script Date	Script Version
2022.1900	4/14/2020 5:30:19 PM	2020.001

Username	Email Address
Andrew.Hurst	Andrew.Hurst@dot.ohio.gov

*Users of this data need to be aware that there are limitations to the forecasts generated by this product that make it suitable only for roadway design projects which are low risk.

Road Name	2026 AADT	2046 AADT	K%	DHV30	D%	T24%	TD%
US 23	28,500	28,500	12.0	3420	70	17.2	9.4
SR 229	2,000	2,000	13.0	260	70	12.3	3.7
US 23	29,000	29,000	12.0	3480	70	17.2	10.0
SR 229	3,500	3,950	13.0	510	70	12.4	5.4

The values in parentheses have been overridden.

Pivot Count Date: 06/09/2022

TFMS - Intersection Forecast Report

Segment Information

Aproach Name	Segment ID	LRS ID	BMP	Midpoint	EMP	Length	Latitude	Longitude
NB	1755	SDELUS00023**C	18.831	20.132	21.433	2.602	40.4152106824452	-83.0741640665798
EB	1756	SDELSR00229**C	0.123	0.1865	0.250	0.127	40.4339748200424	-83.0736768323419
SB	1757	SDELUS00023**C	18.831	20.132	21.433	2.602	40.4152106824452	-83.0741640665798
WB	1758	SDELSR00229**C	0.250	0.256	0.262	0.012	40.43391047765	-83.0723596718048

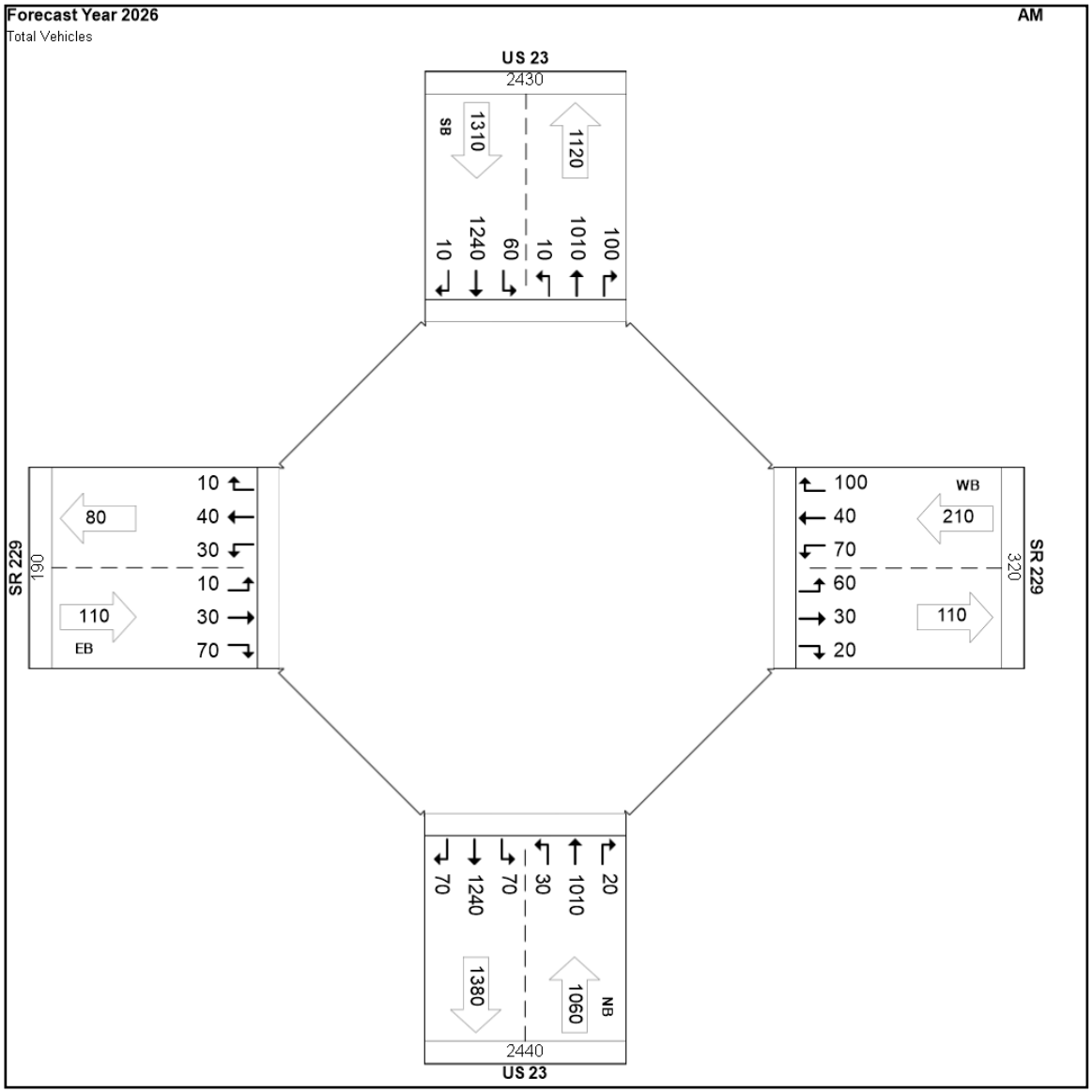
Target Value Summary

Aproach Name	Adt Growth Rate	Adt Growth	2026 AADT	2046 AADT	2026 AM	2046 AM	2026 PM	2046 PM
NB	0.000	0.000	28,500	28,500	2,450	2,450	3,450	3,450
EB	0.100	2.000	2,000	2,000	180	190	260	260
SB	0.000	0.000	29,000	29,000	2,450	2,450	3,450	3,450
WB	0.700	24.000	3,500	3,950	320	370	450	520

The values in parentheses have been overridden.

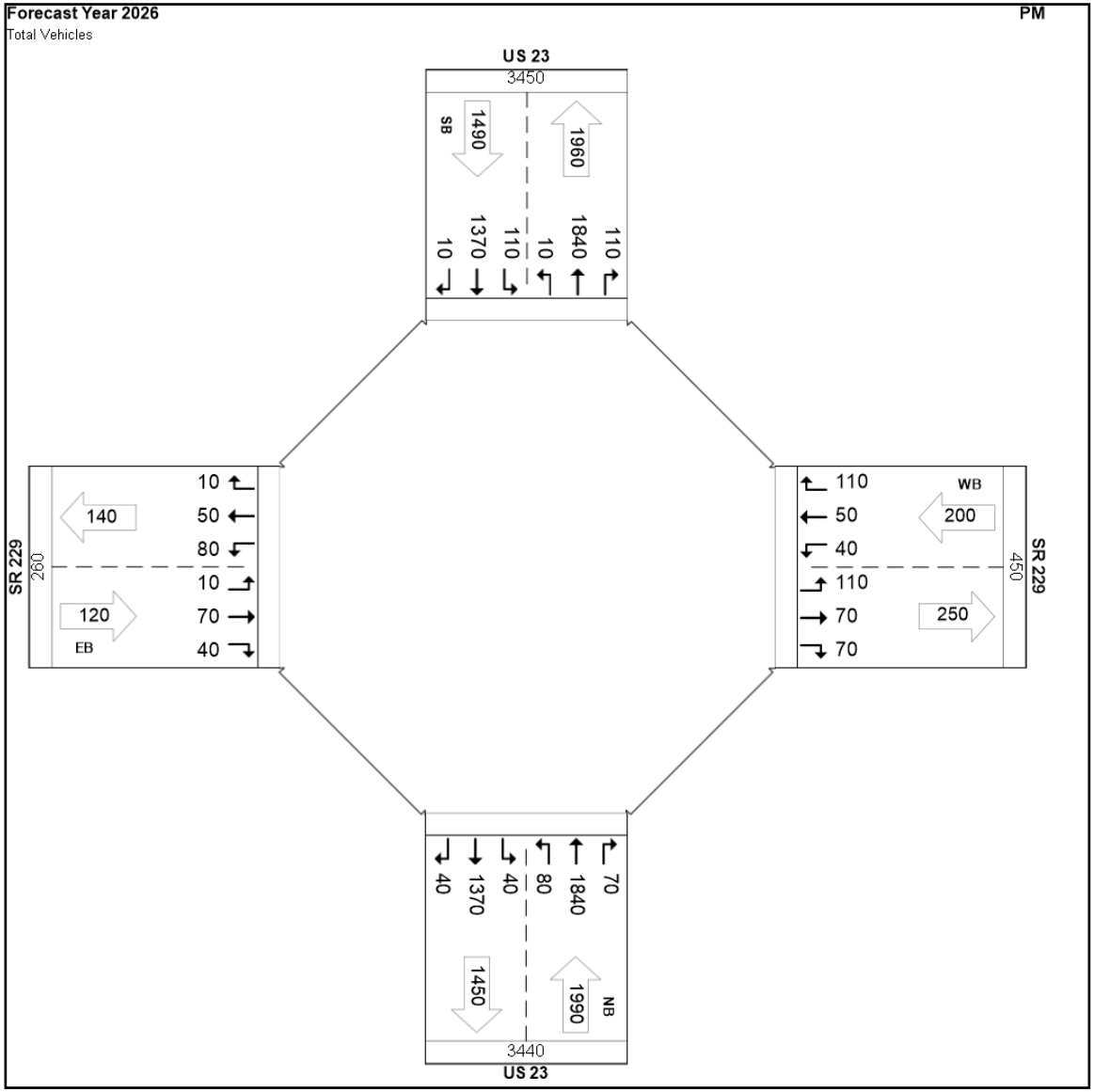
TFMS - Intersection Forecast Report

Opening Year AM

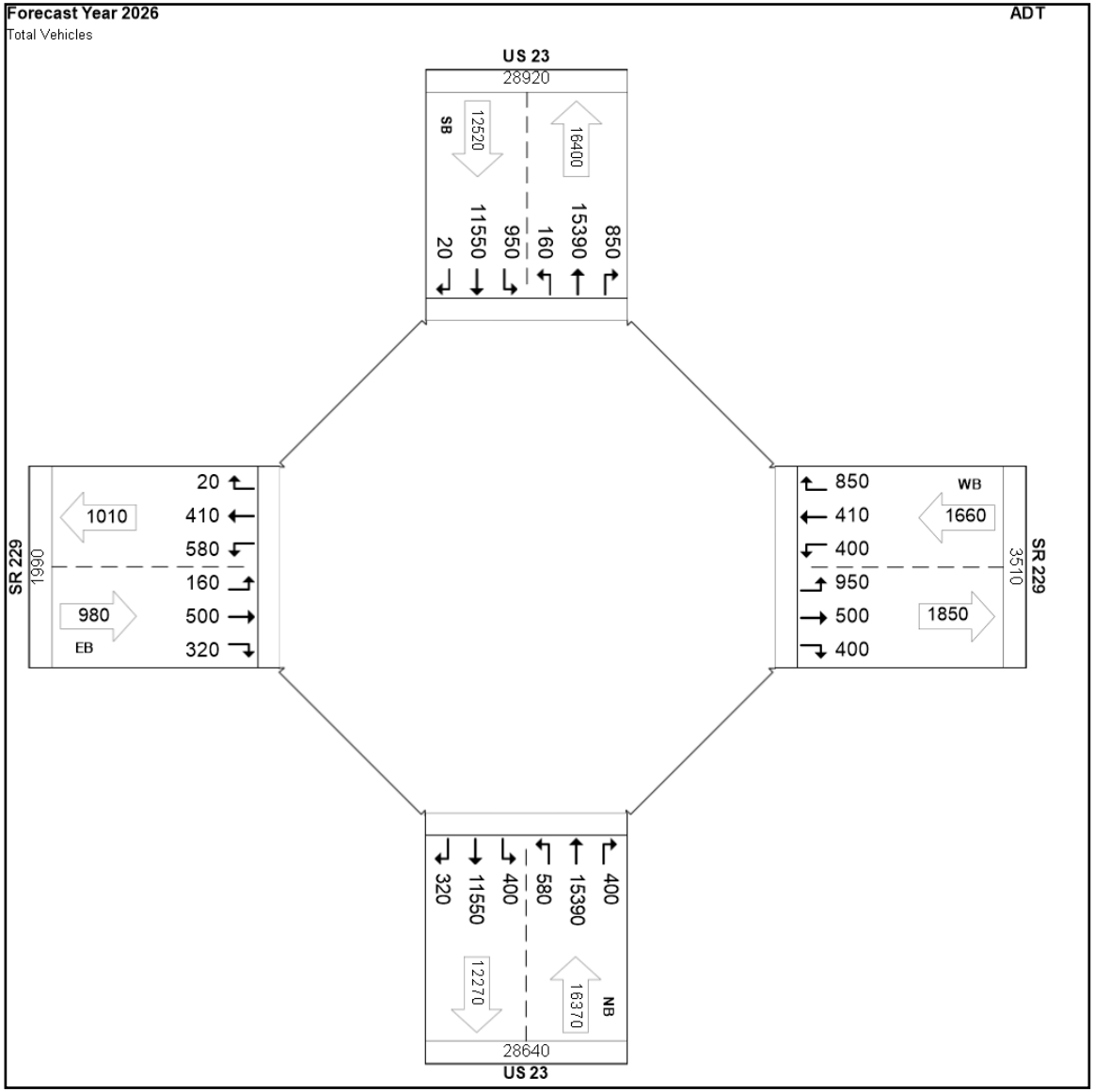


TFMS - Intersection Forecast Report

Opening Year PM

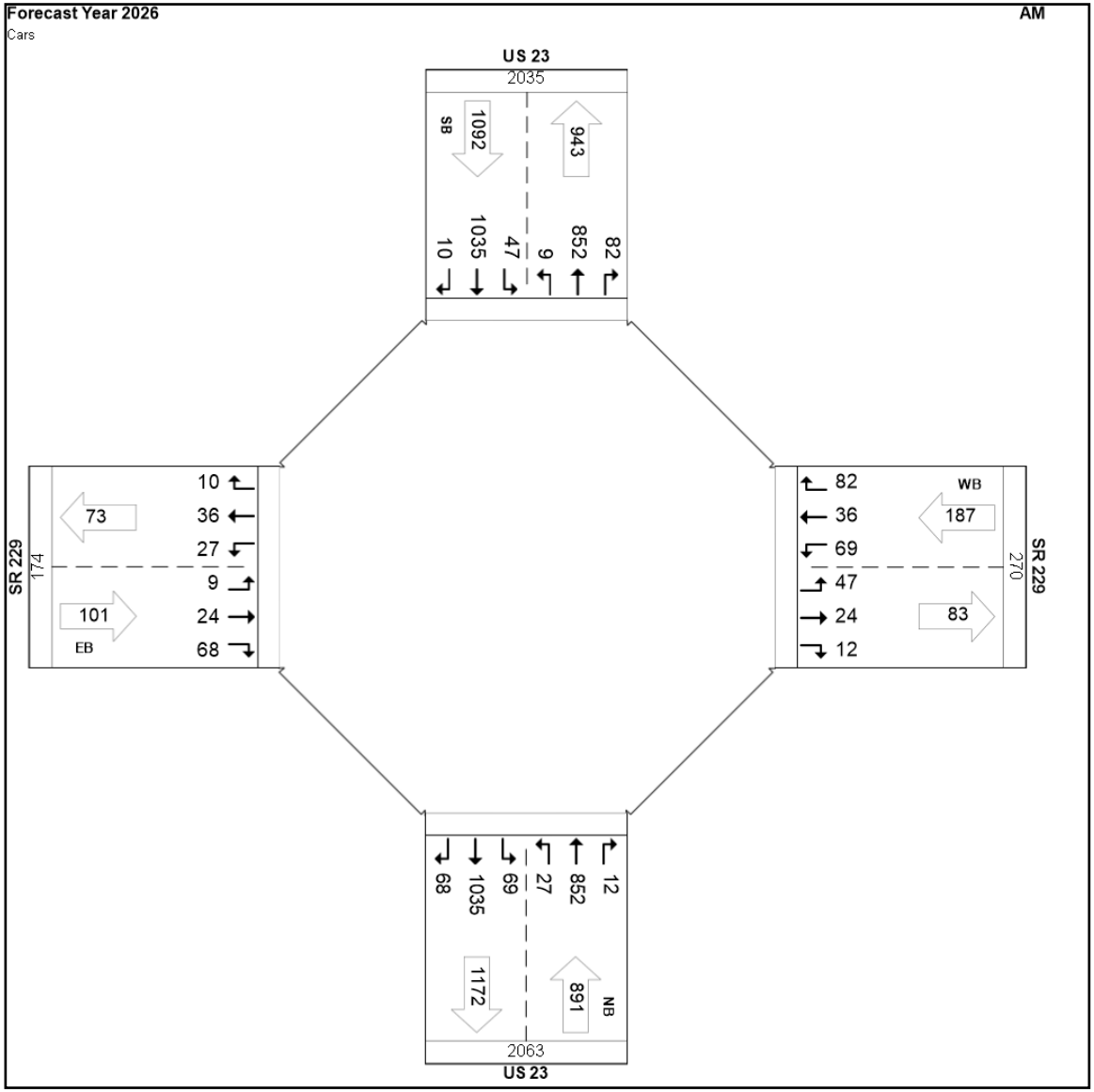


Opening Year ADT



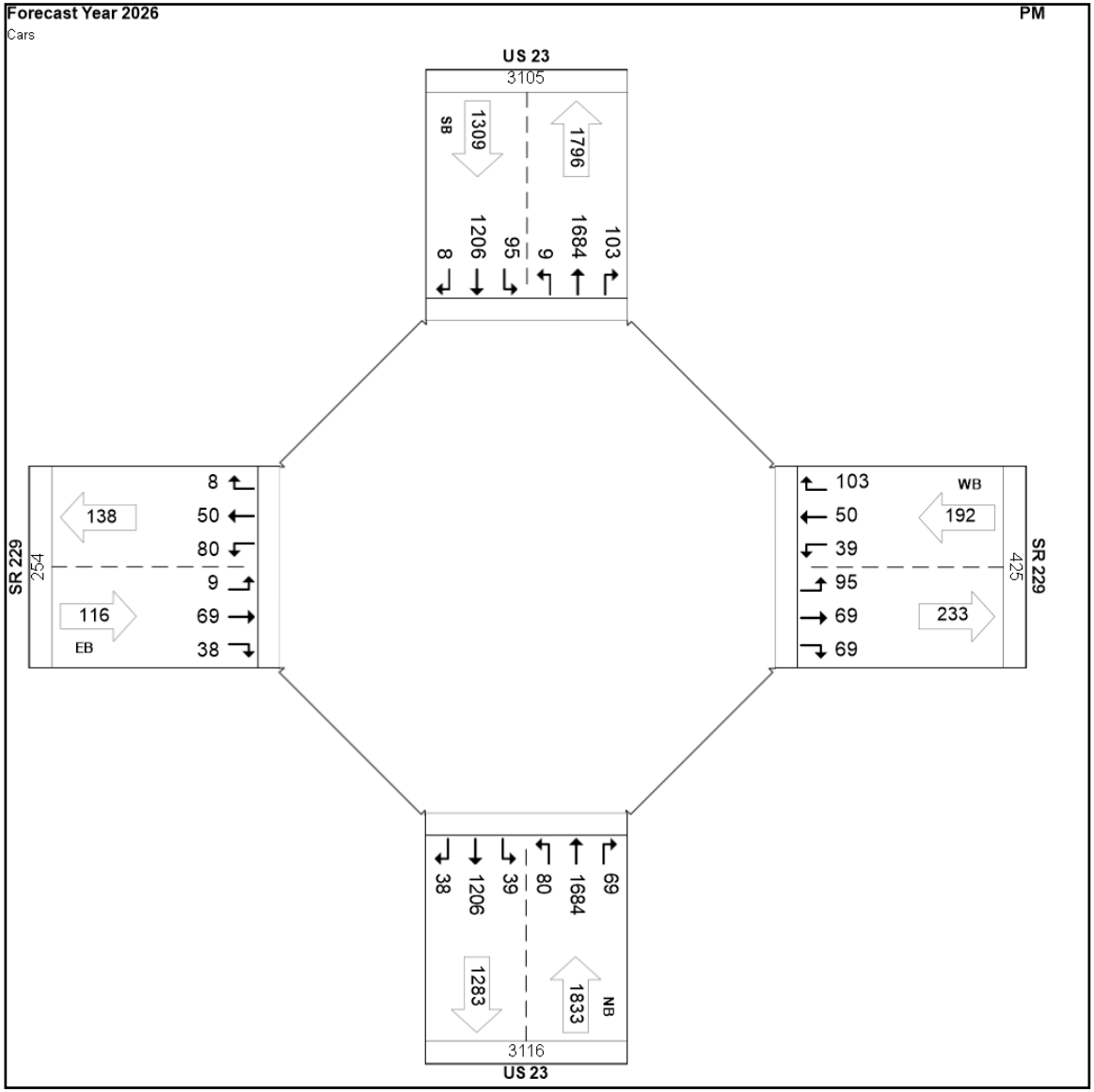
TFMS - Intersection Forecast Report

Opening Year Cars AM



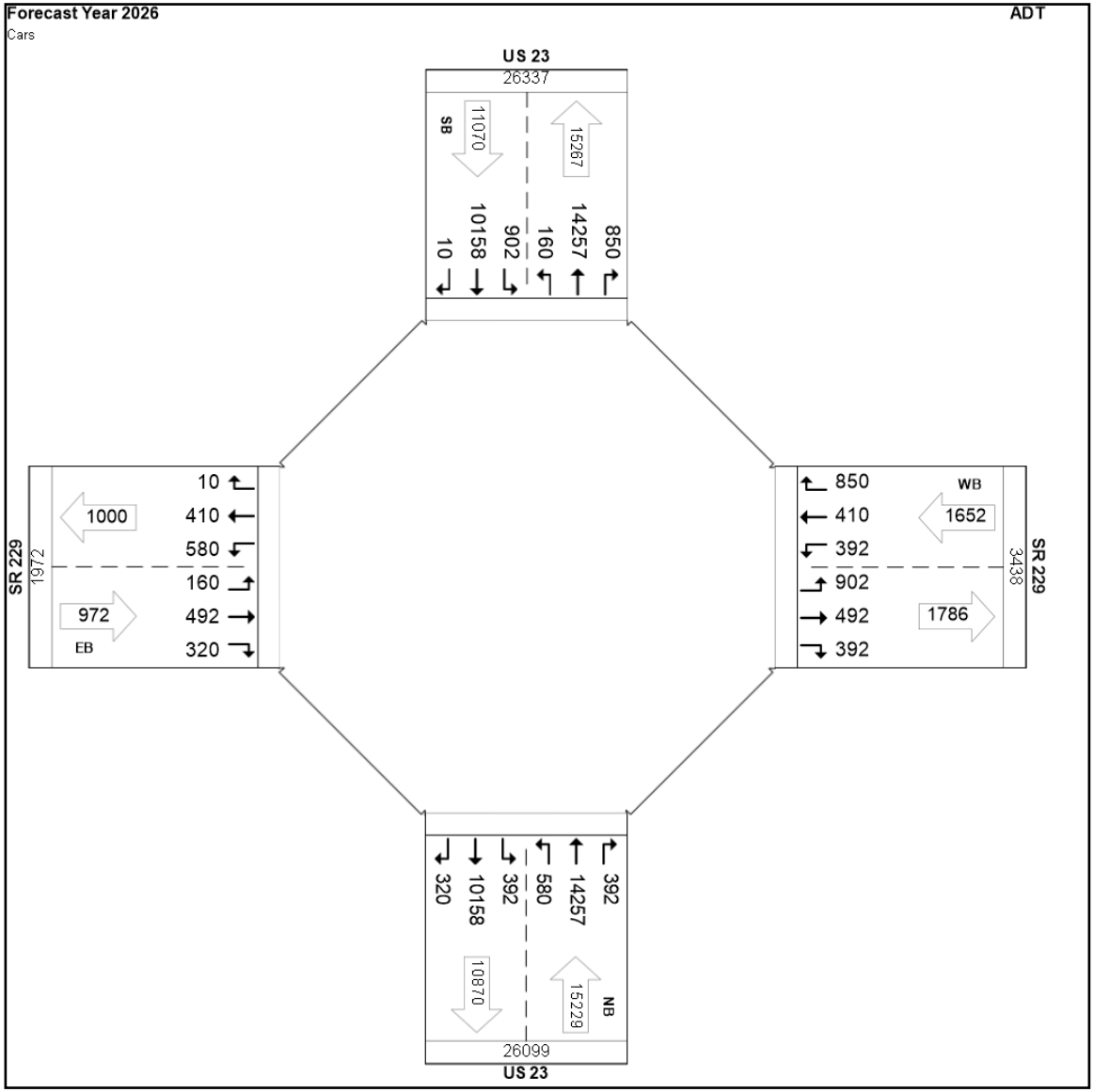
TFMS - Intersection Forecast Report

Opening Year Cars PM

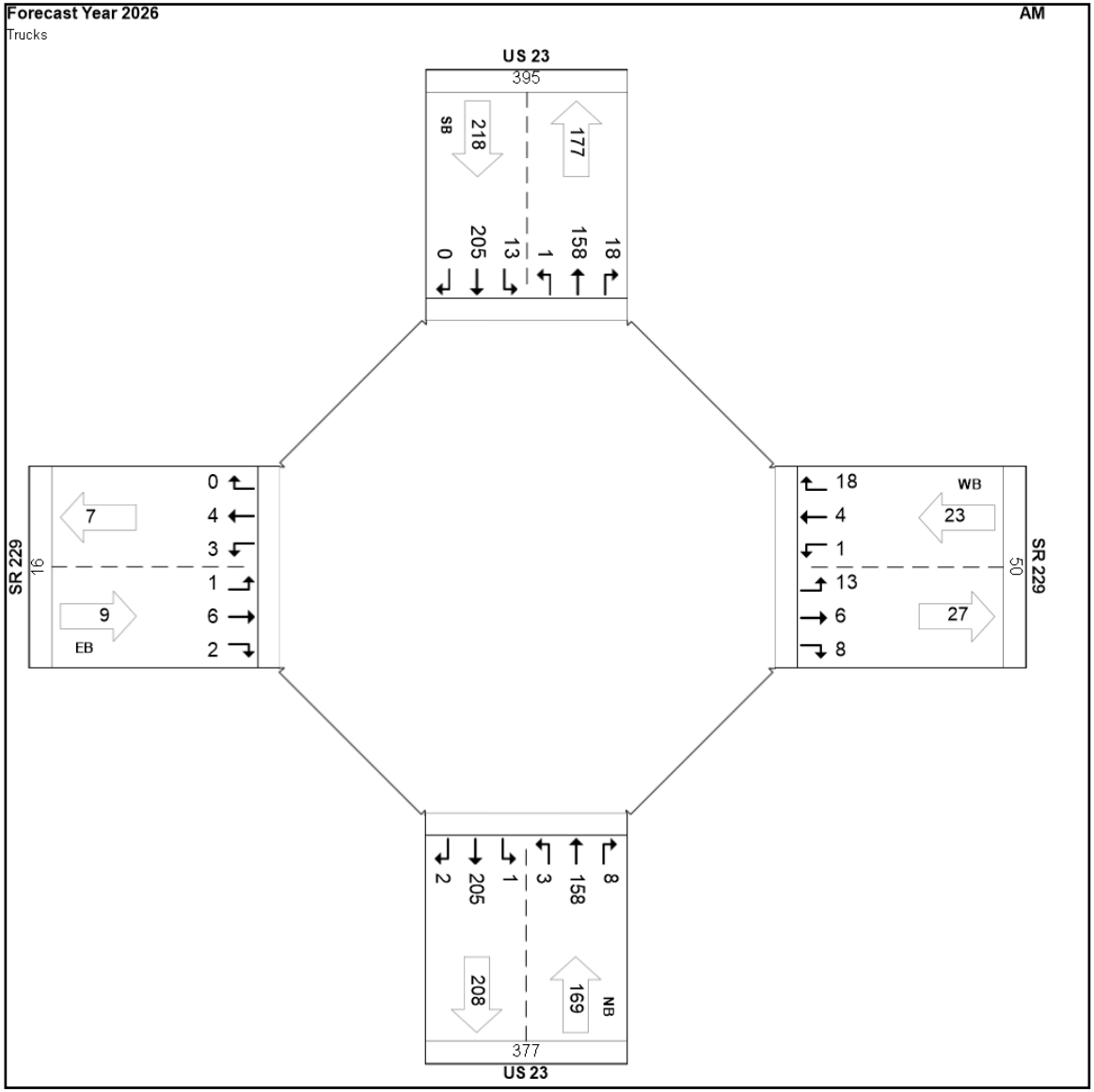


TFMS - Intersection Forecast Report

Opening Year Cars ADT



Opening Year Trucks AM



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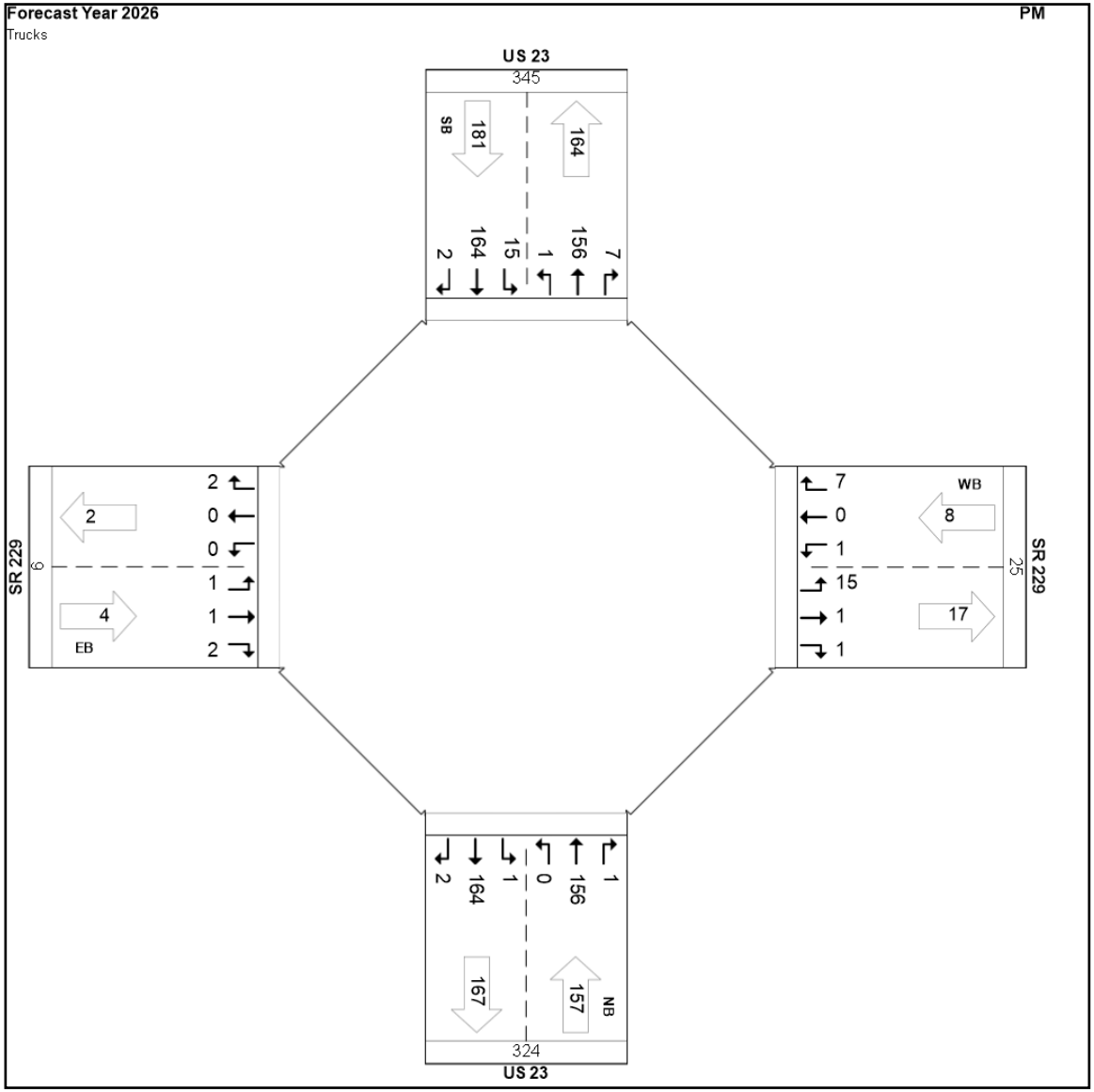
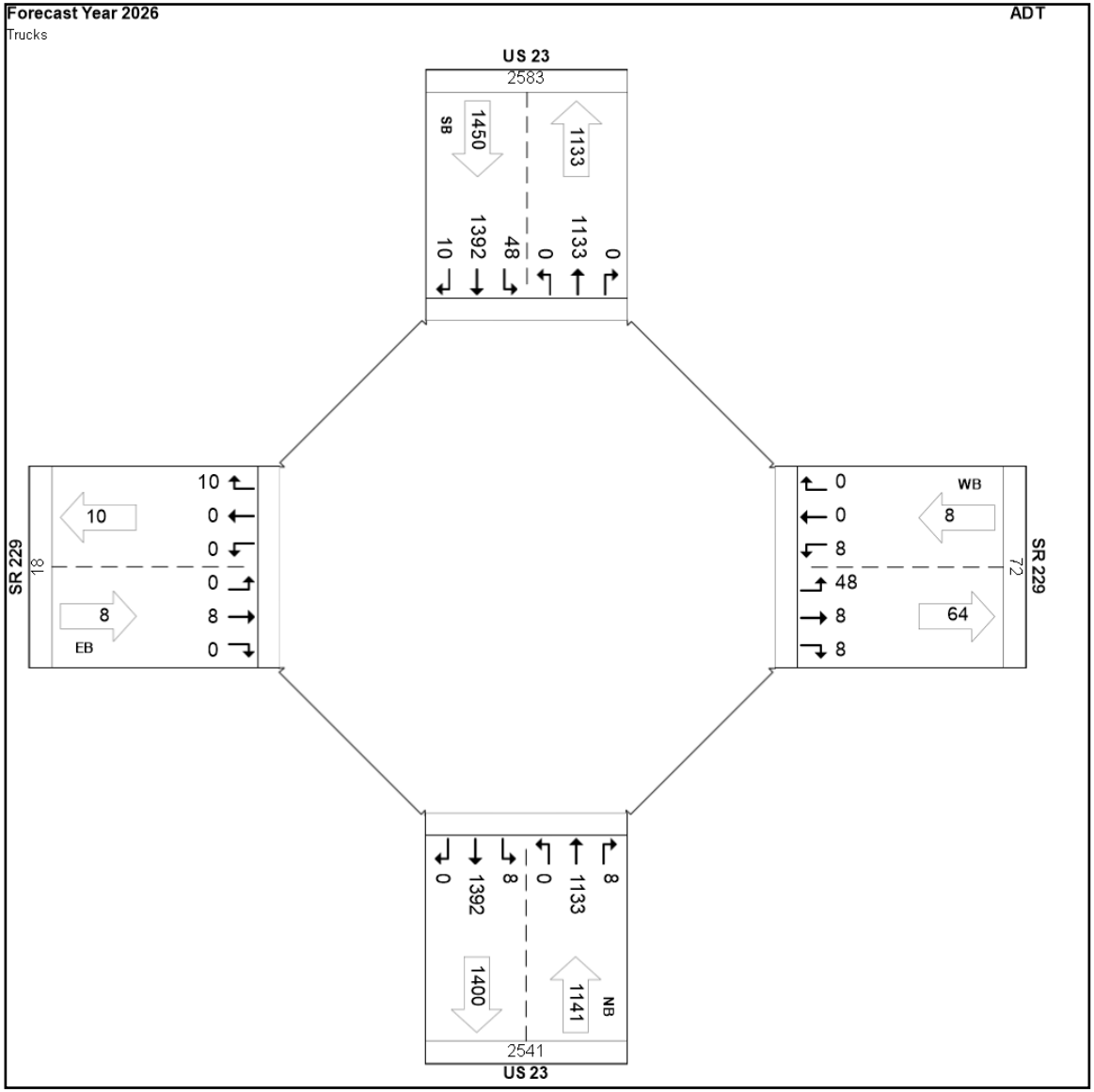
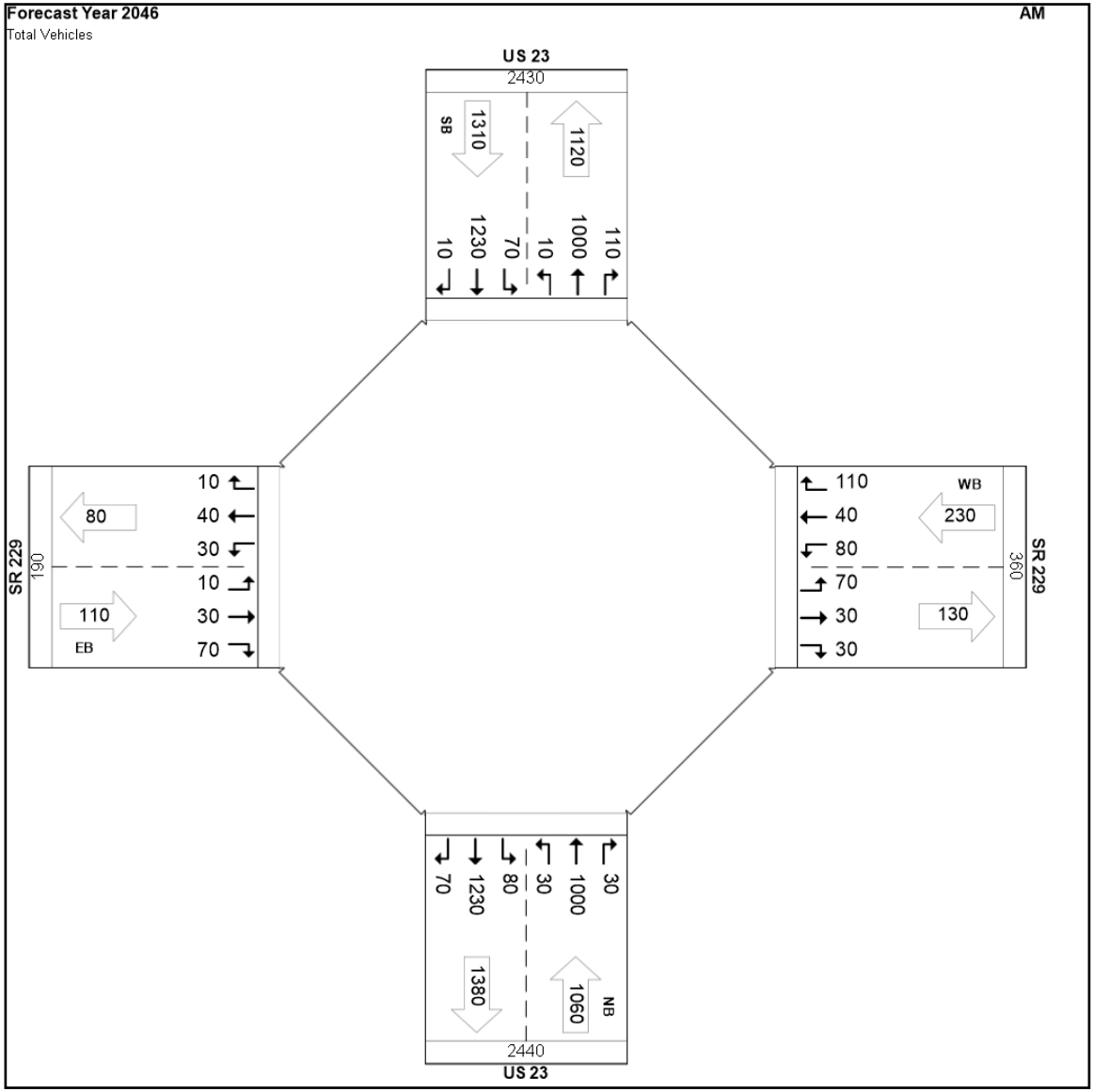


Opening Year Trucks ADT

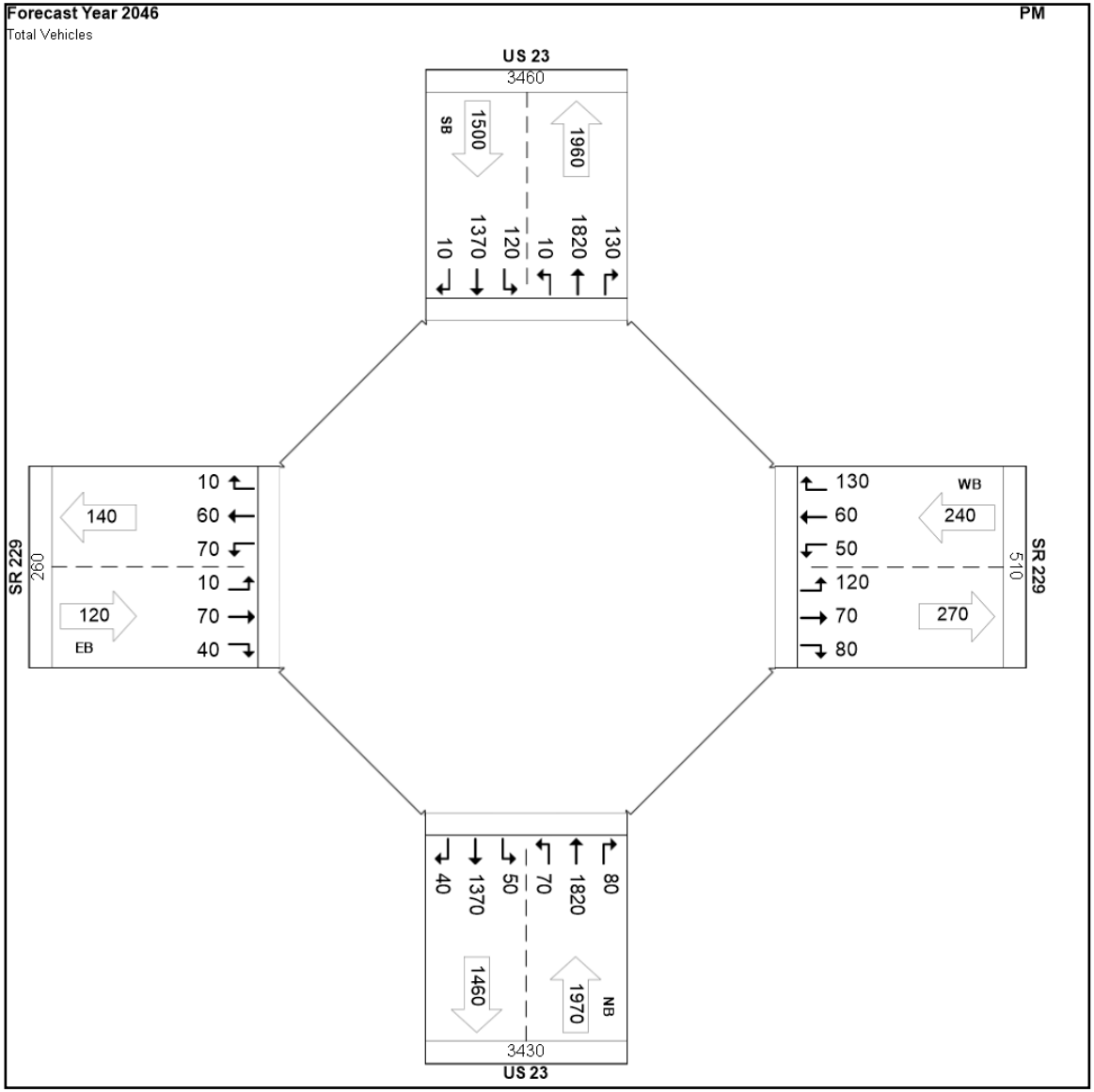


TFMS - Intersection Forecast Report

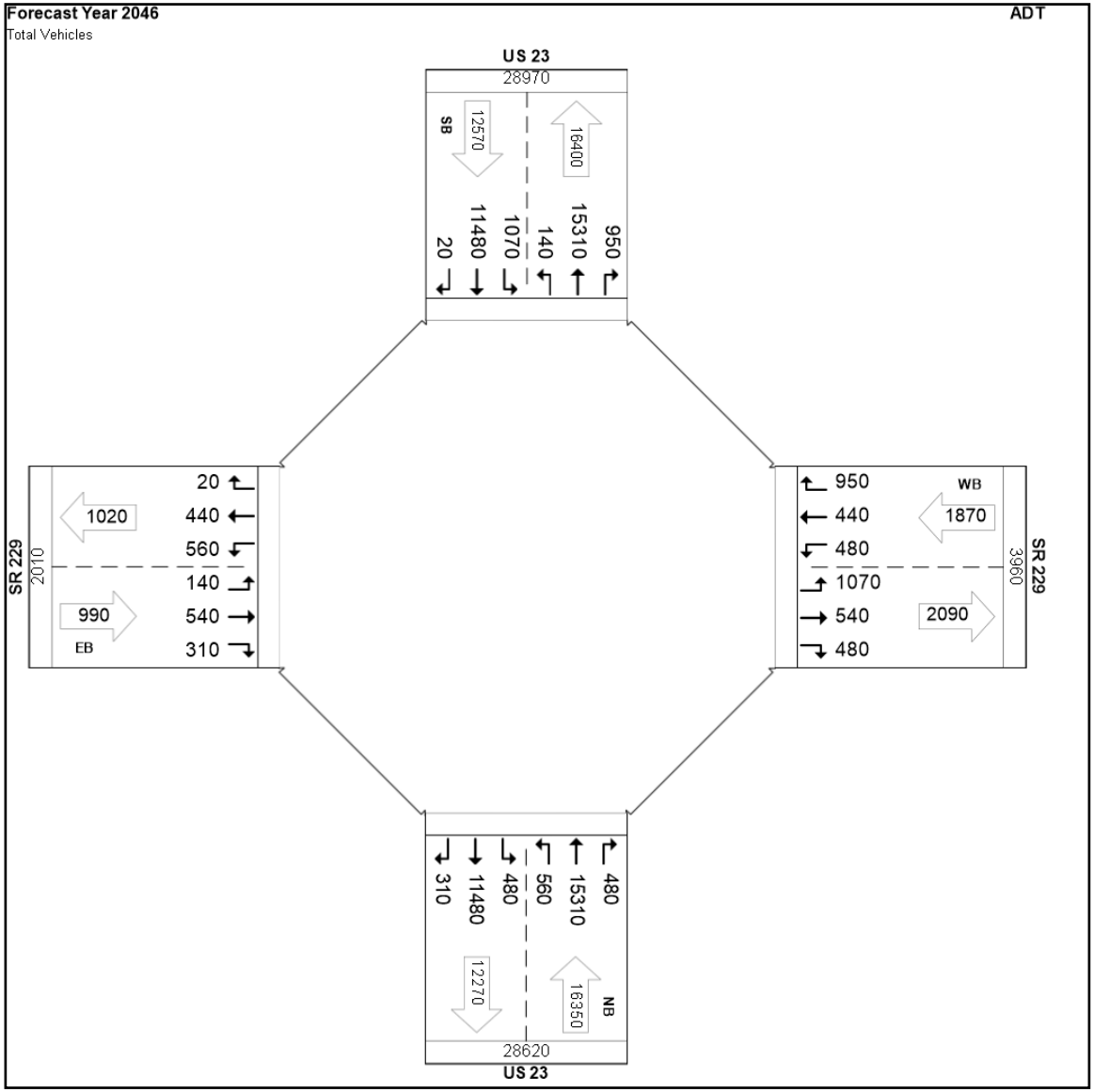
Design Year AM



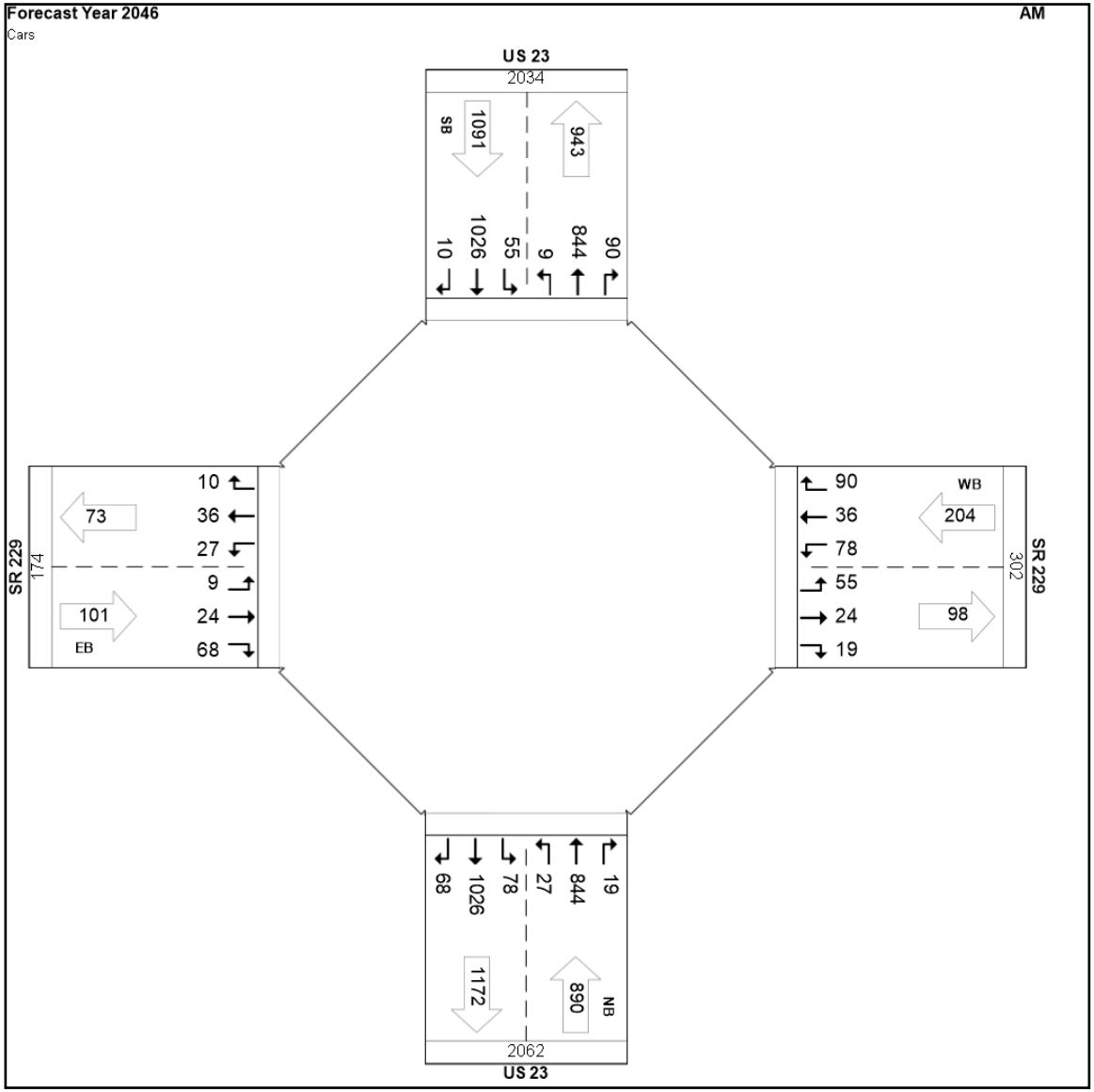
Design Year PM



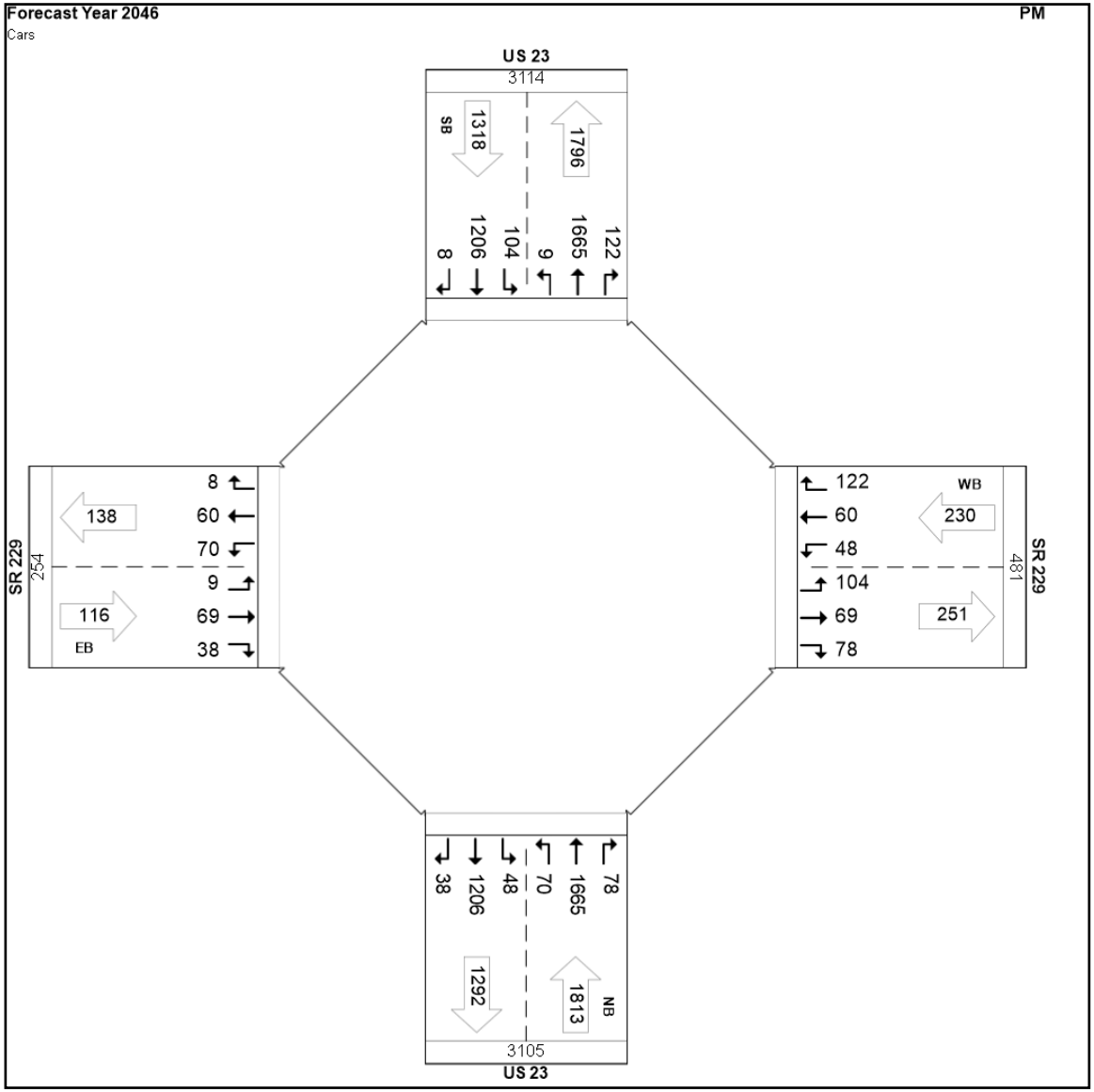
Design Year ADT



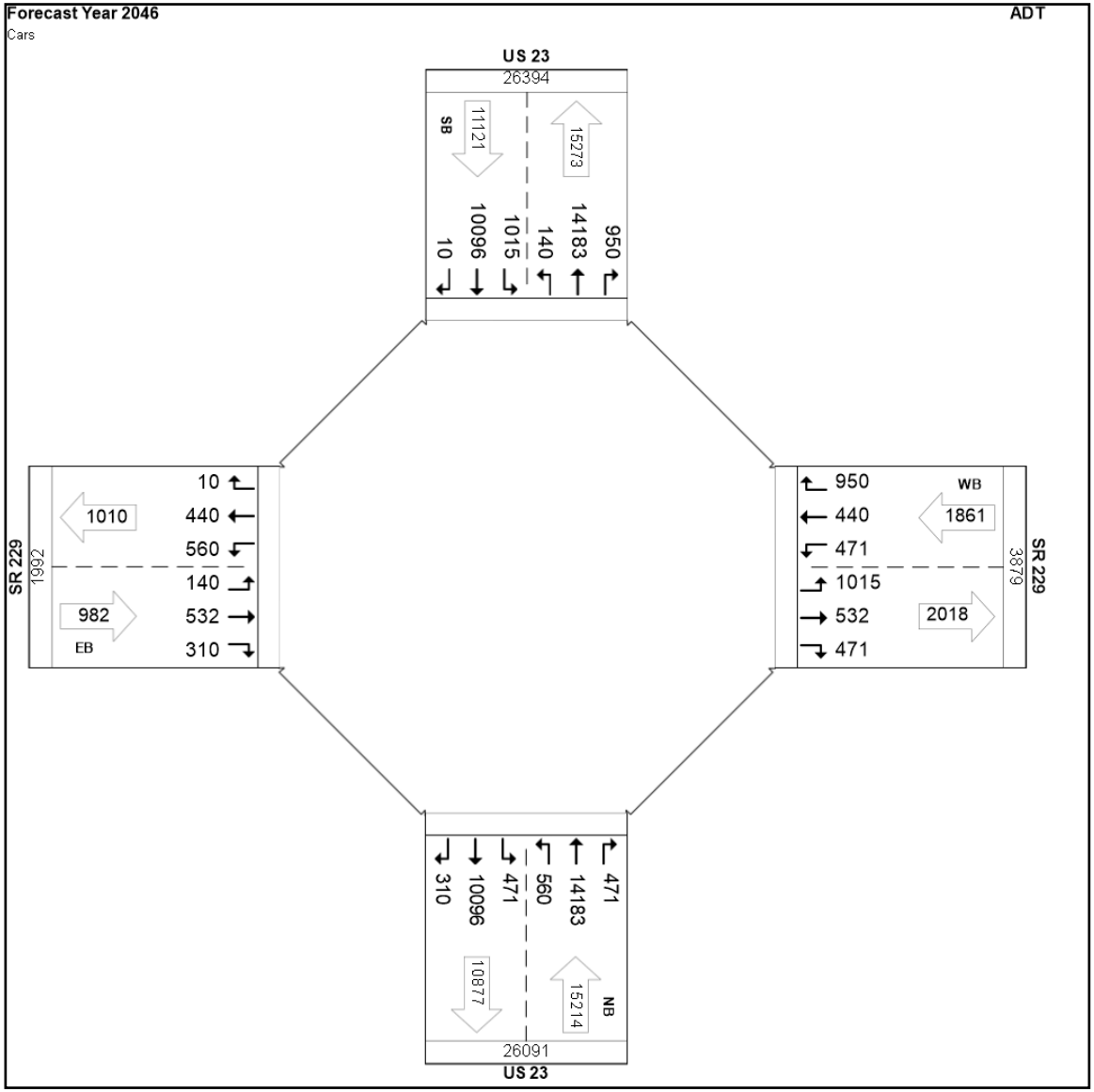
Design Year Cars AM



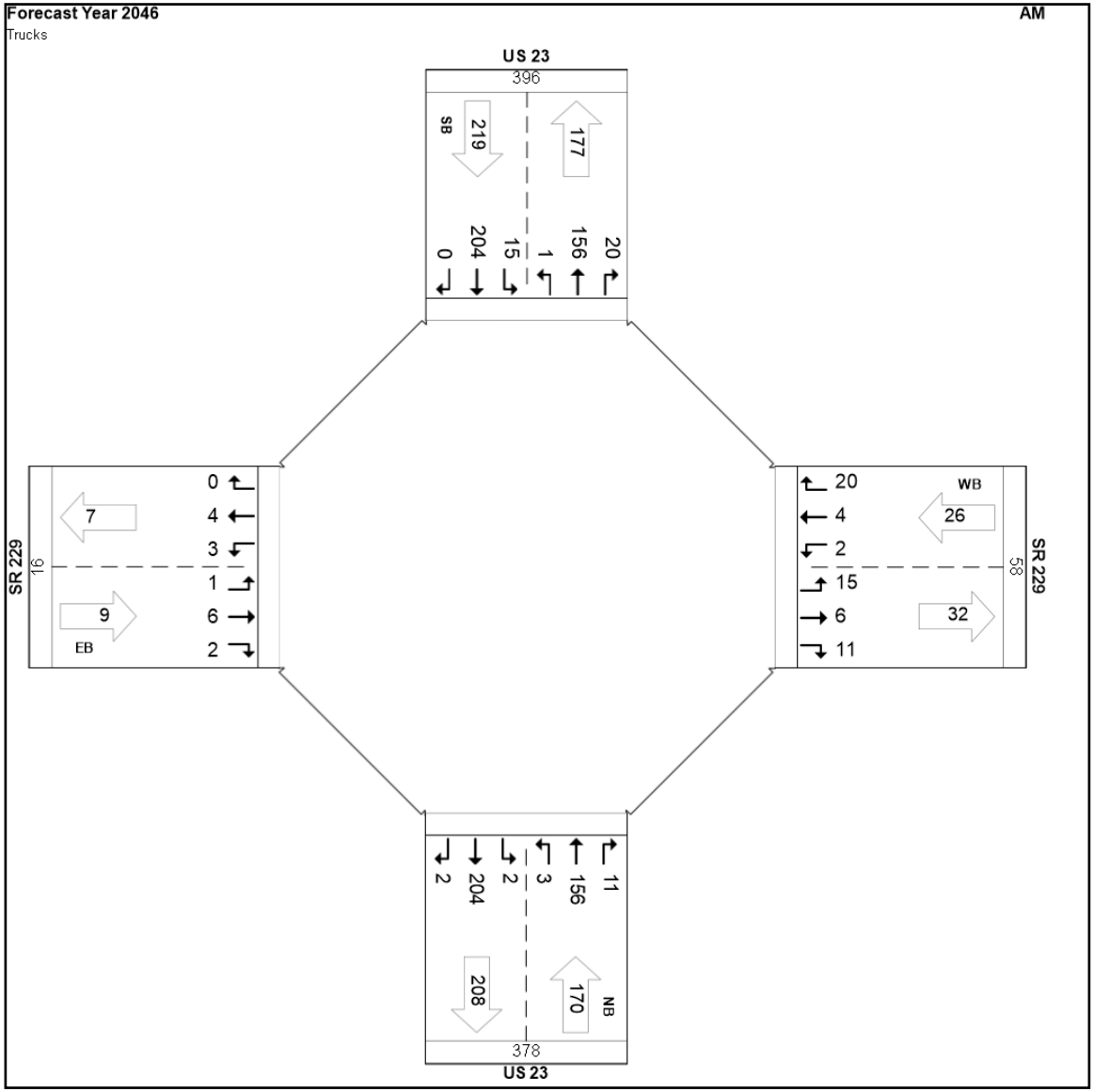
Design Year Cars PM



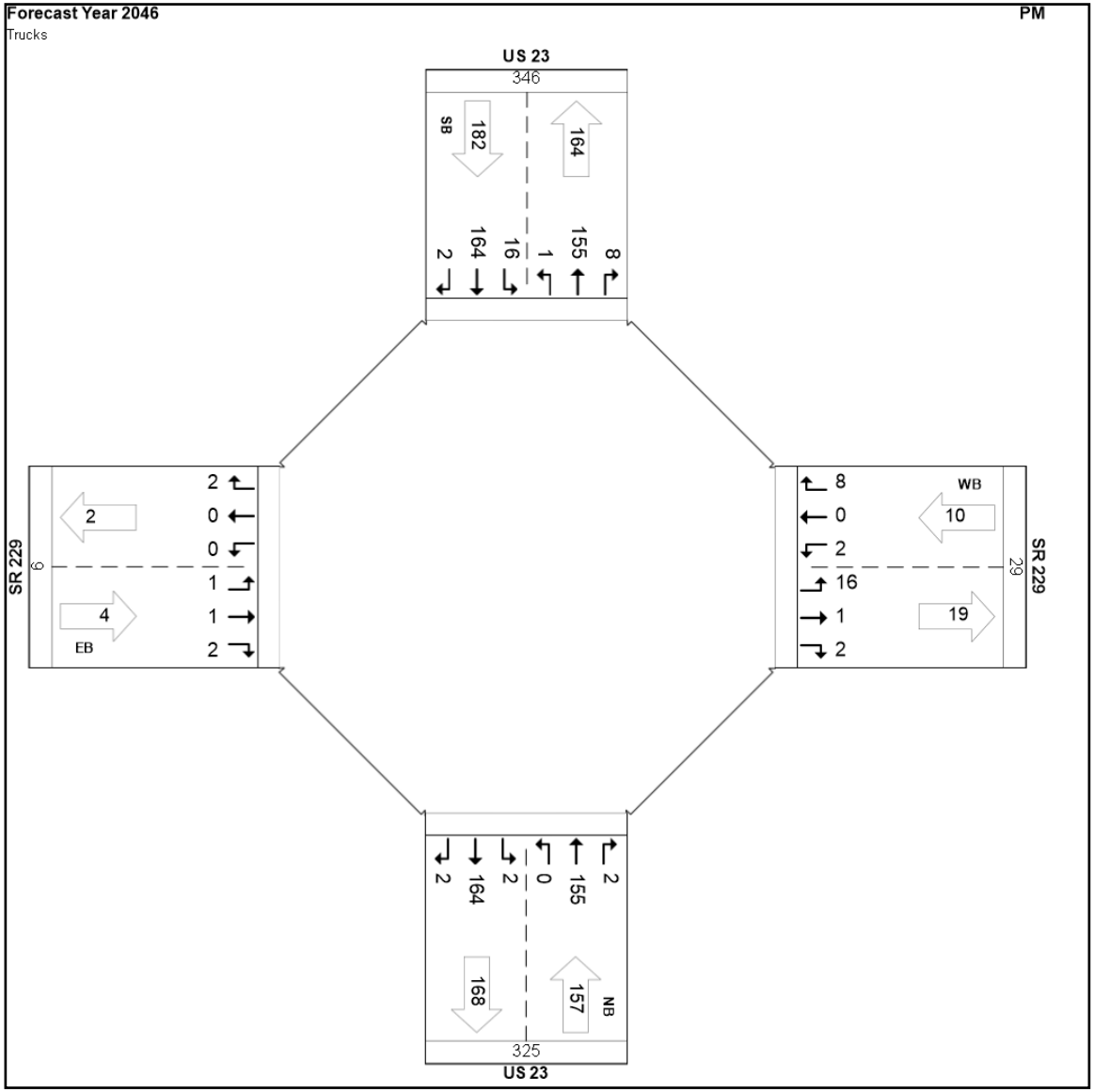
Design Year Cars ADT



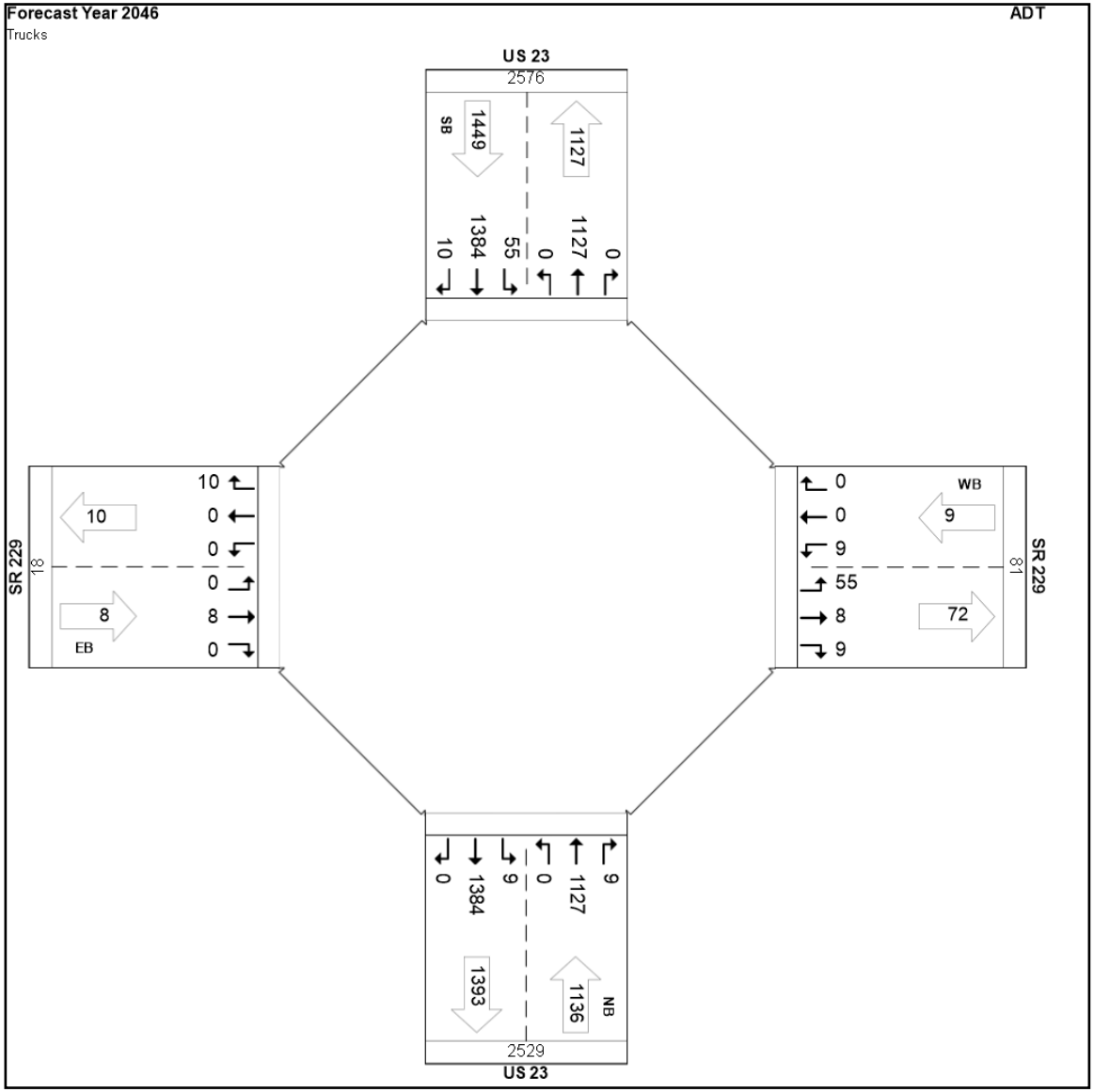
Design Year Trucks AM



Design Year Trucks PM

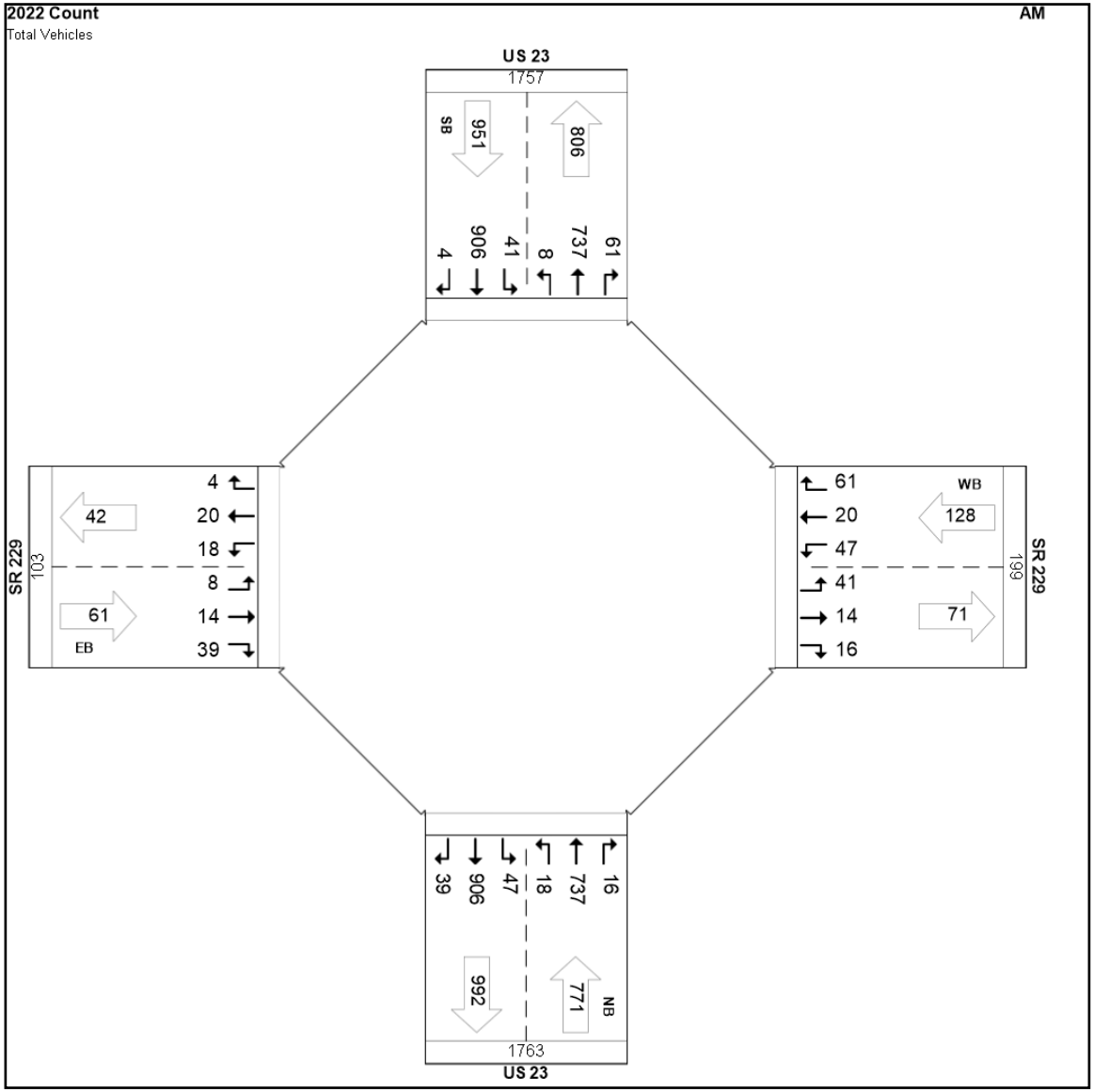


Design Year Trucks ADT



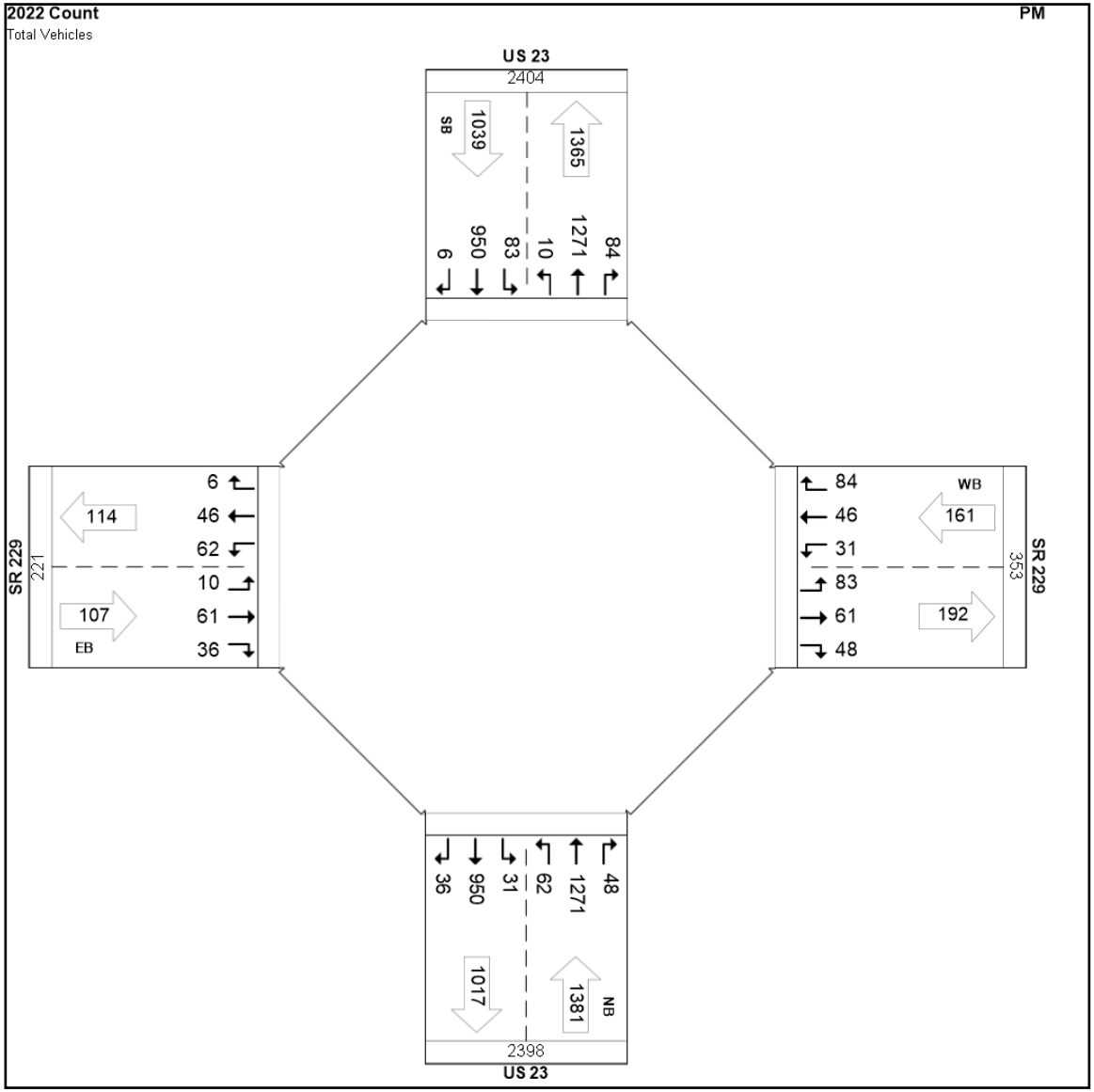
TFMS - Intersection Forecast Report

Pivot Point AM



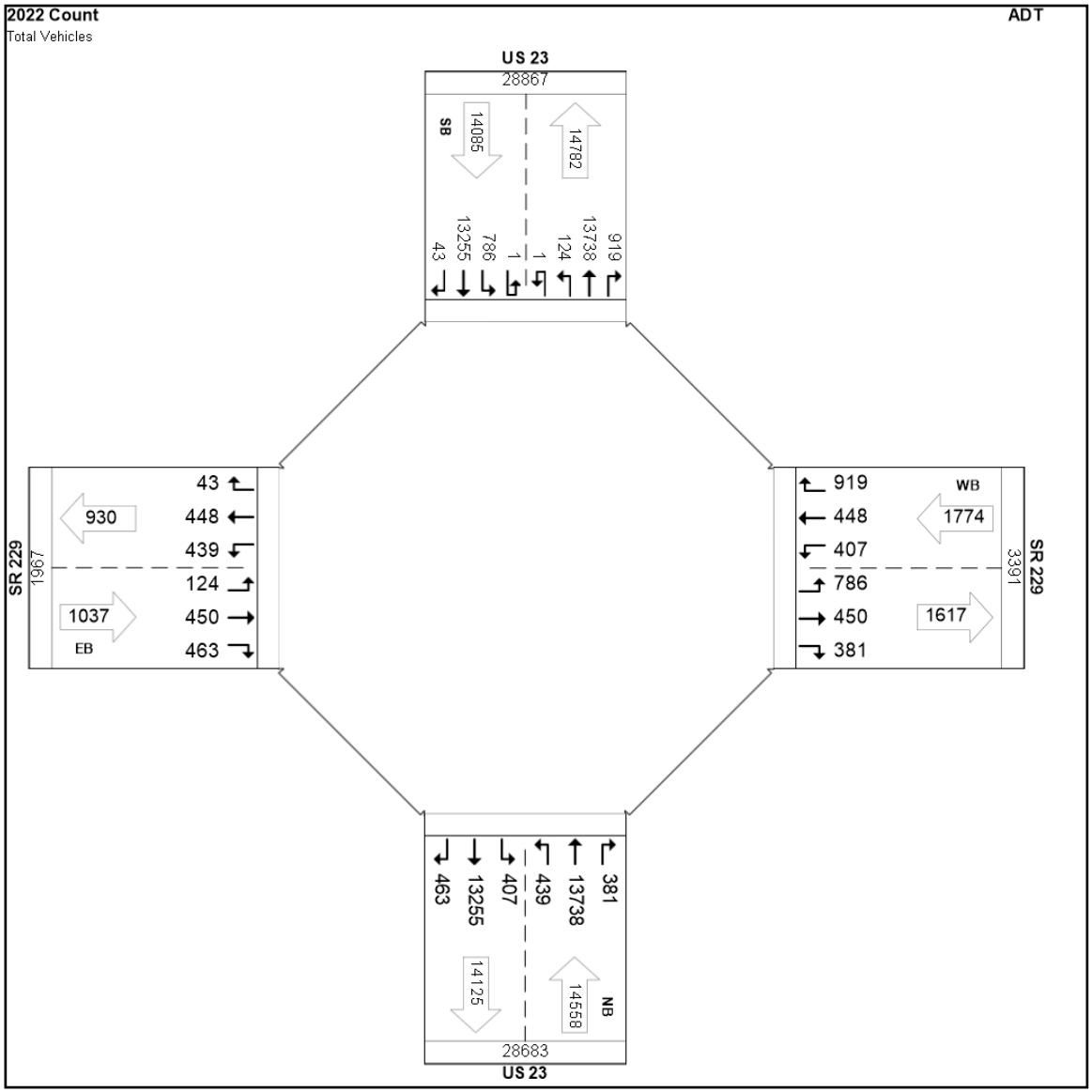
TFMS - Intersection Forecast Report

Pivot Point PM

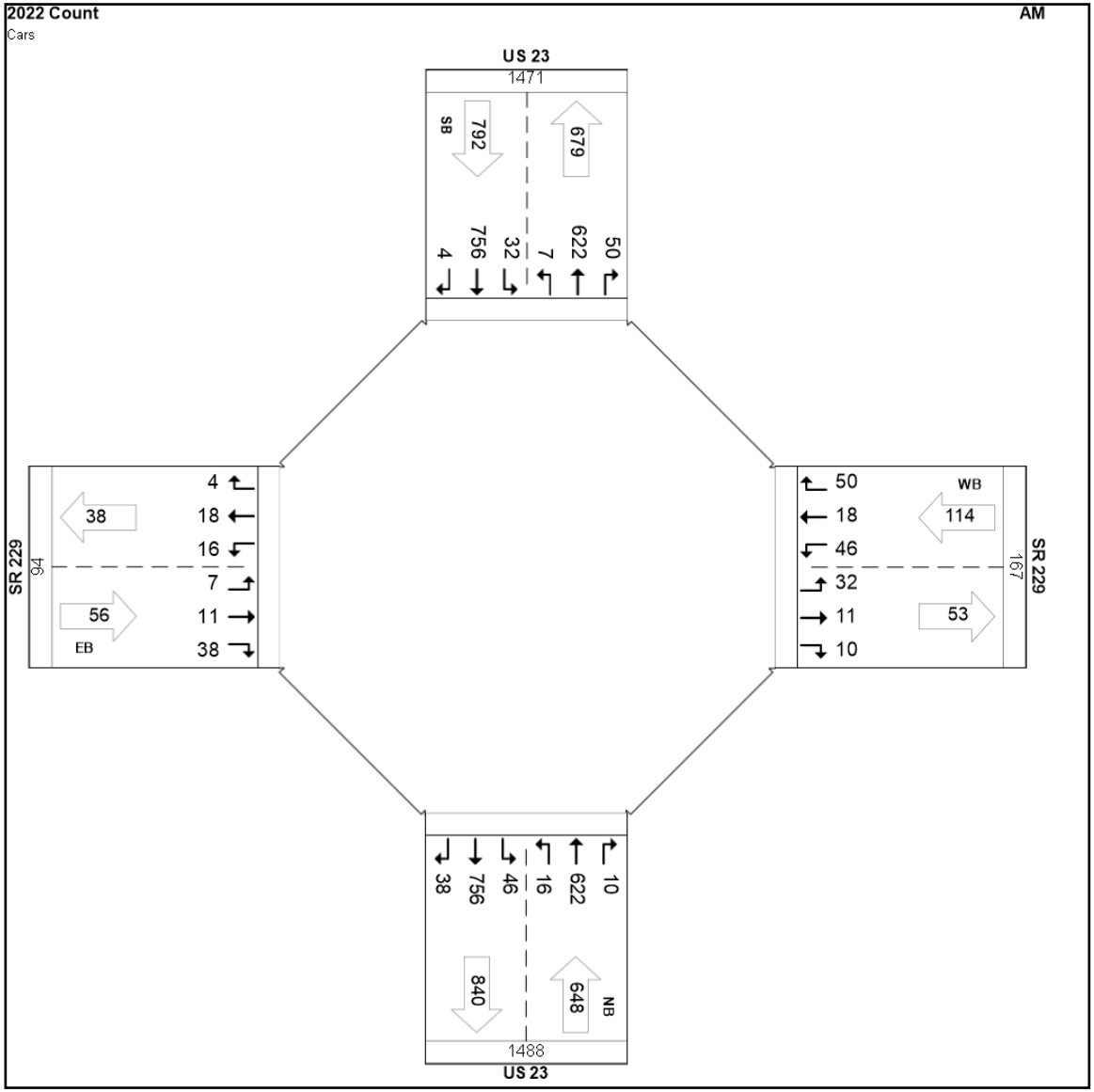


TFMS - Intersection Forecast Report

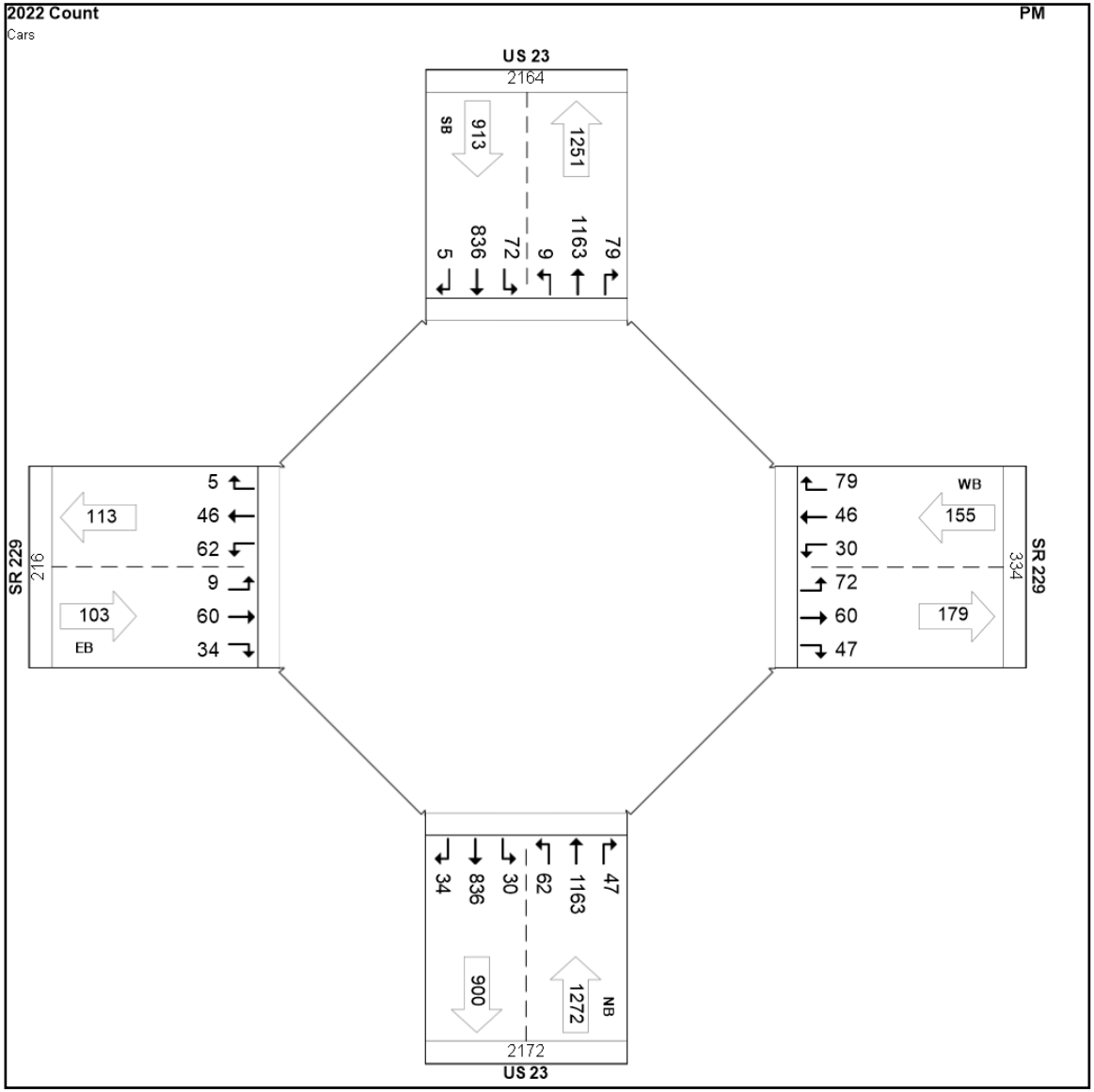
Pivot Point ADT



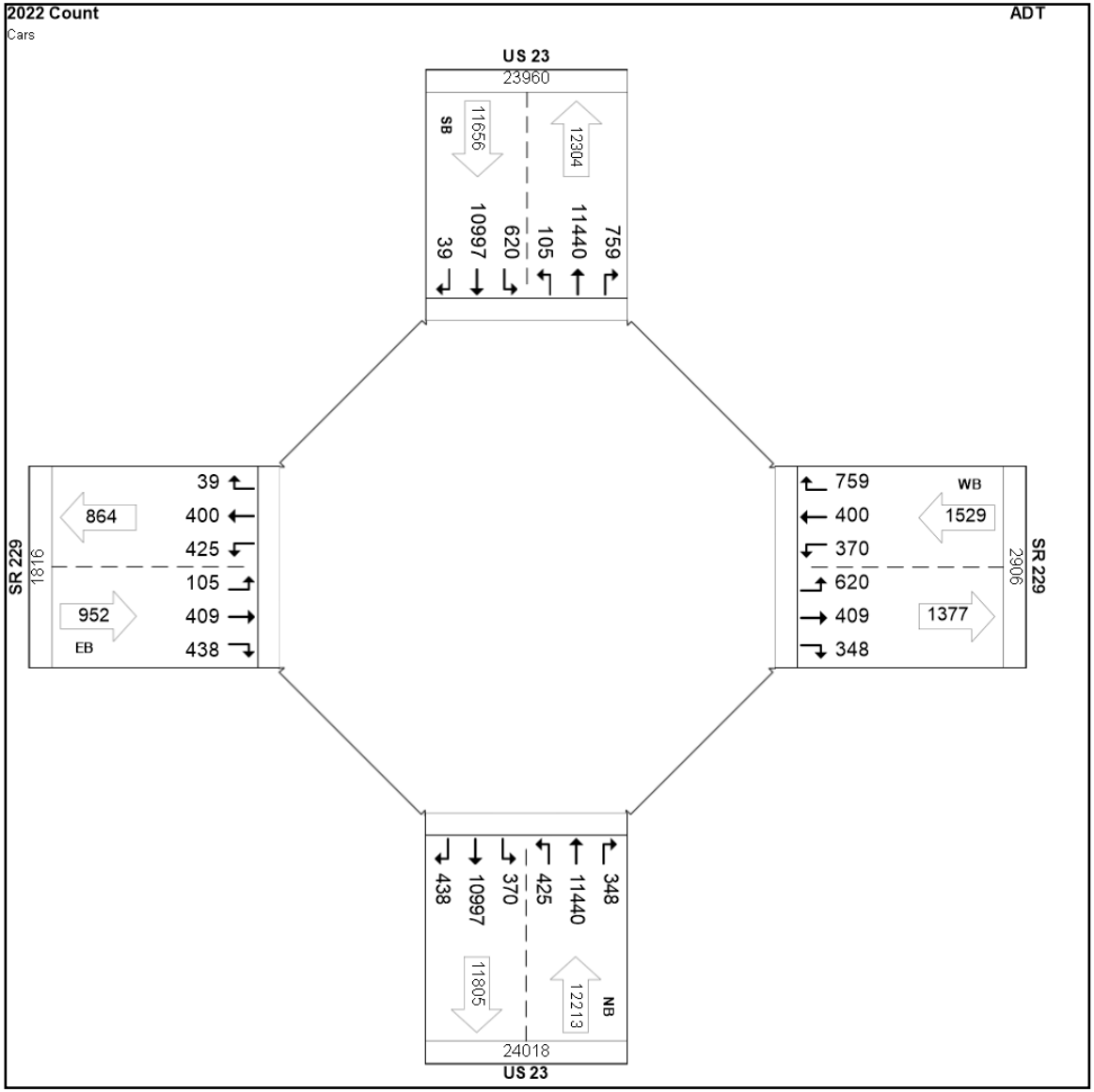
Pivot Point Cars AM



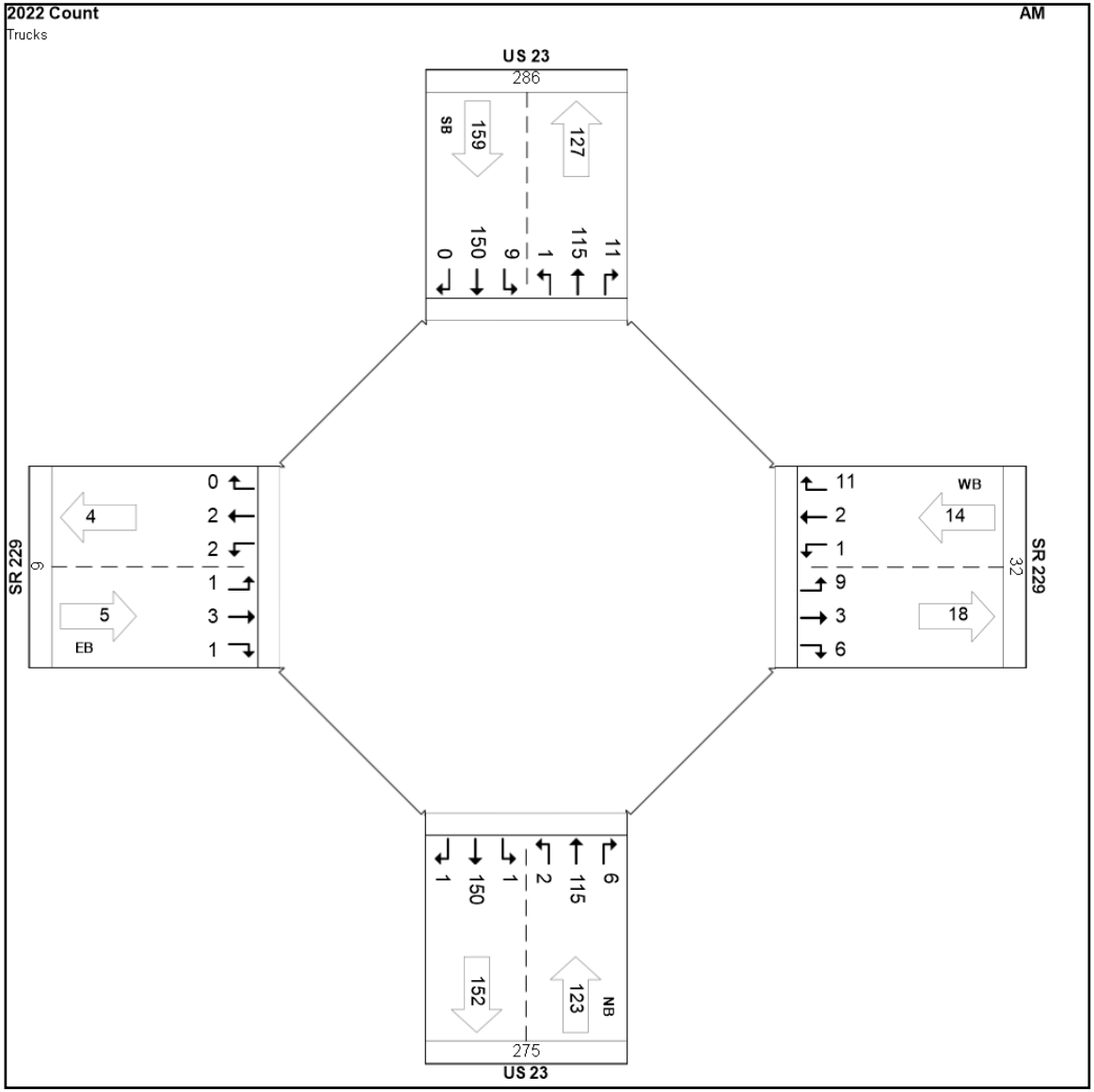
Pivot Point Cars PM



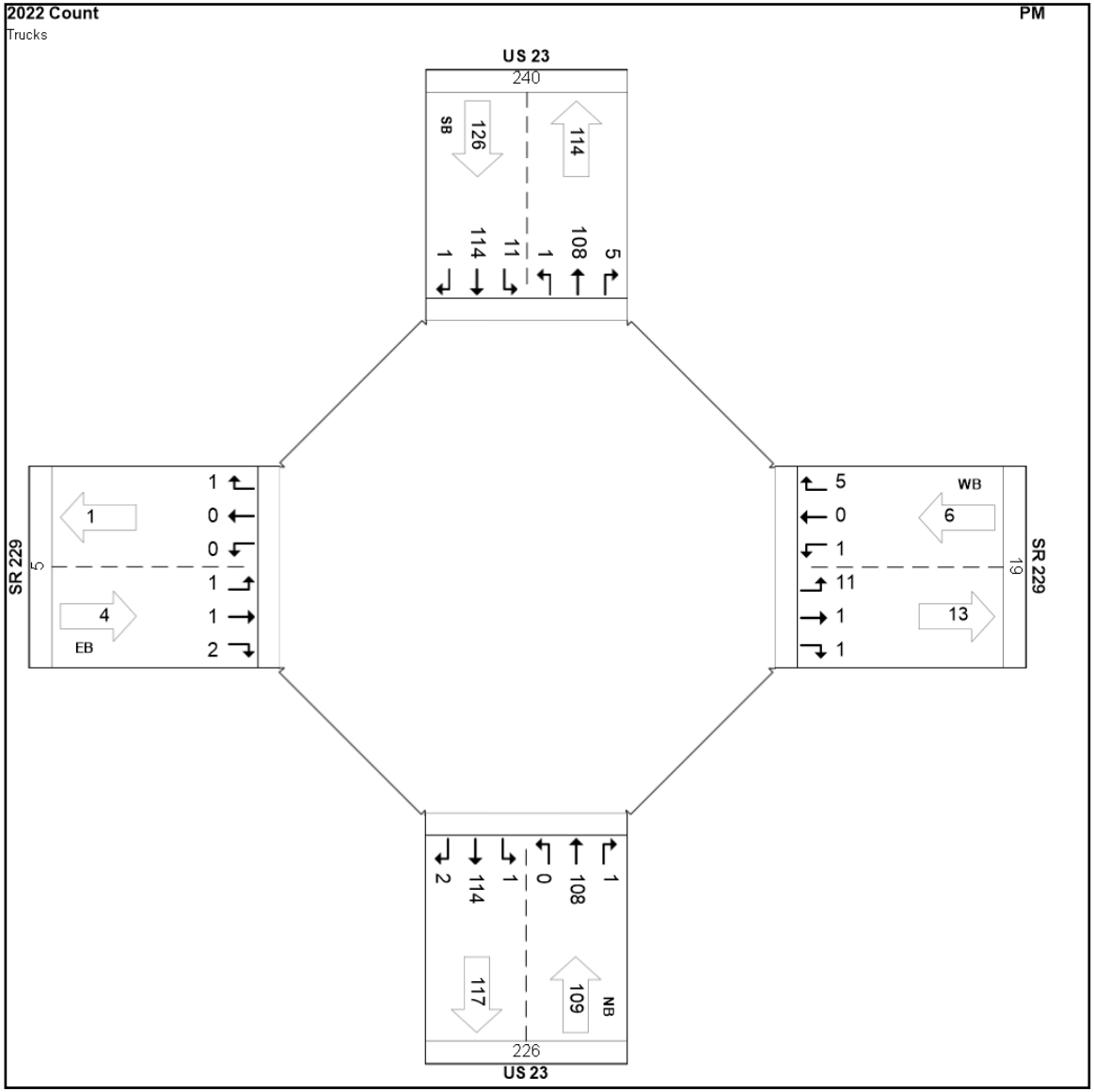
Pivot Point Cars ADT



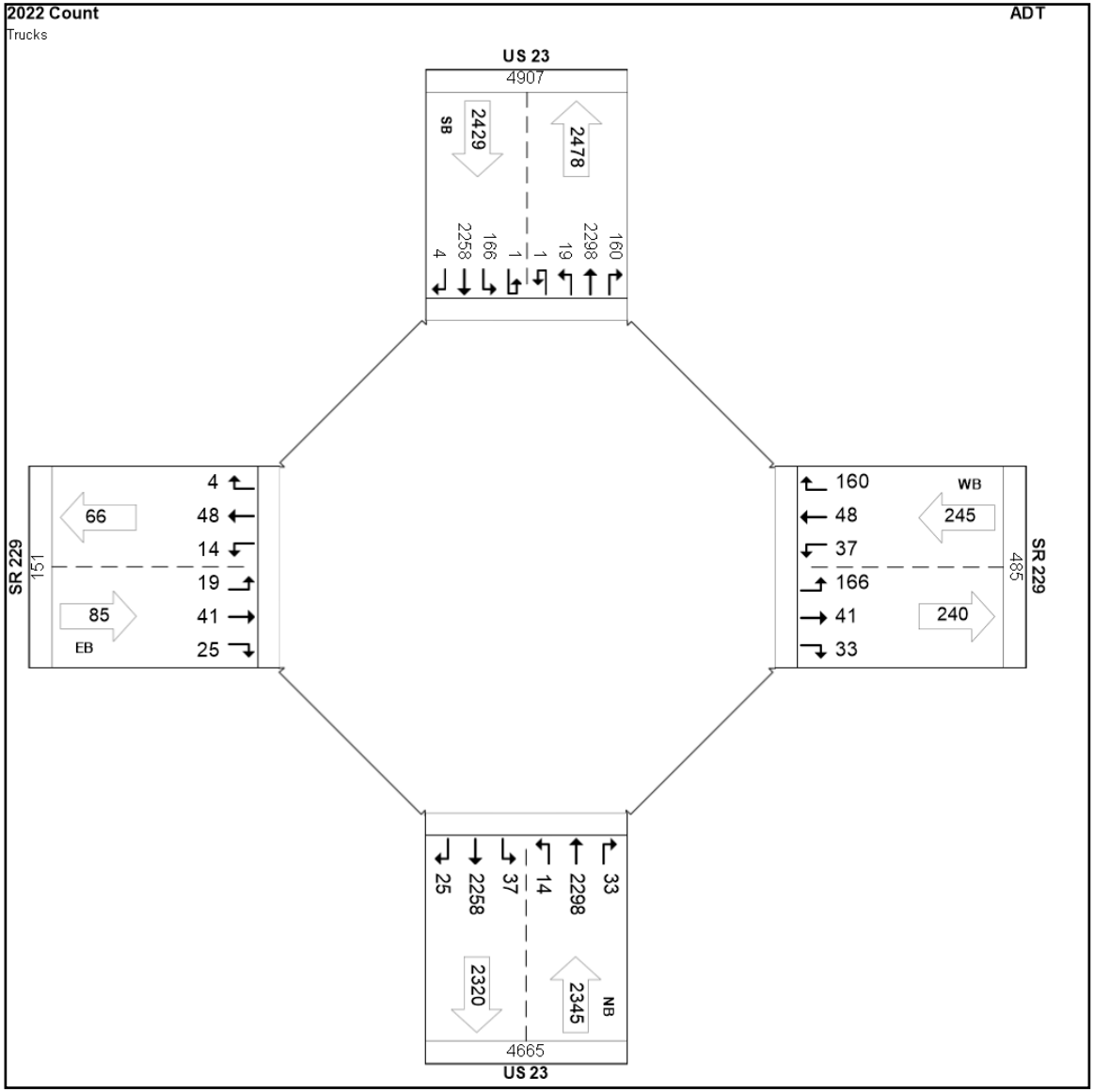
Pivot Point Trucks AM



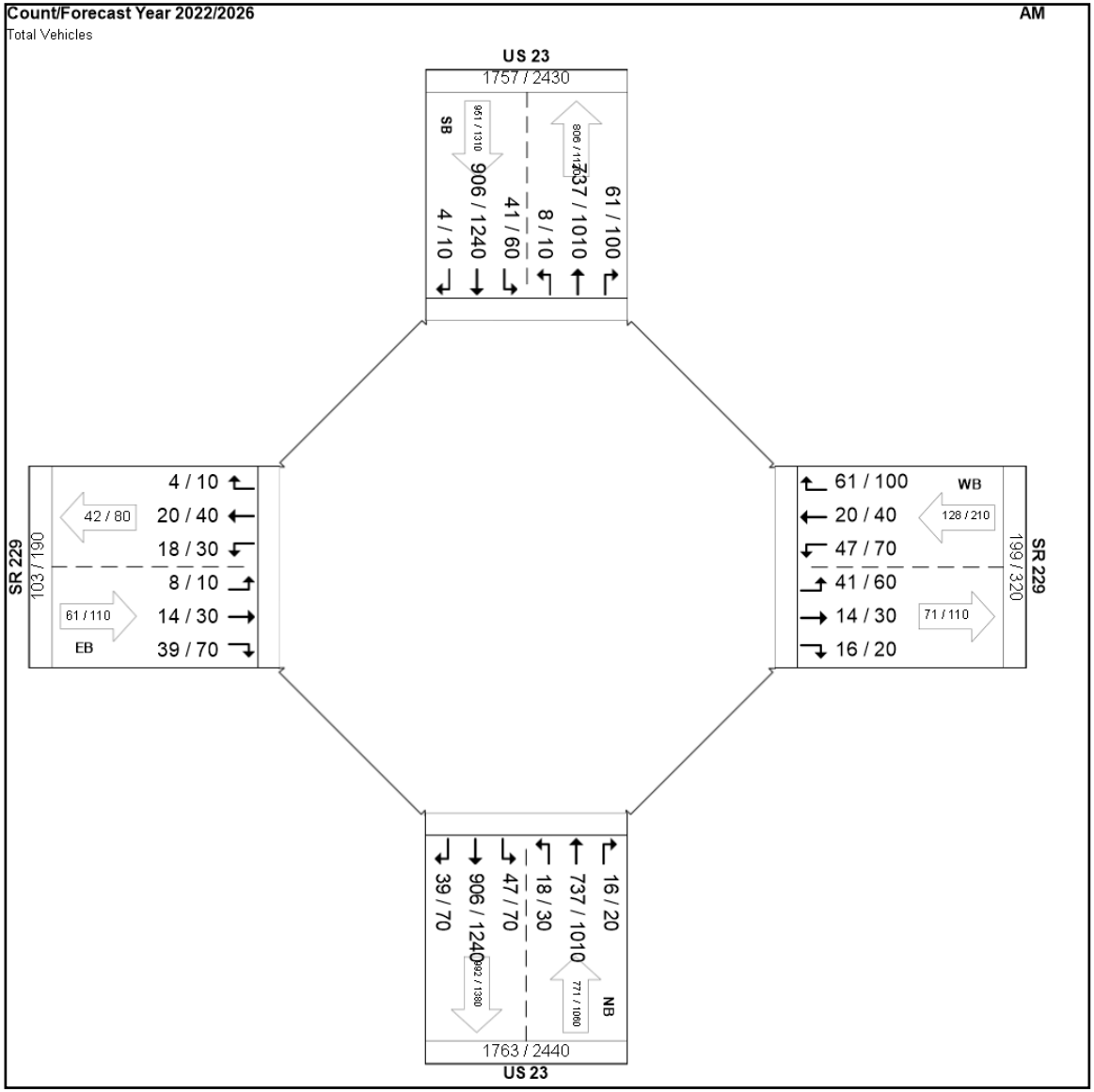
Pivot Point Trucks PM



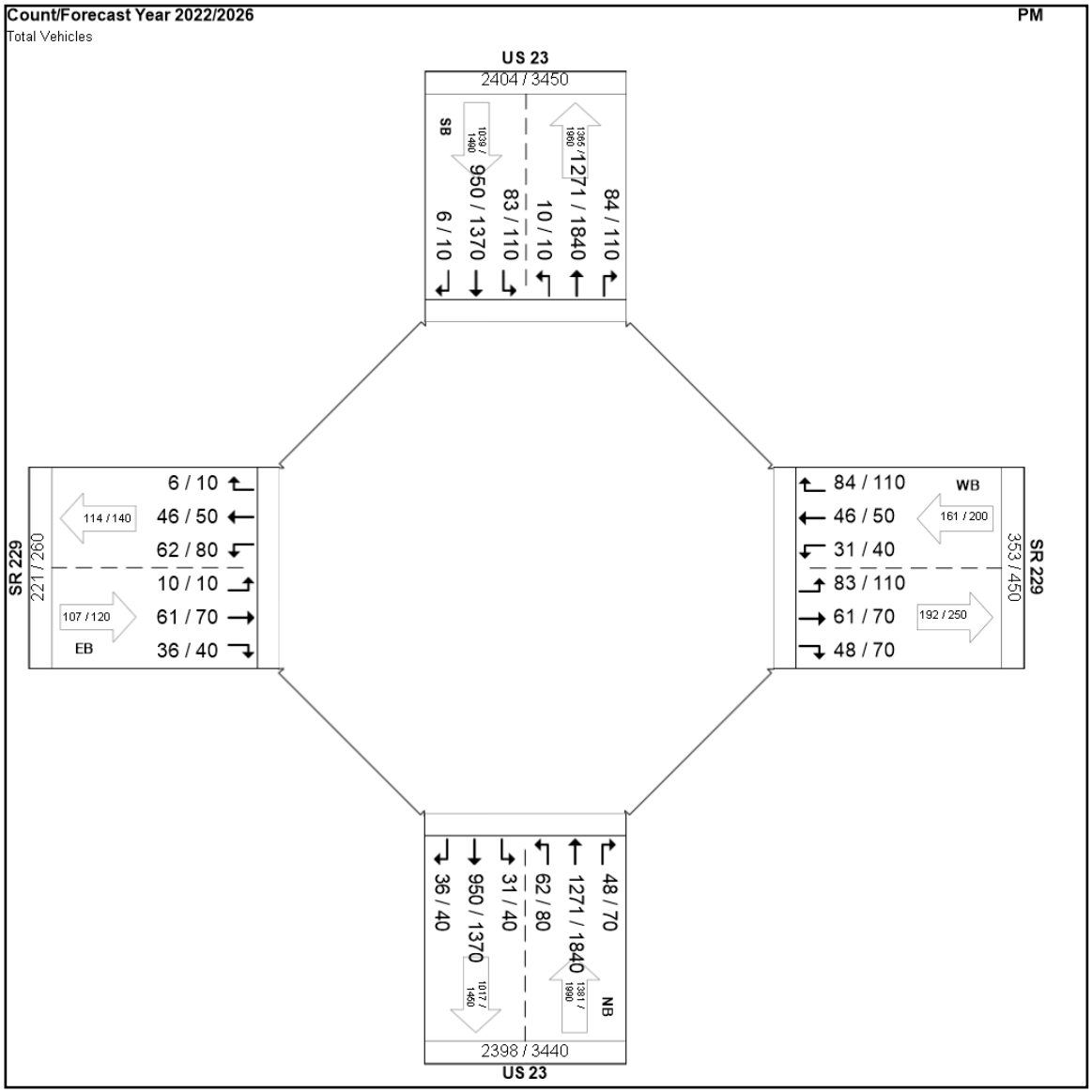
Pivot Point Trucks ADT



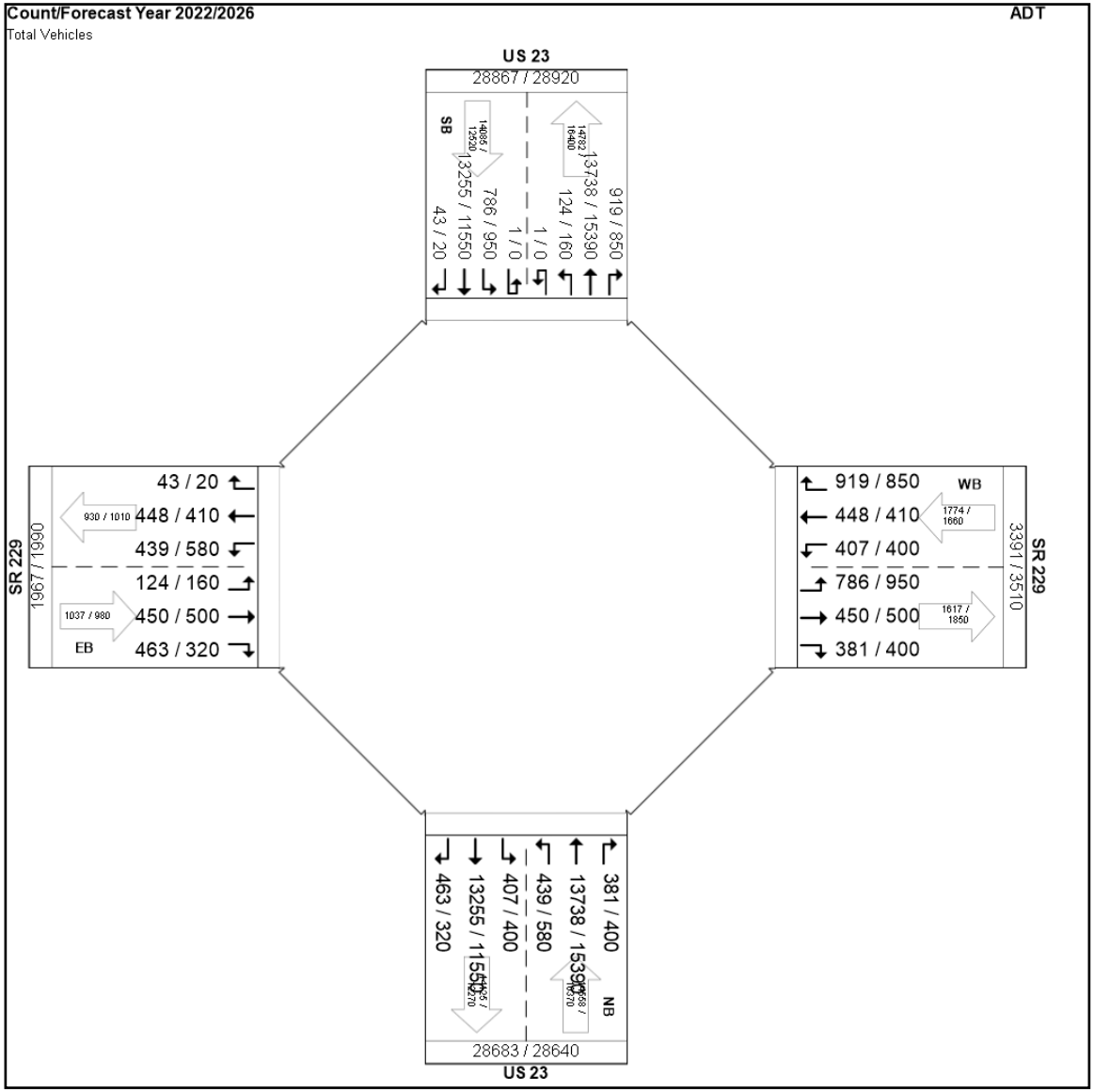
Count VS Opening Year AM



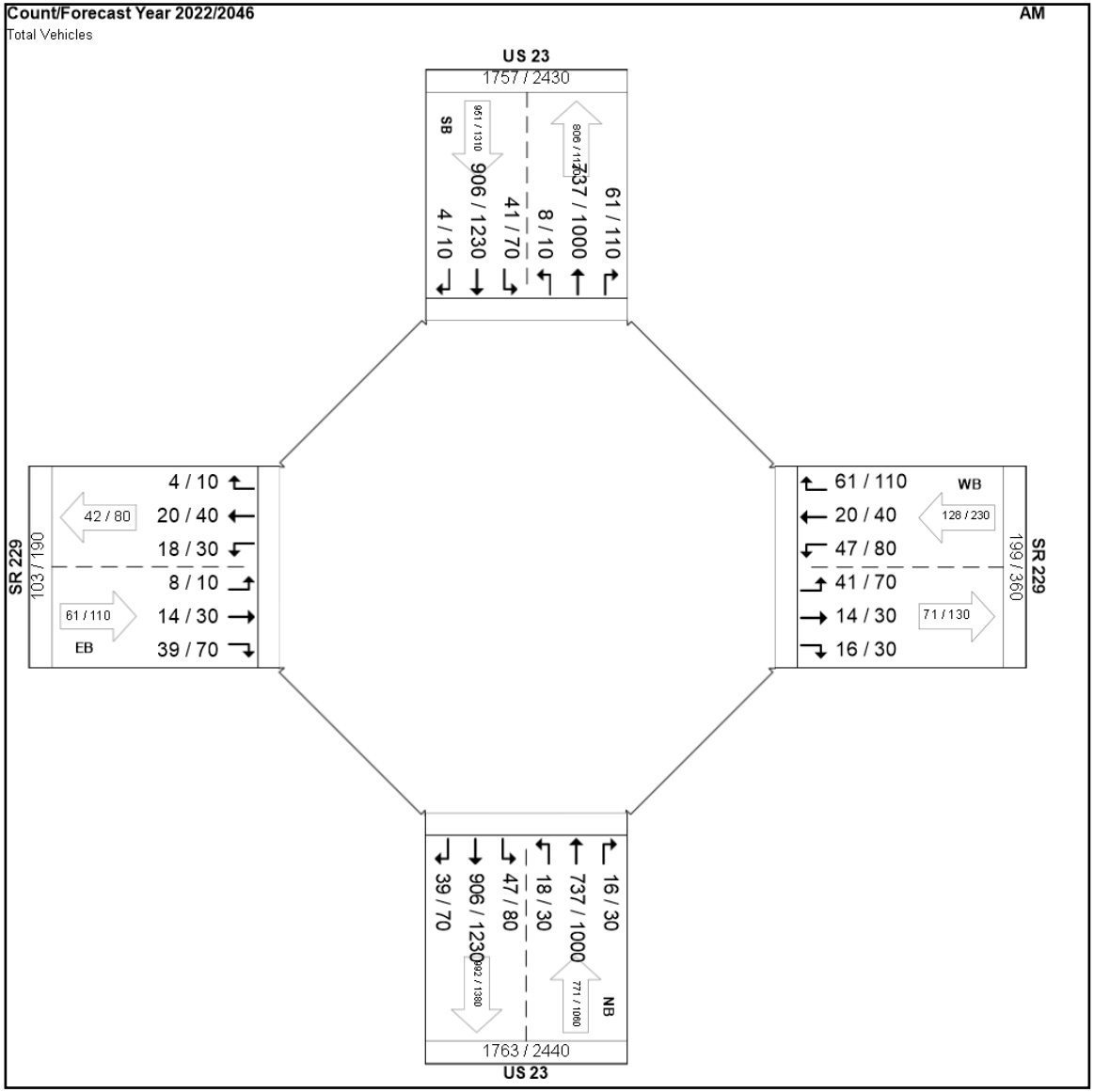
Count VS Opening Year PM



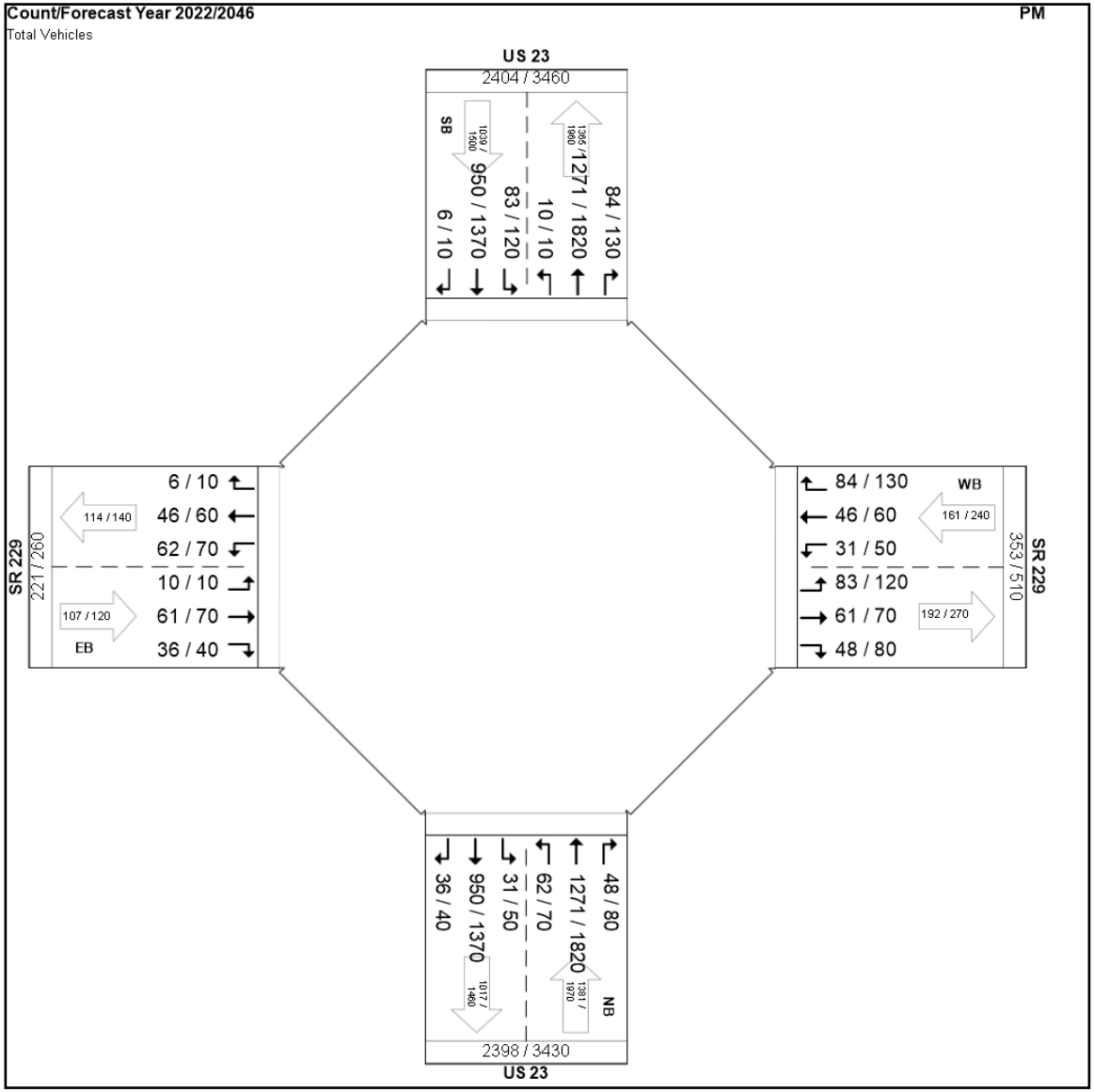
Count VS Opening Year ADT



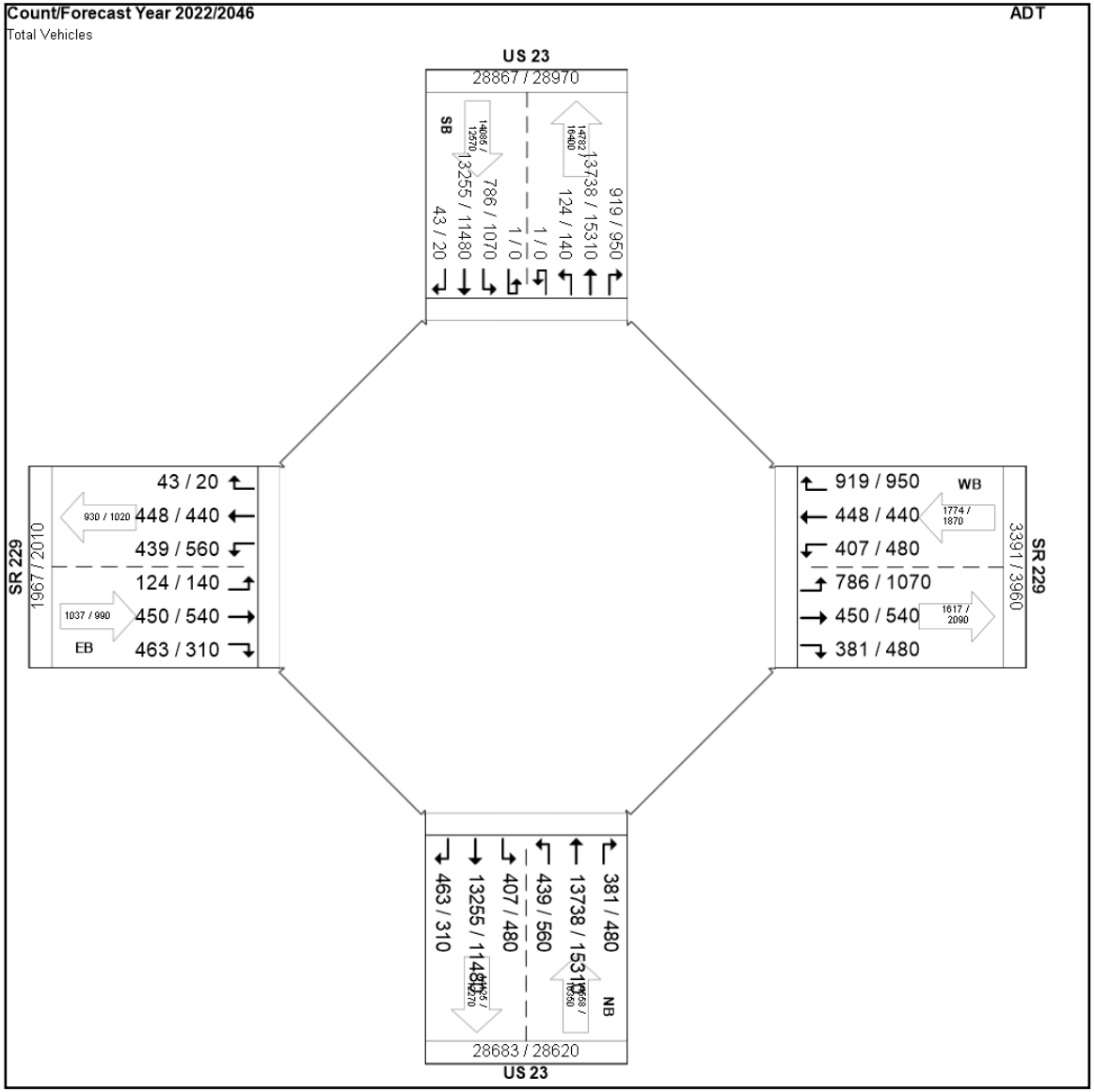
Count VS Design Year AM



Count VS Design Year PM



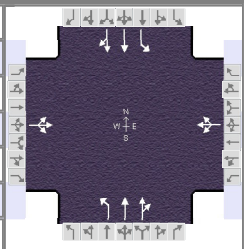
Count VS Design Year ADT



Appendix F: Traffic Operations HCS Output

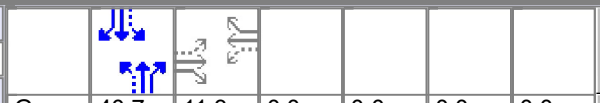
HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.250
Analyst		Analysis Date	Aug 19, 2022	Area Type	Other
Jurisdiction		Time Period	2026 AM	PHF	0.92
Urban Street	US 23	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	SR 229	File Name	2026 AM No Build.xus		
Project Description	2026 AM No Build				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	30	70	70	40	100	30	1010	20	60	1240	10

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4
Green	40.7	11.3	0.0	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	4.0	0.0	0.0	0.0	0.0				
Red	0.0	0.0	0.0	0.0	0.0	0.0				

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		8.0		8.0		6.0		6.0
Phase Duration, s		15.3		15.3		44.7		44.7
Change Period, ($Y+R_c$), s		4.0		4.0		4.0		4.0
Max Allow Headway (*MAH*), s		3.1		3.1		0.0		0.0
Queue Clearance Time (g_s), s		6.0		10.7				
Green Extension Time (g_e), s		0.6		0.6		0.0		0.0
Phase Call Probability		1.00		1.00				
Max Out Probability		0.00		0.00				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		120			228		33	562	558	65	680	679
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1591			1483		366	1707	1695	459	1707	1702
Queue Service Time (g_s), s		0.0			4.8		3.1	9.5	9.5	4.8	12.8	12.8
Cycle Queue Clearance Time (g_c), s		4.0			8.7		16.0	9.5	9.5	14.3	12.8	12.8
Green Ratio (*g/C*)		0.19			0.19		0.68	0.68	0.68	0.68	0.68	0.68
Capacity (*c*), veh/h		366			360		290	1158	1150	359	1158	1154
Volume-to-Capacity Ratio (*X*)		0.327			0.635		0.112	0.485	0.485	0.182	0.588	0.588
Back of Queue (*Q*), ft/ln (95 th percentile)												
Back of Queue (*Q*), veh/ln (95 th percentile)		2.2			4.7		0.4	2.6	2.6	0.7	3.6	3.6
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		21.4			23.2		9.4	4.6	4.6	8.1	5.2	5.2
Incremental Delay (d_2), s/veh		0.2			0.7		0.8	1.5	1.5	1.1	2.2	2.2
Initial Queue Delay (d_3), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		21.6			23.9		10.2	6.1	6.1	9.2	7.4	7.4
Level of Service (LOS)		C			C		B	A	A	A	A	A
Approach Delay, s/veh / LOS	21.6	C		23.9	C		6.2	A		7.4	A	
Intersection Delay, s/veh / LOS	8.8						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.28	B	2.28	B	1.62	B	1.62	B
Bicycle LOS Score / LOS	0.68	A	0.86	A	1.44	A	1.66	B

HCS Two-Way Stop-Control Report

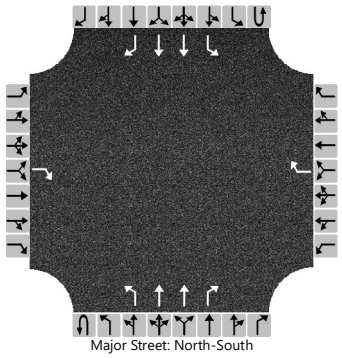
General Information

Analyst	
Agency/Co.	
Date Performed	7/15/2022
Analysis Year	2022
Time Analyzed	2026 AM
Intersection Orientation	North-South
Project Description	RCUT

Site Information

Intersection	US 23 & SR 229
Jurisdiction	
East/West Street	SR 229
North/South Street	US 23
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	1	0	1	2	1	0	1	2	1
Configuration				R				R		L	T	R		L	T	R
Volume (veh/h)				110				210	0	30	1020	50	0	60	1310	50
Percent Heavy Vehicles (%)				9				11	13	10			13	21		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)				6.9				6.9		4.1				4.1		
Critical Headway (sec)				7.08				7.12		4.30				4.52		
Base Follow-Up Headway (sec)				3.3				3.3		2.2				2.2		
Follow-Up Headway (sec)				3.39				3.41		2.30				2.41		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				120				228		33				65		
Capacity, c (veh/h)				359				453		414				499		
v/c Ratio				0.33				0.50		0.08				0.13		
95% Queue Length, Q_{95} (veh)				1.4				2.8		0.3				0.4		
Control Delay (s/veh)				19.9				20.7		14.4				13.3		
Level of Service (LOS)				C				C		B				B		
Approach Delay (s/veh)	19.9				20.7				0.4				0.6			
Approach LOS	C				C				A				A			

HCS Two-Way Stop-Control Report

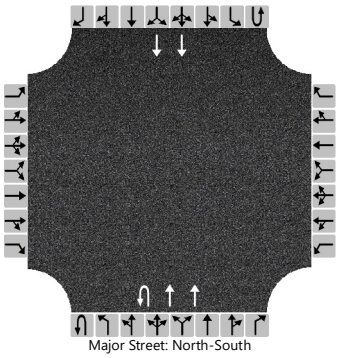
General Information

Analyst	
Agency/Co.	
Date Performed	5/25/2022
Analysis Year	2022
Time Analyzed	2026 AM
Intersection Orientation	North-South
Project Description	RCUT north intersection

Site Information

Intersection	US 23 & SR 229
Jurisdiction	
East/West Street	SR 229
North/South Street	US 23
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	1	0	2	0	0	0	2	0
Configuration									U		T				T	
Volume (veh/h)									110		1120				1310	
Percent Heavy Vehicles (%)									13							
Proportion Time Blocked																
Percent Grade (%)																
Right Turn Channelized																
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)									4.3							
Critical Headway (sec)									4.60							
Base Follow-Up Headway (sec)									2.6							
Follow-Up Headway (sec)									2.70							

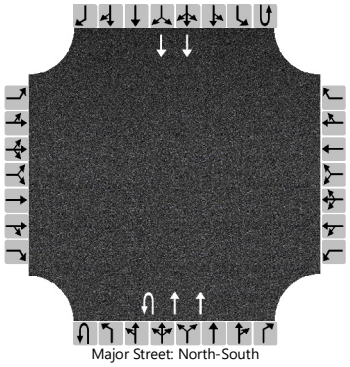
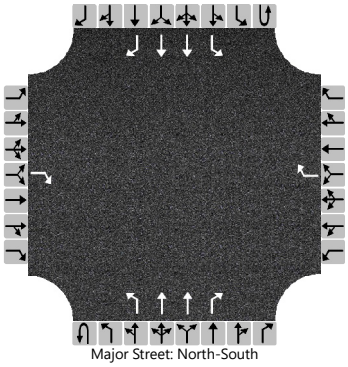
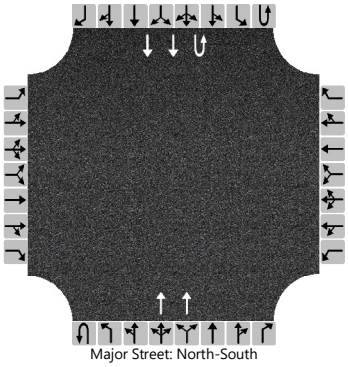
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)									120							
Capacity, c (veh/h)									352							
v/c Ratio									0.34							
95% Queue Length, Q_{95} (veh)									1.5							
Control Delay (s/veh)									20.4							
Level of Service (LOS)									C							
Approach Delay (s/veh)									1.8							
Approach LOS									A							

HCS Alternative Intersections Results Summary

General Information				Alternative Intersection Information	
Agency				Intersection Type	RCUT with TWSC
Analyst		Analysis Date	7/15/2022	Segment One Distance, ft	800
Jurisdiction		Duration, h	0.25	Segment Two Distance, ft	800
Intersection	US 23 & SR 229	PHF	0.92	Arterial Direction	North-South
Main Intersection File	2026 AM RCUT.xtw				
North Crossover File	2026 AM RCUT north.xtw				
South Crossover File	2026 AM RCUT south.xtw				
Project Description	RCUT				

Demand	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h									110		1120				1310	
Intersection Two Demand (*v*), veh/h				110				210	0	30	1020	50	0	60	1310	50
Intersection Three Demand (*v*), veh/h											1060		40		1380	

(1) North Crossover	(2) Main Intersection	(3) South Crossover
		
Major Street: North-South	Major Street: North-South	Major Street: North-South

Queue-to-Storage Ratio	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Intersection One (R_Q)									0.12							
Intersection Two (R_Q)				0.11				0.22		0.02				0.04		
Intersection Three (R_Q)													0.03			

Alternative Intesection Results

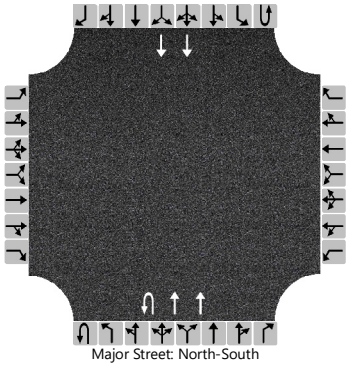
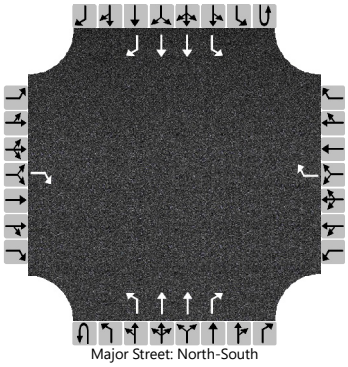
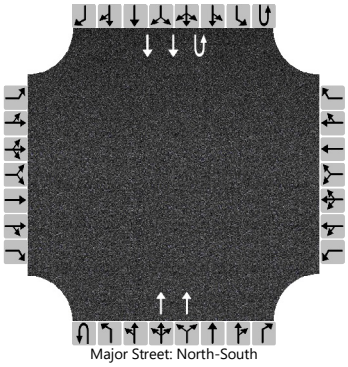
O-D	O-D Movements	Flow Rate (veh/h)	Control Delay (s/veh)	EDTT (s/veh)	ETT (s/veh)	v/c>1?	R_Q>1?	LOS
EBL	EBR(2) + SBU(3) + NBT(2)	11	33.6	18.1	51.7	No	No	D
EBT	EBR(2) + SBU(3) + NBR(2)	33	33.6	18.1	51.7	No	No	D
EBR	EBR(2)	76	19.9	--	19.9	No	No	B
WBL	WBR(2) + NBU(1) + SBT(2)	76	41.1	18.1	59.2	No	No	E
WBT	WBR(2) + NBU(1) + SBR(2)	43	41.1	18.1	59.2	No	No	E
WBR	WBR(2)	109	20.7	--	20.7	No	No	C
NBL	NBL(2)	33	14.4	--	14.4	No	No	B
NBT	NBT(2)	1098	0.0	--	0.0	--	--	A
NBR	NBR(2)	22	0.0	--	0.0	--	--	A
SBL	SBL(2)	65	13.3	--	13.3	No	No	B
SBT	SBT(2)	1348	0.0	--	0.0	--	--	A
SBR	SBR(2)	11	0.0	--	0.0	--	--	A

Overall Results	EB		WB		NB		SB	
Approach ETT, s/veh | LOS	31.6	C	40.8	D	0.4	A	0.6	A
Intersection ETT, s/veh | LOS	4.9				A			

HCS Alternative Intersections Results Summary

General Information				Alternative Intersection Information	
Agency				Intersection Type	RCUT with TWSC
Analyst		Analysis Date	7/15/2022	Segment One Distance, ft	800
Jurisdiction		Duration, h	0.25	Segment Two Distance, ft	800
Intersection	US 23 & SR 229	PHF	0.92	Arterial Direction	North-South
Main Intersection File	2026 AM RCUT.xtw				
North Crossover File	2026 AM RCUT north.xtw				
South Crossover File	2026 AM RCUT south.xtw				
Project Description	RCUT				

Demand	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h									110		1120				1310	
Intersection Two Demand (*v*), veh/h				110				210	0	30	1020	50	0	60	1310	50
Intersection Three Demand (*v*), veh/h											1060		40		1380	

(1) North Crossover	(2) Main Intersection	(3) South Crossover
		
Major Street: North-South	Major Street: North-South	Major Street: North-South

Queue-to-Storage Ratio	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Intersection One (R_Q)									0.12							
Intersection Two (R_Q)				0.11				0.22		0.02				0.04		
Intersection Three (R_Q)													0.03			

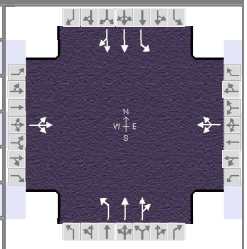
Alternative Intesection Results

O-D	O-D Movements	Flow Rate (veh/h)	Control Delay (s/veh)	EDTT (s/veh)	ETT (s/veh)	v/c>1?	R_Q>1?	LOS
EBL	EBR(2) + SBU(3) + NBT(2)	11	33.6	18.1	51.7	No	No	D
EBT	EBR(2) + SBU(3) + NBR(2)	33	33.6	18.1	51.7	No	No	D
EBR	EBR(2)	76	19.9	--	19.9	No	No	B
WBL	WBR(2) + NBU(1) + SBT(2)	76	41.1	18.1	59.2	No	No	E
WBT	WBR(2) + NBU(1) + SBR(2)	43	41.1	18.1	59.2	No	No	E
WBR	WBR(2)	109	20.7	--	20.7	No	No	C
NBL	NBL(2)	33	14.4	--	14.4	No	No	B
NBT	NBT(2)	1098	0.0	--	0.0	--	--	A
NBR	NBR(2)	22	0.0	--	0.0	--	--	A
SBL	SBL(2)	65	13.3	--	13.3	No	No	B
SBT	SBT(2)	1348	0.0	--	0.0	--	--	A
SBR	SBR(2)	11	0.0	--	0.0	--	--	A

Overall Results	EB		WB		NB		SB	
Approach ETT, s/veh | LOS	31.6	C	40.8	D	0.4	A	0.6	A
Intersection ETT, s/veh | LOS	4.9				A			

HCS Signalized Intersection Results Summary

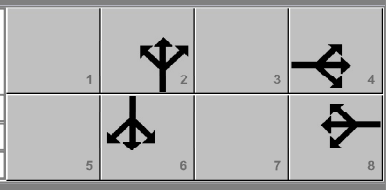
General Information				Intersection Information	
Agency				Duration, h	0.250
Analyst		Analysis Date	Aug 19, 2022	Area Type	Other
Jurisdiction		Time Period	2026 PM	PHF	0.92
Urban Street	US 23	Analysis Year	2022	Analysis Period	1> 16:30
Intersection	SR 229	File Name	2026 PM No Build.xus		
Project Description	2026 PM No Build				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	70	40	40	50	110	80	1840	70	110	1370	10

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	41.4	10.6	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	0.0	0.0	0.0	0.0	0.0	0.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		8.0		8.0		6.0		6.0
Phase Duration, s		14.6		14.6		45.4		45.4
Change Period, (*Y+R c*), s		4.0		4.0		4.0		4.0
Max Allow Headway (*MAH*), s		3.0		3.0		0.0		0.0
Queue Clearance Time (*g s*), s		6.2		10.1				
Green Extension Time (*g e*), s		0.6		0.6		0.0		0.0
Phase Call Probability		1.00		1.00				
Max Out Probability		0.00		0.00				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		130			217		87	1038	1038	120	751	749
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1655			1531		319	1707	1685	182	1707	1703
Queue Service Time (*g s*), s		0.0			3.9		12.5	28.9	29.9	11.5	14.6	14.6
Cycle Queue Clearance Time (*g c*), s		4.2			8.1		27.1	28.9	29.9	41.4	14.6	14.6
Green Ratio (*g/C*)		0.18			0.18		0.69	0.69	0.69	0.69	0.69	0.69
Capacity (*c*), veh/h		358			343		262	1177	1162	155	1177	1174
Volume-to-Capacity Ratio (*X*)		0.364			0.633		0.332	0.882	0.893	0.772	0.638	0.638
Back of Queue (*Q*), ft/ln (95 th percentile)												
Back of Queue (*Q*), veh/ln (95 th percentile)		2.5			4.5		1.5	9.6	10.1	5.0	3.8	3.9
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (*d 1*), s/veh		22.0			23.6		12.7	7.4	7.5	28.3	5.2	5.2
Incremental Delay (*d 2*), s/veh		0.2			0.7		3.4	9.7	10.6	30.4	2.6	2.7
Initial Queue Delay (*d 3*), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		22.3			24.3		16.1	17.0	18.2	58.7	7.8	7.8
Level of Service (LOS)		C			C		B	B	B	E	A	A
Approach Delay, s/veh / LOS	22.3	C		24.3	C		17.5	B		11.6	B	
Intersection Delay, s/veh / LOS	15.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.28	B	2.28	B	1.61	B	1.61	B
Bicycle LOS Score / LOS	0.70	A	0.85	A	2.27	B	1.82	B

HCS Two-Way Stop-Control Report

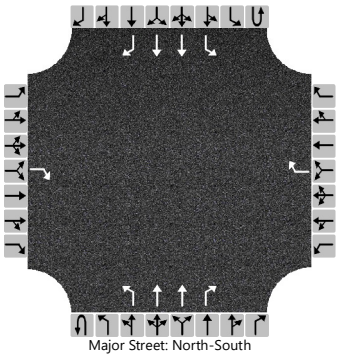
General Information

Analyst	
Agency/Co.	
Date Performed	7/15/2022
Analysis Year	2022
Time Analyzed	2026 PM
Intersection Orientation	North-South
Project Description	RCUT

Site Information

Intersection	US 23 & SR 229
Jurisdiction	
East/West Street	SR 229
North/South Street	US 23
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	1	0	1	2	1	0	1	2	1
Configuration				R				R		L	T	R		L	T	R
Volume (veh/h)				120				200	0	80	1850	140	0	110	1410	60
Percent Heavy Vehicles (%)				4				5	13	10			13	10		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)				6.9				6.9		4.1				4.1		
Critical Headway (sec)				6.98				7.00		4.30				4.30		
Base Follow-Up Headway (sec)				3.3				3.3		2.2				2.2		
Follow-Up Headway (sec)				3.34				3.35		2.30				2.30		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				130				217		87				120		
Capacity, c (veh/h)				341				234		370				218		
v/c Ratio				0.38				0.93		0.23				0.55		
95% Queue Length, Q_{95} (veh)				1.7				8.0		0.9				2.9		
Control Delay (s/veh)				22.0				85.9		17.7				39.9		
Level of Service (LOS)				C				F		C				E		
Approach Delay (s/veh)	22.0				85.9				0.7				2.8			
Approach LOS	C				F				A				A			

HCS Two-Way Stop-Control Report

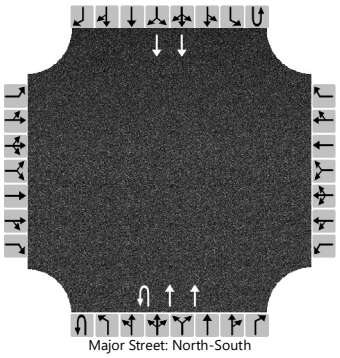
General Information

Analyst	
Agency/Co.	
Date Performed	5/25/2022
Analysis Year	2022
Time Analyzed	2026 PM
Intersection Orientation	North-South
Project Description	RCUT north intersection

Site Information

Intersection	US 23 & SR 229
Jurisdiction	
East/West Street	SR 229
North/South Street	US 23
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	1	0	2	0	0	0	2	0
Configuration									U		T				T	
Volume (veh/h)									90		1960				1490	
Percent Heavy Vehicles (%)									13							
Proportion Time Blocked																
Percent Grade (%)																
Right Turn Channelized																
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)									4.3							
Critical Headway (sec)									4.60							
Base Follow-Up Headway (sec)									2.6							
Follow-Up Headway (sec)									2.70							

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)									98							
Capacity, c (veh/h)									291							
v/c Ratio									0.34							
95% Queue Length, Q_{95} (veh)									1.4							
Control Delay (s/veh)									23.5							
Level of Service (LOS)									C							
Approach Delay (s/veh)									1.0							
Approach LOS									A							

HCS Two-Way Stop-Control Report

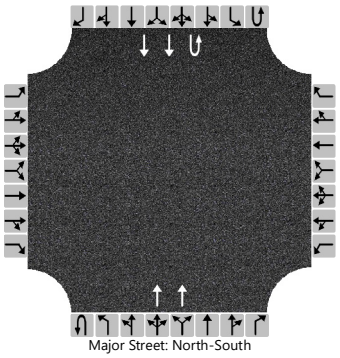
General Information

Analyst	
Agency/Co.	
Date Performed	7/15/2022
Analysis Year	2022
Time Analyzed	2026 PM
Intersection Orientation	North-South
Project Description	RCUT south intersection

Site Information

Intersection	US 23 & SR 229
Jurisdiction	
East/West Street	SR 229
North/South Street	US 23
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	2	0	1	0	2	0
Configuration											T		U		T	
Volume (veh/h)											1990		80		1450	
Percent Heavy Vehicles (%)													13			
Proportion Time Blocked																
Percent Grade (%)																
Right Turn Channelized																
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)													4.3			
Critical Headway (sec)													4.60			
Base Follow-Up Headway (sec)													2.6			
Follow-Up Headway (sec)													2.70			

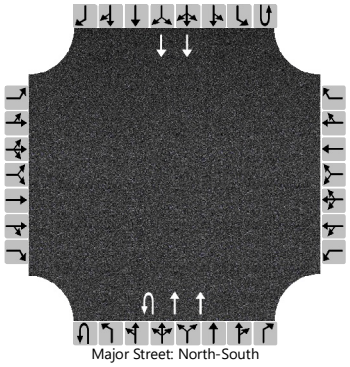
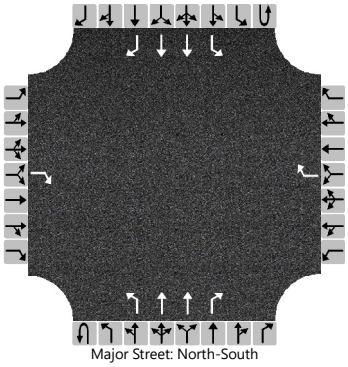
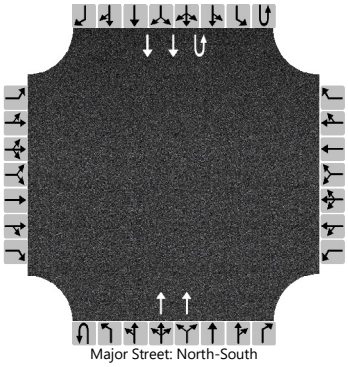
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)													87			
Capacity, c (veh/h)													170			
v/c Ratio													0.51			
95% Queue Length, Q_{95} (veh)													2.5			
Control Delay (s/veh)													46.5			
Level of Service (LOS)													E			
Approach Delay (s/veh)													2.4			
Approach LOS													A			

HCS Alternative Intersections Results Summary

General Information				Alternative Intersection Information	
Agency				Intersection Type	RCUT with TWSC
Analyst		Analysis Date	7/15/2022	Segment One Distance, ft	800
Jurisdiction		Duration, h	0.25	Segment Two Distance, ft	800
Intersection	US 23 & SR 229	PHF	0.92	Arterial Direction	North-South
Main Intersection File	2026 PM RCUT.xtw				
North Crossover File	2026 PM RCUT north.xtw				
South Crossover File	2026 PM RCUT south.xtw				
Project Description	RCUT				

Demand	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h									90		1960				1490	
Intersection Two Demand (*v*), veh/h				120				200	0	80	1850	140	0	110	1410	60
Intersection Three Demand (*v*), veh/h											1990		80		1450	

(1) North Crossover	(2) Main Intersection	(3) South Crossover
		
Major Street: North-South	Major Street: North-South	Major Street: North-South

Queue-to-Storage Ratio	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR
Intersection One (R_Q)																
Intersection Two (R_Q)																
Intersection Three (R_Q)																

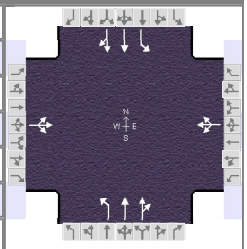
Alternative Intesection Results

O-D	O-D Movements	Flow Rate (veh/h)	Control Delay (s/veh)	EDTT (s/veh)	ETT (s/veh)	v/c>1?	R_Q>1?	LOS
EBL	EBR(2) + SBU(3) + NBT(2)	11	68.5	18.1	86.6	No	No	F
EBT	EBR(2) + SBU(3) + NBR(2)	76	68.5	18.1	86.6	No	No	F
EBR	EBR(2)	43	22.0	--	22.0	No	No	C
WBL	WBR(2) + NBU(1) + SBT(2)	43	109.5	18.1	127.6	No	No	F
WBT	WBR(2) + NBU(1) + SBR(2)	54	109.5	18.1	127.6	No	No	F
WBR	WBR(2)	120	85.9	--	85.9	No	No	F
NBL	NBL(2)	87	17.7	--	17.7	No	No	B
NBT	NBT(2)	2000	0.0	--	0.0	--	--	A
NBR	NBR(2)	76	0.0	--	0.0	--	--	A
SBL	SBL(2)	120	39.9	--	39.9	No	No	D
SBT	SBT(2)	1489	0.0	--	0.0	--	--	A
SBR	SBR(2)	11	0.0	--	0.0	--	--	A

Overall Results	EB		WB		NB		SB	
Approach ETT, s/veh | LOS	65.2	E	104.5	F	0.7	A	3.0	A
Intersection ETT, s/veh | LOS	9.1				A			

HCS Signalized Intersection Results Summary

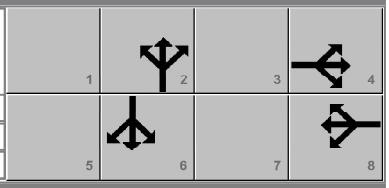
General Information				Intersection Information	
Agency				Duration, h	0.250
Analyst		Analysis Date	Aug 19, 2022	Area Type	Other
Jurisdiction		Time Period	2026 AM	PHF	0.92
Urban Street	US 23	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	SR 229	File Name	2046 AM No Build.xus		
Project Description	2046 AM No Build				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	30	70	80	40	110	30	1000	30	70	1230	10

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	39.7	12.3	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	0.0	0.0	0.0	0.0	0.0	0.0	



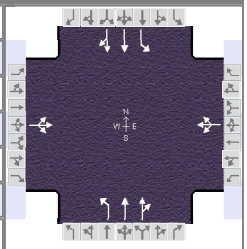
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		8.0		8.0		6.0		6.0
Phase Duration, s		16.3		16.3		43.7		43.7
Change Period, (*Y+R c*), s		4.0		4.0		4.0		4.0
Max Allow Headway (*MAH*), s		3.1		3.1		0.0		0.0
Queue Clearance Time (*g s*), s		5.9		11.7				
Green Extension Time (*g e*), s		0.7		0.6		0.0		0.0
Phase Call Probability		1.00		1.00				
Max Out Probability		0.00		0.00				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		120			250		33	563	557	76	675	673
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1591			1471		370	1707	1690	459	1707	1702
Queue Service Time (*g s*), s		0.0			5.8		3.2	10.0	10.0	6.0	13.3	13.3
Cycle Queue Clearance Time (*g c*), s		3.9			9.7		16.5	10.0	10.0	16.0	13.3	13.3
Green Ratio (*g/C*)		0.20			0.20		0.66	0.66	0.66	0.66	0.66	0.66
Capacity (*c*), veh/h		391			382		283	1130	1118	348	1130	1127
Volume-to-Capacity Ratio (*X*)		0.306			0.654		0.115	0.498	0.498	0.219	0.597	0.597
Back of Queue (*Q*), ft/ln (95 th percentile)												
Back of Queue (*Q*), veh/ln (95 th percentile)		2.2			5.1		0.4	3.0	3.0	0.9	4.2	4.1
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (*d 1*), s/veh		20.5			22.7		10.3	5.1	5.1	9.2	5.7	5.7
Incremental Delay (*d 2*), s/veh		0.2			0.7		0.8	1.6	1.6	1.4	2.3	2.3
Initial Queue Delay (*d 3*), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		20.7			23.4		11.1	6.7	6.7	10.6	8.0	8.0
Level of Service (LOS)		C			C		B	A	A	B	A	A
Approach Delay, s/veh / LOS	20.7	C		23.4	C		6.8	A		8.1	A	
Intersection Delay, s/veh / LOS	9.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.28	B	2.28	B	1.62	B	1.62	B
Bicycle LOS Score / LOS	0.68	A	0.90	A	1.44	A	1.66	B

HCS Signalized Intersection Results Summary

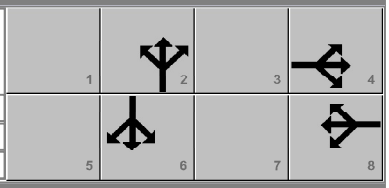
General Information				Intersection Information	
Agency				Duration, h	0.250
Analyst		Analysis Date	Aug 19, 2022	Area Type	Other
Jurisdiction		Time Period	2046 PM	PHF	0.92
Urban Street	US 23	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	SR 229	File Name	2046 PM No Build.xus		
Project Description	2046 PM No Build				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	70	40	50	60	130	70	1820	80	120	1370	10

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	39.6	12.4	0.0	0.0	0.0	0.0	
Yellow	4.0	4.0	0.0	0.0	0.0	0.0	
Red	0.0	0.0	0.0	0.0	0.0	0.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		8.0		8.0		6.0		6.0
Phase Duration, s		16.4		16.4		43.6		43.6
Change Period, (*Y+R c*), s		4.0		4.0		4.0		4.0
Max Allow Headway (*MAH*), s		3.1		3.1		0.0		0.0
Queue Clearance Time (*g s*), s		6.0		11.8				
Green Extension Time (*g e*), s		0.7		0.7		0.0		0.0
Phase Call Probability		1.00		1.00				
Max Out Probability		0.00		0.00				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		130			261		76	1033	1033	130	751	749
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1654			1521		319	1707	1682	184	1707	1703
Queue Service Time (*g s*), s		0.0			5.7		11.4	31.2	32.5	7.1	16.0	16.0
Cycle Queue Clearance Time (*g c*), s		4.0			9.8		27.5	31.2	32.5	39.6	16.0	16.0
Green Ratio (*g/C*)		0.21			0.21		0.66	0.66	0.66	0.66	0.66	0.66
Capacity (*c*), veh/h		407			387		245	1126	1110	142	1126	1123
Volume-to-Capacity Ratio (*X*)		0.320			0.674		0.310	0.917	0.931	0.920	0.666	0.667
Back of Queue (*Q*), ft/ln (95 th percentile)												
Back of Queue (*Q*), veh/ln (95 th percentile)		2.4			5.3		1.5	12.5	13.3	6.9	5.3	5.3
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (*d 1*), s/veh		20.5			22.6		14.6	8.8	9.0	29.4	6.2	6.2
Incremental Delay (*d 2*), s/veh		0.2			0.8		3.3	13.1	14.8	56.7	3.1	3.1
Initial Queue Delay (*d 3*), s/veh		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		20.6			23.4		17.8	21.8	23.8	86.1	9.3	9.3
Level of Service (LOS)		C			C		B	C	C	F	A	A
Approach Delay, s/veh / LOS	20.6	C		23.4	C		22.6	C		15.5	B	
Intersection Delay, s/veh / LOS	19.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.27	B	2.27	B	1.62	B	1.62	B
Bicycle LOS Score / LOS	0.70	A	0.92	A	2.25	B	1.83	B