final report

March 16, 2021

Traffic Impact Study

KJS LLC Apartments
4805 Bardstown Road
Louisville, KY

Prepared for

Louisville Metro Planning Commission
Kentucky Transportation Cabinet

STATE OF KENTUCKY
DIANE B. ZIMMERMAN
#16,462
Diane B. Zimmerman
LICENSED
PROFESSIONAL ENGINEER

DIANE B. ZIMMERMAN
Traffic Engineering, LLC

12803 High Meadows Pike
Prospect, KY 40059
502.648.1858
dianebzim@att.net

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INTRODUCTION

The development plan for 4805 Bardstown Road shows 348 apartment units. **Figure 1** displays a map of the site. Access to the development will be at an entrance on Bardstown Road and one on Watterson Trail. The purpose of this study is to examine the traffic impacts of the development upon the adjacent highway system. For this study the impact area was defined to be the Bardstown Road intersection with Watterson Trail and the proposed entrances.

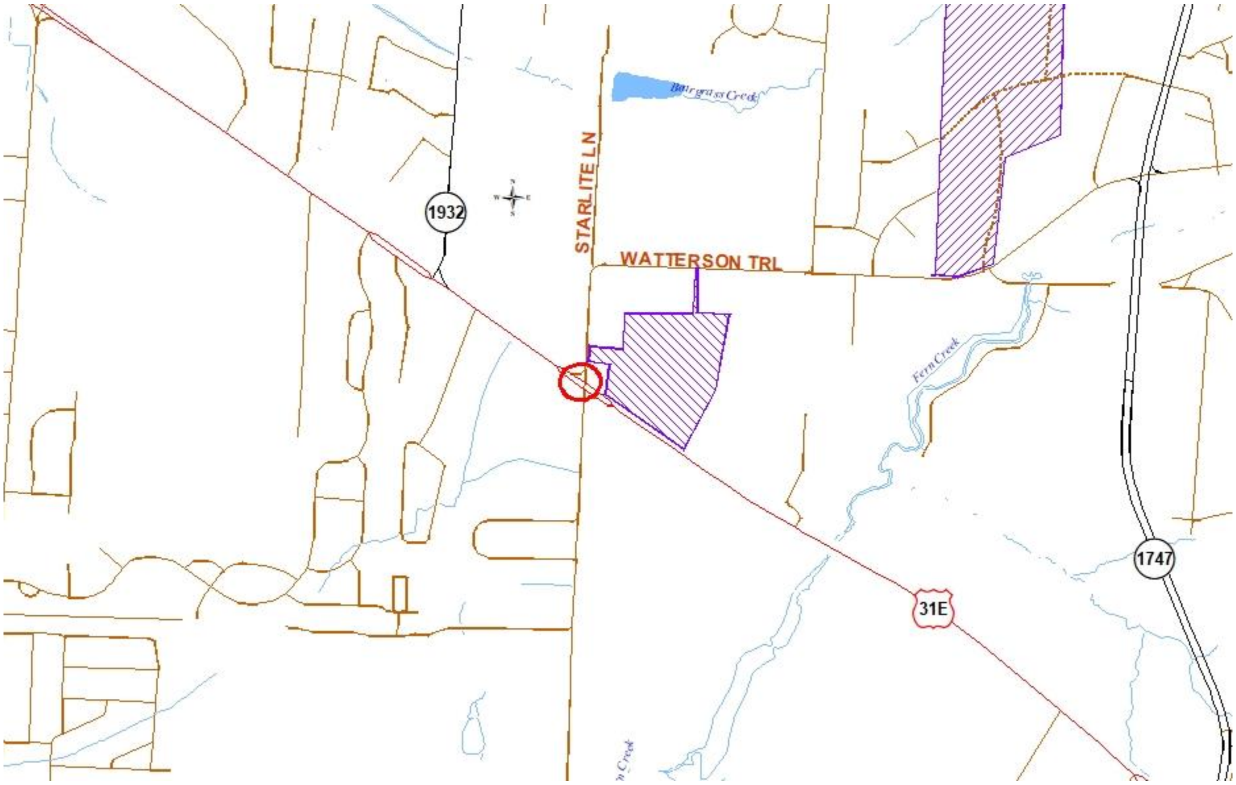


Figure 1. Site Map

EXISTING CONDITIONS

Watterson Trail is maintained by Louisville Metro with an estimated 2021 Average Annual Daily Traffic (AADT) volume of 9,400 vehicles per day between Hurstbourne Parkway and Bardstown Road, as estimated by the Kentucky Transportation Cabinet count station 455. The road has two lanes of eleven feet and four-foot shoulders through study area. The speed limit is 35 mph. There are no sidewalks.

Bardstown Road is a state-maintained road (US 31E) with an estimated 2021 ADT of 25,500 vehicles per day between Watterson Trail and Hurstbourne Parkway, as estimated from the Kentucky Transportation Cabinet 2019 count at station P80. The road is a four-lane highway with twelve-foot lanes, four-foot paved shoulders, and a two-way left turn lane through the study area. The speed limit is 45 mph. There are no sidewalks. The intersection with Watterson Trail is controlled with traffic signal and is part of a coordinated signal system. The intersection with Watterson Trail has left lanes and free-flow right-turn lanes to and from Watterson Trail. The Watterson Trail approach has a shared left and thru. TARC provides service along Bardstown Road.

Peak hour traffic count for the intersections were obtained on April 30, 2015. The peak hours occurred between 7:00 to 8:00 am and 4:30 to 5:30 pm. These counts were compared January 2020 counts on Bardstown Road at Breckenridge Lane and Hurstbourne Parkway. The 2020 counts were similar to the 2015, therefore no adjustment was made to the 2020. **Figure 2** illustrates the existing a.m. and p.m. peak hour traffic volumes. The Appendix contains the full count data.

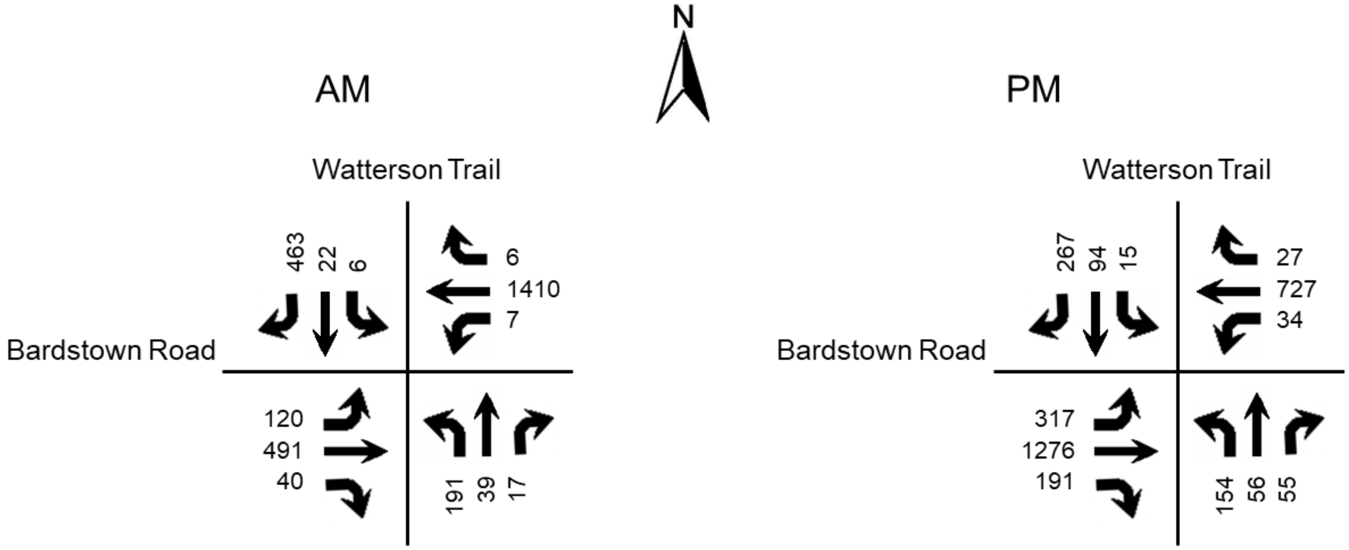

N
AM
Watterson Trail
Bardstown Road
463
22
6
6
1410
7
120
491
40
191
39
17
PM
Watterson Trail
Bardstown Road
267
94
15
27
727
34
317
1276
191
154
56
55

Figure 2. Existing Peak Hour Volumes

FUTURE CONDITIONS

The project completion date is 2024. An annual growth rate of 0.5 percent was applied to the volumes. This was determined by the historical growth at KYTC station P80. Additionally, trip generation for the approved Hurstbourne Commons has been included. **Figure 3** displays the 2024 No Build peak hour volumes.

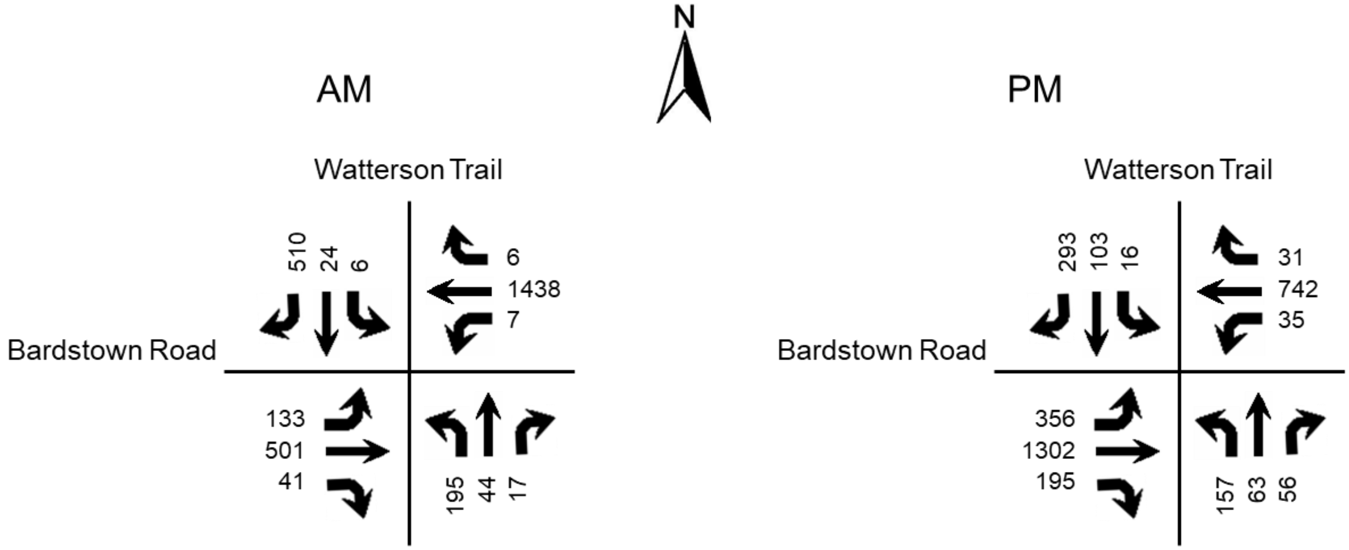

N
AM
PM
Watterson Trail
Bardstown Road
510
24
6
6
1438
7
133
501
41
195
44
17
293
103
16
31
742
35
356
1302
195
157
63
56

Figure 3. 2024 No Build Peak Hour Volumes

TRIP GENERATION

The Institute of Transportation Engineers Trip Generation Manual, 10th Edition contains trip generation rates for a wide range of developments. The land use of "Multi-family (Mid-Rise) (221)" was reviewed and determined to be the best match. The trip generation results are listed in **Table 1**. The trips were assigned to the highway network with the percentages shown in **Figure 4**. **Figure 5** shows the trips generated by this development and distributed throughout the road network during the peak hours. **Figure 6** displays the individual turning movements for the peak hours when the development is completed.

Table 1. Peak Hour Trips Generated by Site

	A.M. Peak Hour			P.M. Peak Hour		
Land Use	**Trips**	**In**	**Out**	**Trips**	**In**	**Out**
Multi-family (Mid-Rise) 348 units	116	30	116	147	90	57

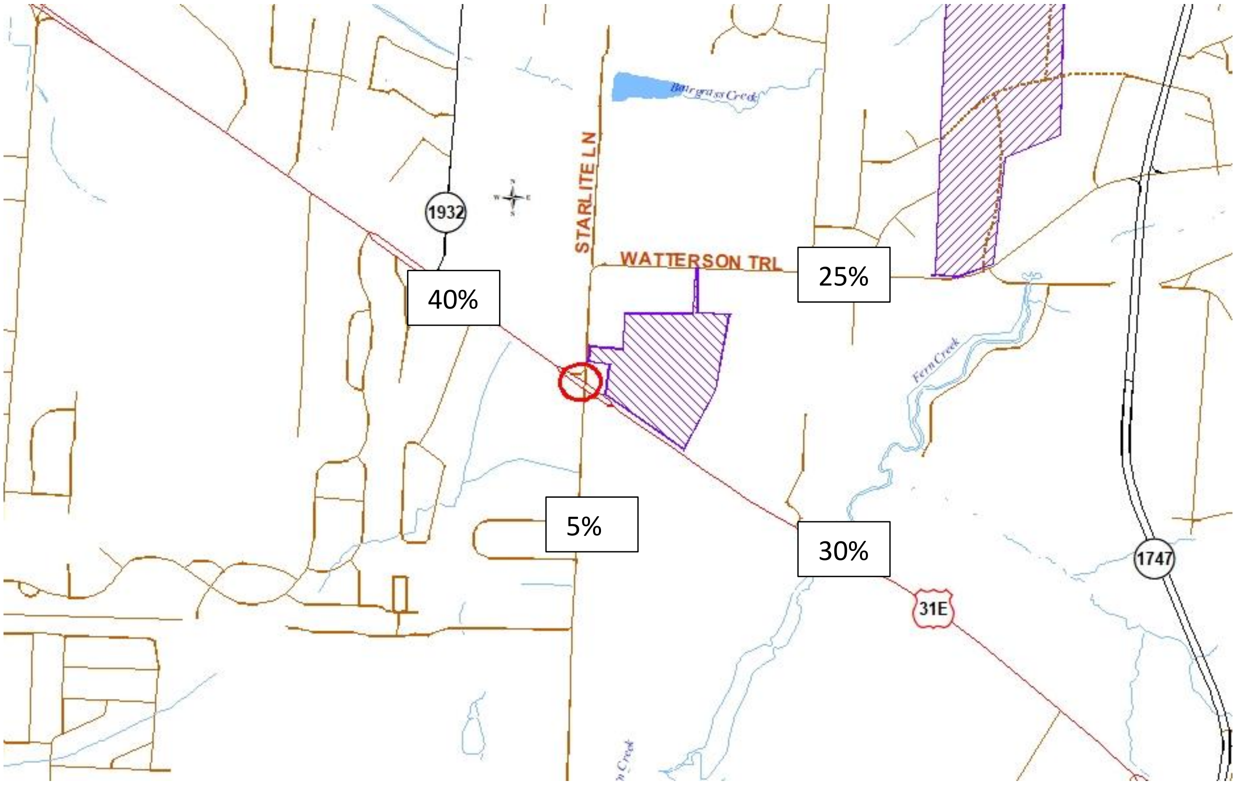

1932
STARLITE LN
Beargrass Creek
WATTERSON TRL
40%
25%
Fern Creek
5%
30%
1747
31E

Figure 4. Trip Distribution Percentages

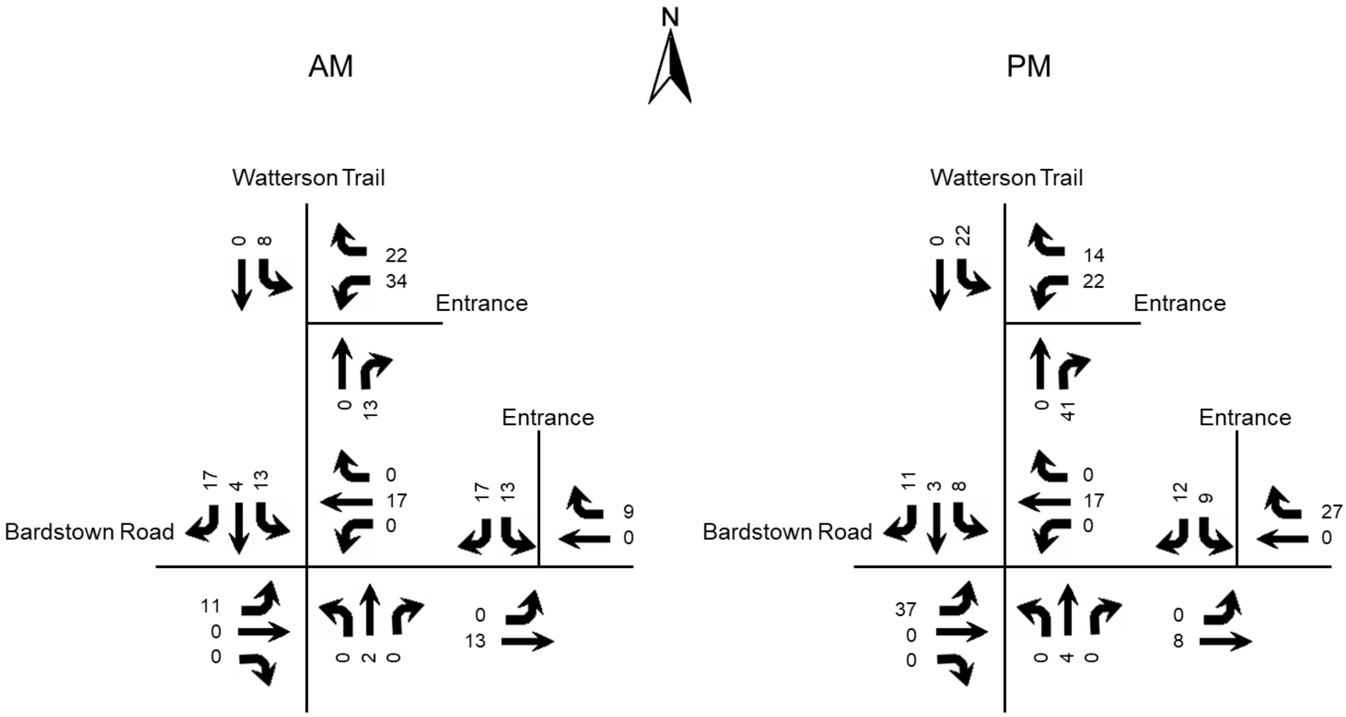

AM
N
PM
Watterson Trail
0
8
22
34
Entrance
0
13
Entrance
17
4
13
0
17
0
17
13
9
0
Bardstown Road
11
0
0
0
2
0
0
13
Watterson Trail
0
22
14
22
Entrance
0
41
Entrance
11
3
8
0
17
0
12
9
27
0
Bardstown Road
37
0
0
0
4
0
0
8

Figure 5. Peak Hour Trips Generated by Site

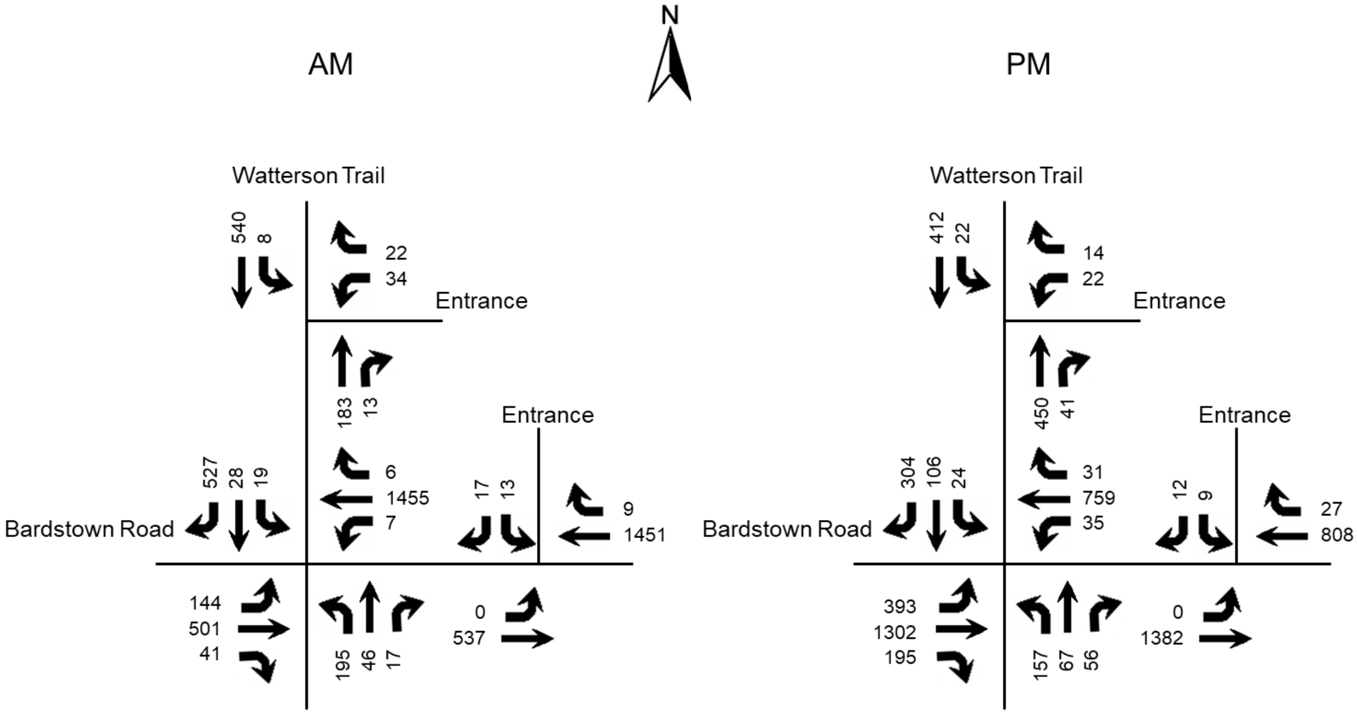

AM
N
PM
Watterson Trail
540
8
22
34
Entrance
183
13
Entrance
527
28
19
6
1455
7
17
13
9
1451
Bardstown Road
144
501
41
195
46
17
0
537
Watterson Trail
412
22
14
22
Entrance
450
41
Entrance
304
106
24
31
759
35
12
9
27
808
Bardstown Road
393
1302
195
157
67
56
0
1382

Figure 6. 2024 Build Peak Hour Volumes

ANALYSIS

The qualitative measure of operation for a roadway facility or intersection is evaluated by assigning a “Level of Service”. Level of Service is a ranking scale from A through F, “A” is the best operating condition and “F” is the worst. Level of Service results depend upon the facility that is analyzed. In this case, the Level of Service is based upon the total delay experienced for lanes at stop-controlled intersections.

To evaluate the impact of the proposed development, the vehicle delays at the intersections were determined using procedures detailed in the Highway Capacity Manual, 6th edition. Future delays and Level of Service were determined for the intersections using the HCS Streets (version 7.9) software. The delays and Level of Service are summarized in **Table 2**. In the signalized intersection reports Bardstown Road is north/south, but will be shown in the tables to match the diagrams.

Table 2. Peak Hour Level of Service

	A.M.			P.M.		
Approach	2020 Existing	2024 No Build	2024 Build	2020 Existing	2024 No Build	2024 Build
Bardstown Road at Watterson Trail	**E 58.6**	**E 61.1**	**E 63.0**	**C 32.7**	**D 35.6**	**D 37.2**
Bardstown Road Eastbound	D 44.8	D 45.3	D 45.9	C 29.0	C 33.3	C 35.4
Bardstown Road Westbound	E 78.1	F 84.1	F 88.1	C 35.0	D 37.7	D 39.1
Watterson Trail Northbound	F 80.9	F 81.5	F 81.6	E 67.5	E 67.4	E 67.4
Watterson Trail Southbound	B 12.4	B 12.4	B 13.6	C 21.4	C 20.8	C 21.3
Watterson Trail at Entrance						
Entrance Westbound			B 14.2			C 17.4
Watterson Trail Northbound (left)			A 7.7			A 8.5
Bardstown Road at Entrance						
Bardstown Road Eastbound (left)			B 13.7			A 9.8
Entrance Southbound			D 26.4			C 16.5

Key: Level of Service, Delay in seconds per vehicle

The entrances were evaluated for turn lanes using the Kentucky Transportation Cabinet Highway Design Guidance Manual dated July, 2020. The traffic impact policy requires using volumes for ten years beyond opening date, or 2034. The 2034 volumes were determined applying a 0.5 percent annual growth rate from 2024. Figure 7 illustrates the 2034 No Build volumes. Figure 8 illustrates the 2034 Build Volumes. Using the volumes in Figure 8, no turn lanes will be required at the entrances. **Table 3** summarizes the delay and Level of Service for 2034.

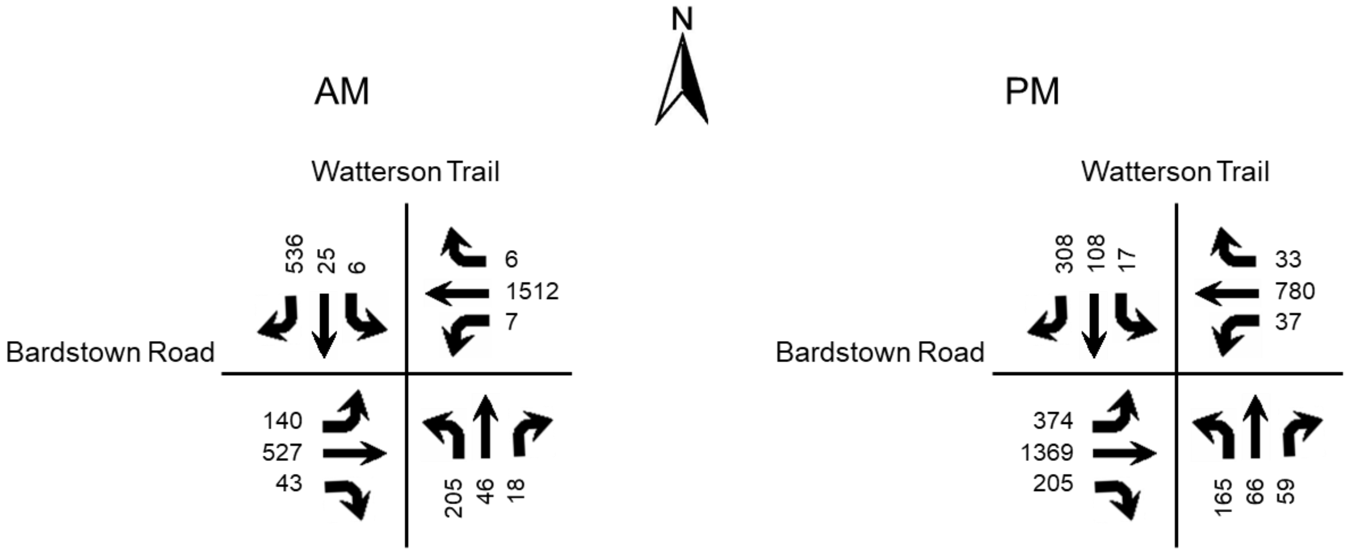

N
AM
PM
Watterson Trail
536
25
6
6
1512
7
Bardstown Road
140
527
43
205
46
18
Watterson Trail
308
108
17
33
780
37
Bardstown Road
374
1369
205
165
66
59

Figure 7. 2034 No Build Peak Hour Volumes

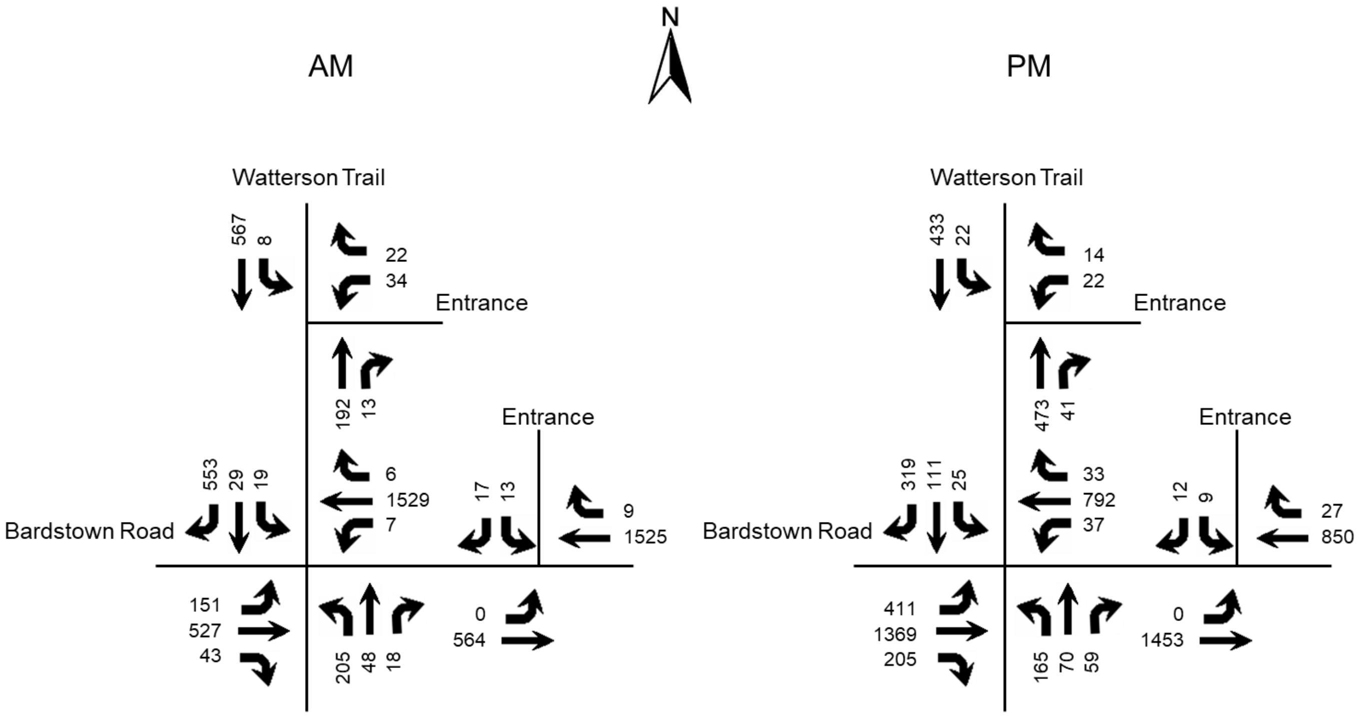

N
AM
PM
Watterson Trail
567
8
22
34
Entrance
192
13
Entrance
553
29
19
6
1529
7
17
13
9
1525
Bardstown Road
151
527
43
205
48
18
0
564
Watterson Trail
433
22
14
22
Entrance
473
41
Entrance
319
111
25
33
792
37
12
9
27
850
Bardstown Road
411
1369
205
165
70
59
0
1453

Figure 8. 2034 Build Peak Hour Volumes

Table 3. Peak Hour Level of Service (2034)

	A.M.			P.M.		
Approach	2020 Existing	2034 No Build	2034 Build	2020 Existing	2034 No Build	2034 Build
Bardstown Road at Watterson Trail	**E 58.6**	**E 70.4**	**E 72.6**	**C 32.7**	**D 37.9**	**D 39.8**
Bardstown Road Eastbound	D 44.8	D 45.3	D 45.9	C 29.0	C 36.2	C 38.6
Bardstown Road Westbound	E 78.1	F 102.7	F 107.4	C 35.0	D 40.4	D 42.4
Watterson Trail Northbound	F 80.9	F 81.9	F 82.0	E 67.5	E 67.4	E 68.2
Watterson Trail Southbound	B 12.4	B 12.4	B 13.6	C 21.4	C 20.6	C 21.1
Watterson Trail at Entrance						
Entrance Westbound			B 14.7			C 18.3
Watterson Trail Northbound (left)			A 7.7			A 8.6
Bardstown Road at Entrance						
Bardstown Road Eastbound (left)			B 14.3			A 10.0
Entrance Southbound			D 28.7			C 17.2

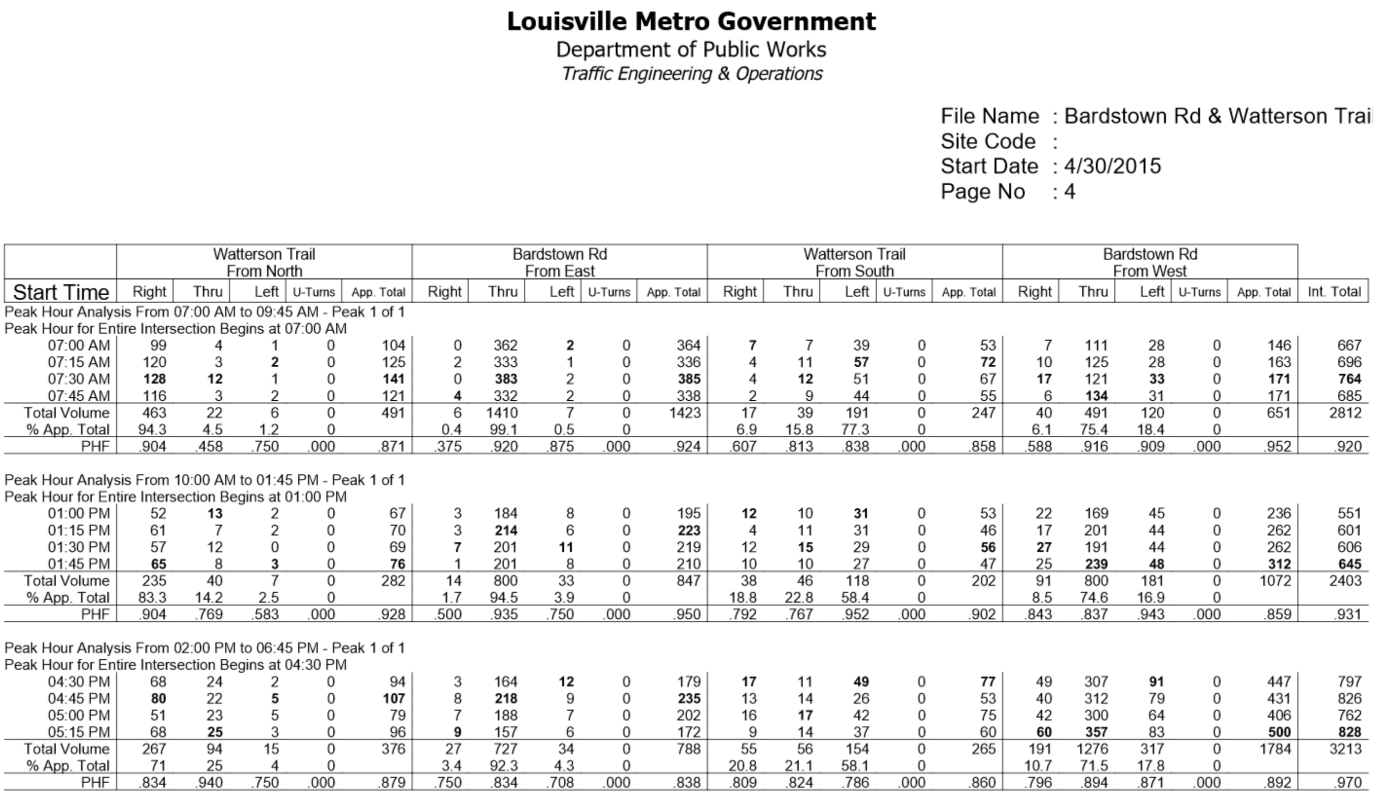
Key: Level of Service, Delay in seconds per vehicle

CONCLUSIONS

Based upon the volume of traffic generated by the development and the amount of traffic forecasted for the year 2024 and 2034, there will be an impact to the existing highway network. No improvements are recommended.

APPENDIX

Traffic Counts

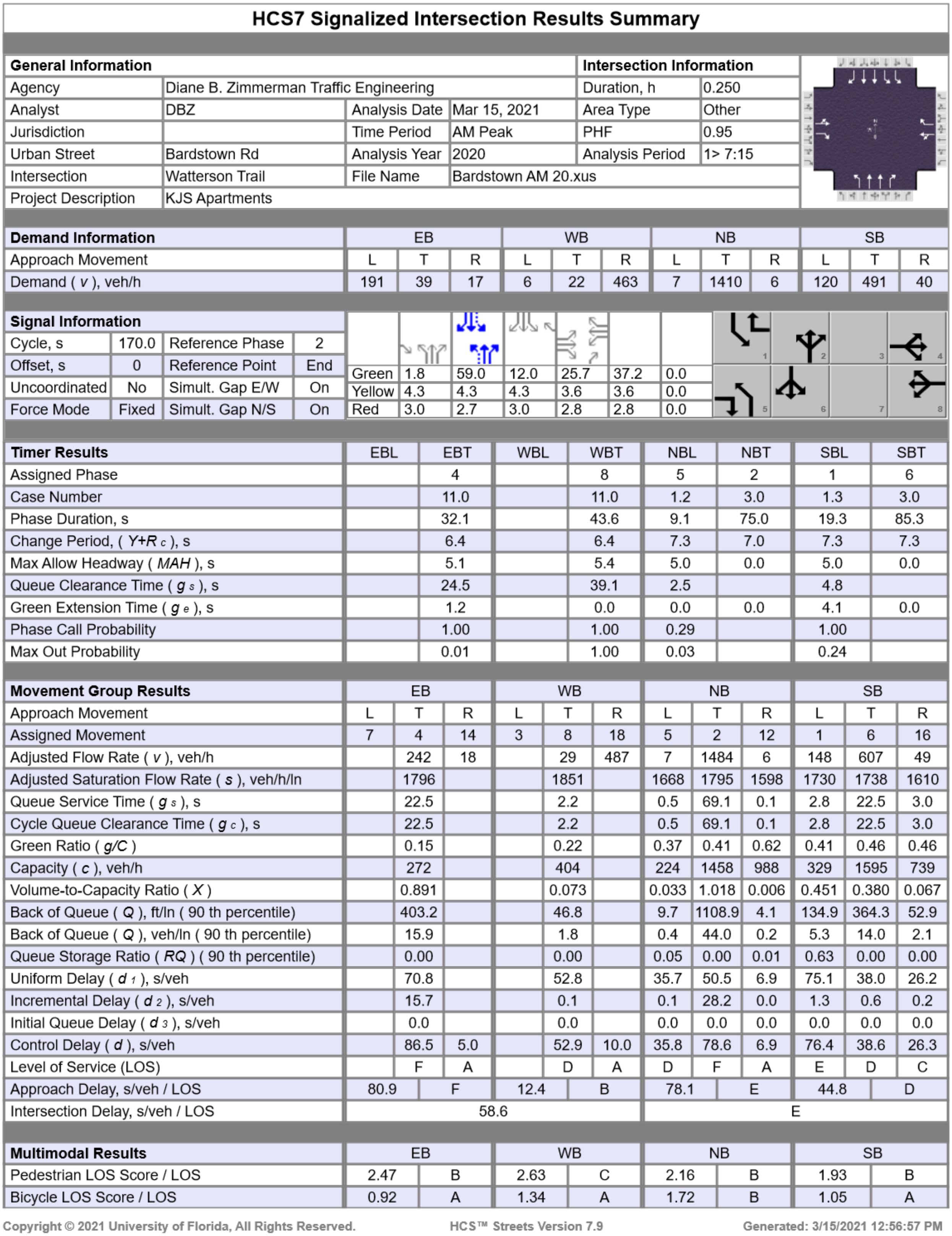


Louisville Metro Government
Department of Public Works
Traffic Engineering & Operations

File Name : Bardstown Rd & Watterson Trail
Site Code :
Start Date : 4/30/2015
Page No : 4

	Watterson Trail From North					Bardstown Rd From East					Watterson Trail From South					Bardstown Rd From West					
Start Time	Right	Thru	Left	U-Turns	App. Total	Right	Thru	Left	U-Turns	App. Total	Right	Thru	Left	U-Turns	App. Total	Right	Thru	Left	U-Turns	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 09:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	99	4	1	0	104	0	362	**2**	0	364	**7**	7	39	0	53	7	111	28	0	146	667
07:15 AM	120	3	**2**	0	125	2	333	1	0	336	4	11	**57**	0	**72**	10	125	28	0	163	696
07:30 AM	**128**	**12**	1	0	**141**	0	**383**	2	0	**385**	4	**12**	51	0	67	**17**	121	**33**	0	**171**	**764**
07:45 AM	116	3	2	0	121	**4**	332	2	0	338	2	9	44	0	55	6	**134**	31	0	171	685
Total Volume	463	22	6	0	491	6	1410	7	0	1423	17	39	191	0	247	40	491	120	0	651	2812
% App. Total	94.3	4.5	1.2	0		0.4	99.1	0.5	0		6.9	15.8	77.3	0		6.1	75.4	18.4	0		
PHF	.904	.458	.750	.000	.871	.375	.920	.875	.000	.924	.607	.813	.838	.000	.858	.588	.916	.909	.000	.952	.920
Peak Hour Analysis From 10:00 AM to 01:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 01:00 PM																					
01:00 PM	52	**13**	2	0	67	3	184	8	0	195	**12**	10	**31**	0	53	22	169	45	0	236	551
01:15 PM	61	7	2	0	70	3	**214**	6	0	**223**	4	11	31	0	46	17	201	44	0	262	601
01:30 PM	57	12	0	0	69	**7**	201	**11**	0	219	12	**15**	29	0	**56**	**27**	191	44	0	262	606
01:45 PM	**65**	8	**3**	0	**76**	1	201	8	0	210	10	10	27	0	47	25	**239**	**48**	0	**312**	**645**
Total Volume	235	40	7	0	282	14	800	33	0	847	38	46	118	0	202	91	800	181	0	1072	2403
% App. Total	83.3	14.2	2.5	0		1.7	94.5	3.9	0		18.8	22.8	58.4	0		8.5	74.6	16.9	0		
PHF	.904	.769	.583	.000	.928	.500	.935	.750	.000	.950	.792	.767	.952	.000	.902	.843	.837	.943	.000	.859	.931
Peak Hour Analysis From 02:00 PM to 06:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	68	24	2	0	94	3	164	**12**	0	179	**17**	11	**49**	0	**77**	49	307	**91**	0	447	797
04:45 PM	**80**	22	**5**	0	**107**	8	**218**	9	0	**235**	13	14	26	0	53	40	312	79	0	431	826
05:00 PM	51	23	5	0	79	7	188	7	0	202	16	**17**	42	0	75	42	300	64	0	406	762
05:15 PM	68	**25**	3	0	96	**9**	157	6	0	172	9	14	37	0	60	**60**	**357**	83	0	**500**	**828**
Total Volume	267	94	15	0	376	27	727	34	0	788	55	56	154	0	265	191	1276	317	0	1784	3213
% App. Total	71	25	4	0		3.4	92.3	4.3	0		20.8	21.1	58.1	0		10.7	71.5	17.8	0		
PHF	.834	.940	.750	.000	.879	.750	.834	.708	.000	.838	.809	.824	.786	.000	.860	.796	.894	.871	.000	.892	.970

HCS Reports



HCS7 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	Diane B. Zimmerman Traffic Engineering			Duration, h	0.250
Analyst	DBZ	Analysis Date	Mar 15, 2021	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.95
Urban Street	Bardstown Rd	Analysis Year	2020	Analysis Period	1> 7:15
Intersection	Watterson Trail	File Name	Bardstown AM 20.xus		
Project Description	KJS Apartments				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	191	39	17	6	22	463	7	1410	6	120	491	40

Signal Information			
Cycle, s	170.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

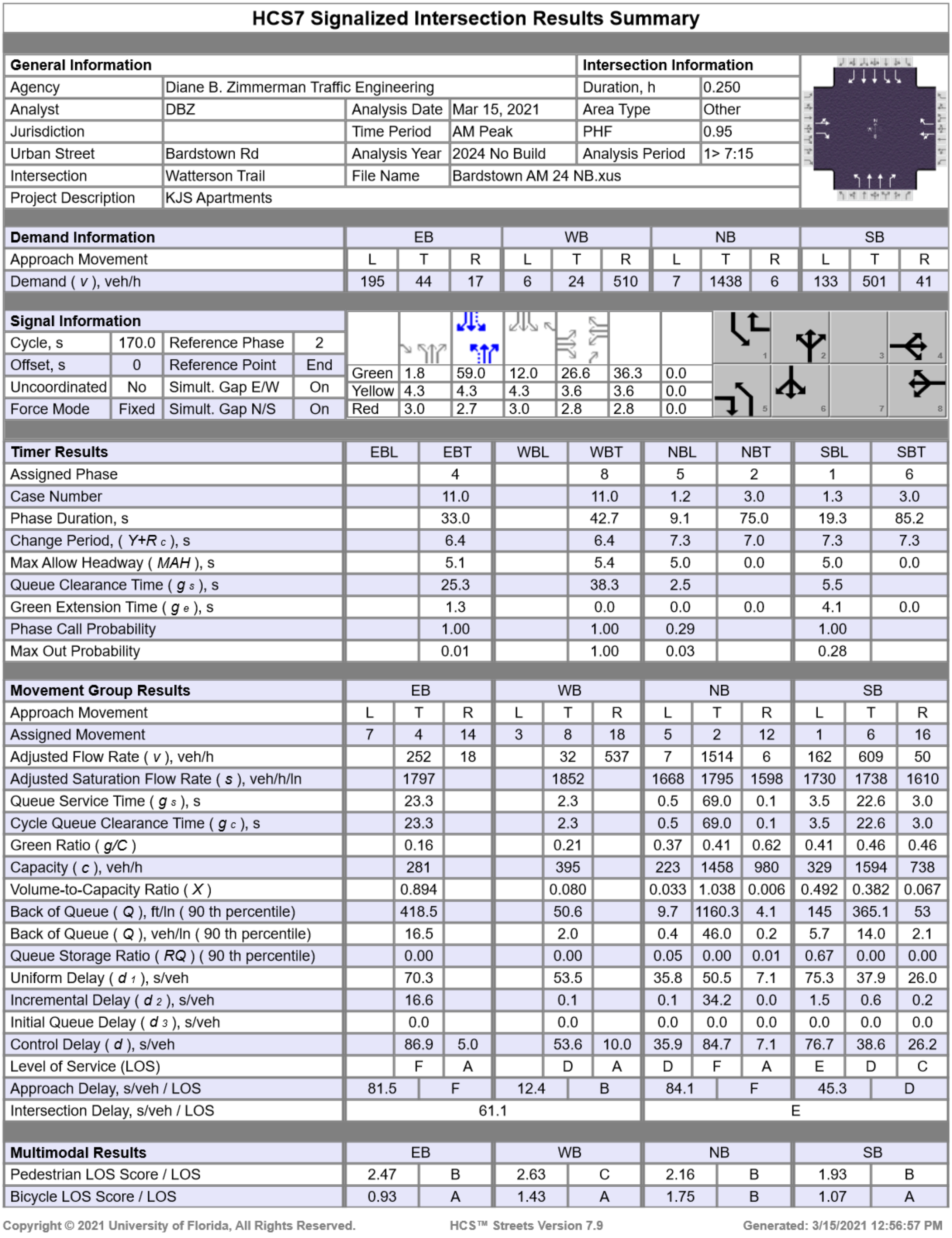
Green	1.8	59.0	12.0	25.7	37.2	0.0
Yellow	4.3	4.3	4.3	3.6	3.6	0.0
Red	3.0	2.7	3.0	2.8	2.8	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		11.0		11.0	1.2	3.0	1.3	3.0
Phase Duration, s		32.1		43.6	9.1	75.0	19.3	85.3
Change Period, (*Y+R c*), s		6.4		6.4	7.3	7.0	7.3	7.3
Max Allow Headway (*MAH*), s		5.1		5.4	5.0	0.0	5.0	0.0
Queue Clearance Time (*g s*), s		24.5		39.1	2.5		4.8	
Green Extension Time (*g e*), s		1.2		0.0	0.0	0.0	4.1	0.0
Phase Call Probability		1.00		1.00	0.29		1.00	
Max Out Probability		0.01		1.00	0.03		0.24	

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		242	18		29	487	7	1484	6	148	607	49
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1796			1851		1668	1795	1598	1730	1738	1610
Queue Service Time (*g s*), s		22.5			2.2		0.5	69.1	0.1	2.8	22.5	3.0
Cycle Queue Clearance Time (*g c*), s		22.5			2.2		0.5	69.1	0.1	2.8	22.5	3.0
Green Ratio (*g/C*)		0.15			0.22		0.37	0.41	0.62	0.41	0.46	0.46
Capacity (*c*), veh/h		272			404		224	1458	988	329	1595	739
Volume-to-Capacity Ratio (*X*)		0.891			0.073		0.033	1.018	0.006	0.451	0.380	0.067
Back of Queue (*Q*), ft/ln (90 th percentile)		403.2			46.8		9.7	1108.9	4.1	134.9	364.3	52.9
Back of Queue (*Q*), veh/ln (90 th percentile)		15.9			1.8		0.4	44.0	0.2	5.3	14.0	2.1
Queue Storage Ratio (*RQ*) (90 th percentile)		0.00			0.00		0.05	0.00	0.01	0.63	0.00	0.00
Uniform Delay (*d 1*), s/veh		70.8			52.8		35.7	50.5	6.9	75.1	38.0	26.2
Incremental Delay (*d 2*), s/veh		15.7			0.1		0.1	28.2	0.0	1.3	0.6	0.2
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		86.5	5.0		52.9	10.0	35.8	78.6	6.9	76.4	38.6	26.3
Level of Service (LOS)		F	A		D	A	D	F	A	E	D	C
Approach Delay, s/veh / LOS	80.9		F	12.4		B	78.1		E	44.8		D
Intersection Delay, s/veh / LOS	58.6						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.47	B	2.63	C	2.16	B	1.93	B
Bicycle LOS Score / LOS	0.92	A	1.34	A	1.72	B	1.05	A

HCS™ Streets Version 7.9 Generated: 3/15/2021 12:56:57 PM



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General Information				Intersection Information	
Agency	Diane B. Zimmerman Traffic Engineering			Duration, h	0.250
Analyst	DBZ	Analysis Date	Mar 15, 2021	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.95
Urban Street	Bardstown Rd	Analysis Year	2024 No Build	Analysis Period	1> 7:15
Intersection	Watterson Trail	File Name	Bardstown AM 24 NB.xus		
Project Description	KJS Apartments				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	195	44	17	6	24	510	7	1438	6	133	501	41

Signal Information			
Cycle, s	170.0	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	1.8	59.0	12.0	26.6	36.3	0.0
Yellow	4.3	4.3	4.3	3.6	3.6	0.0
Red	3.0	2.7	3.0	2.8	2.8	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		11.0		11.0	1.2	3.0	1.3	3.0
Phase Duration, s		33.0		42.7	9.1	75.0	19.3	85.2
Change Period, (*Y+R* c), s		6.4		6.4	7.3	7.0	7.3	7.3
Max Allow Headway (*MAH*), s		5.1		5.4	5.0	0.0	5.0	0.0
Queue Clearance Time (*g* s), s		25.3		38.3	2.5		5.5	
Green Extension Time (*g* e), s		1.3		0.0	0.0	0.0	4.1	0.0
Phase Call Probability		1.00		1.00	0.29		1.00	
Max Out Probability		0.01		1.00	0.03		0.28	

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		252	18		32	537	7	1514	6	162	609	50
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1797			1852		1668	1795	1598	1730	1738	1610
Queue Service Time (*g* s), s		23.3			2.3		0.5	69.0	0.1	3.5	22.6	3.0
Cycle Queue Clearance Time (*g* c), s		23.3			2.3		0.5	69.0	0.1	3.5	22.6	3.0
Green Ratio (*g/C*)		0.16			0.21		0.37	0.41	0.62	0.41	0.46	0.46
Capacity (*c*), veh/h		281			395		223	1458	980	329	1594	738
Volume-to-Capacity Ratio (*X*)		0.894			0.080		0.033	1.038	0.006	0.492	0.382	0.067
Back of Queue (*Q*), ft/ln (90 th percentile)		418.5			50.6		9.7	1160.3	4.1	145	365.1	53
Back of Queue (*Q*), veh/ln (90 th percentile)		16.5			2.0		0.4	46.0	0.2	5.7	14.0	2.1
Queue Storage Ratio (*RQ*) (90 th percentile)		0.00			0.00		0.05	0.00	0.01	0.67	0.00	0.00
Uniform Delay (*d* 1), s/veh		70.3			53.5		35.8	50.5	7.1	75.3	37.9	26.0
Incremental Delay (*d* 2), s/veh		16.6			0.1		0.1	34.2	0.0	1.5	0.6	0.2
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		86.9	5.0		53.6	10.0	35.9	84.7	7.1	76.7	38.6	26.2
Level of Service (LOS)		F	A		D	A	D	F	A	E	D	C
Approach Delay, s/veh / LOS	81.5	F		12.4	B		84.1	F		45.3	D	
Intersection Delay, s/veh / LOS	61.1						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.47	B	2.63	C	2.16	B	1.93	B
Bicycle LOS Score / LOS	0.93	A	1.43	A	1.75	B	1.07	A

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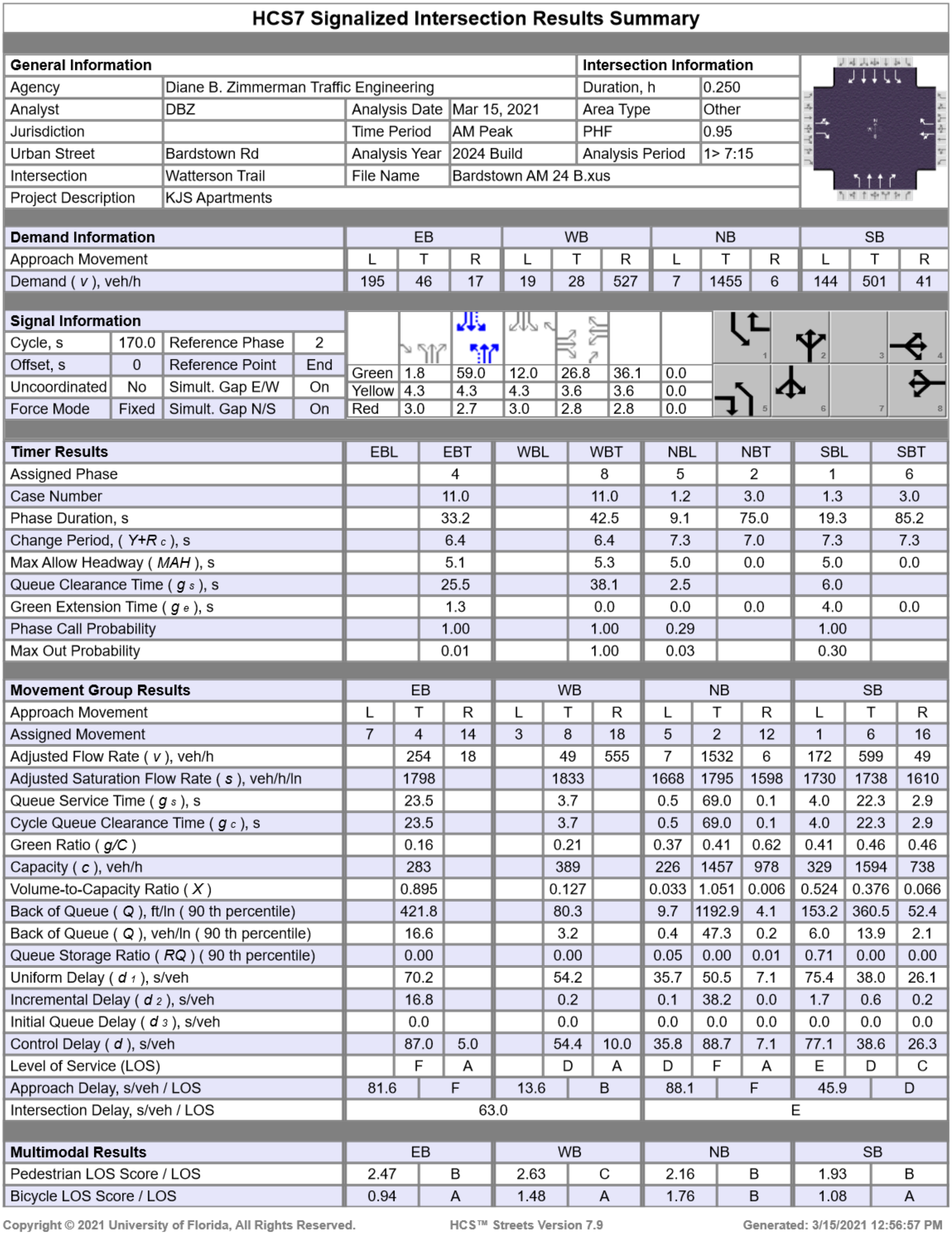

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	Diane B. Zimmerman Traffic Engineering			Duration, h	0.250
Analyst	DBZ	Analysis Date	Mar 15, 2021	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.95
Urban Street	Bardstown Rd	Analysis Year	2024 Build	Analysis Period	1> 7:15
Intersection	Watterson Trail	File Name	Bardstown AM 24 B.xus		
Project Description	KJS Apartments				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	195	46	17	19	28	527	7	1455	6	144	501	41

Signal Information			
Cycle, s	170.0	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	1.8	59.0	12.0	26.8	36.1	0.0
Yellow	4.3	4.3	4.3	3.6	3.6	0.0
Red	3.0	2.7	3.0	2.8	2.8	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		11.0		11.0	1.2	3.0	1.3	3.0
Phase Duration, s		33.2		42.5	9.1	75.0	19.3	85.2
Change Period, (*Y+R* c), s		6.4		6.4	7.3	7.0	7.3	7.3
Max Allow Headway (*MAH*), s		5.1		5.3	5.0	0.0	5.0	0.0
Queue Clearance Time (*g* s), s		25.5		38.1	2.5		6.0	
Green Extension Time (*g* e), s		1.3		0.0	0.0	0.0	4.0	0.0
Phase Call Probability		1.00		1.00	0.29		1.00	
Max Out Probability		0.01		1.00	0.03		0.30	

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		254	18		49	555	7	1532	6	172	599	49
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1798			1833		1668	1795	1598	1730	1738	1610
Queue Service Time (*g* s), s		23.5			3.7		0.5	69.0	0.1	4.0	22.3	2.9
Cycle Queue Clearance Time (*g* c), s		23.5			3.7		0.5	69.0	0.1	4.0	22.3	2.9
Green Ratio (*g/C*)		0.16			0.21		0.37	0.41	0.62	0.41	0.46	0.46
Capacity (*c*), veh/h		283			389		226	1457	978	329	1594	738
Volume-to-Capacity Ratio (*X*)		0.895			0.127		0.033	1.051	0.006	0.524	0.376	0.066
Back of Queue (*Q*), ft/ln (90 th percentile)		421.8			80.3		9.7	1192.9	4.1	153.2	360.5	52.4
Back of Queue (*Q*), veh/ln (90 th percentile)		16.6			3.2		0.4	47.3	0.2	6.0	13.9	2.1
Queue Storage Ratio (*RQ*) (90 th percentile)		0.00			0.00		0.05	0.00	0.01	0.71	0.00	0.00
Uniform Delay (*d* 1), s/veh		70.2			54.2		35.7	50.5	7.1	75.4	38.0	26.1
Incremental Delay (*d* 2), s/veh		16.8			0.2		0.1	38.2	0.0	1.7	0.6	0.2
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		87.0	5.0		54.4	10.0	35.8	88.7	7.1	77.1	38.6	26.3
Level of Service (LOS)		F	A		D	A	D	F	A	E	D	C
Approach Delay, s/veh / LOS	81.6	F		13.6	B		88.1	F		45.9	D	
Intersection Delay, s/veh / LOS	63.0						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.47	B	2.63	C	2.16	B	1.93	B
Bicycle LOS Score / LOS	0.94	A	1.48	A	1.76	B	1.08	A

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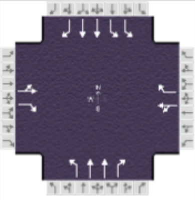
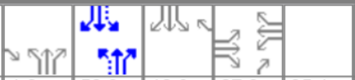
HCS7 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	Diane B. Zimmerman Traffic Engineering			Duration, h	0.250
Analyst	DBZ	Analysis Date	Mar 15, 2021	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.95
Urban Street	Bardstown Rd	Analysis Year	2034 No Build	Analysis Period	1> 7:15
Intersection	Watterson Trail	File Name	Bardstown AM 34 NB.xus		
Project Description	KJS Apartments				

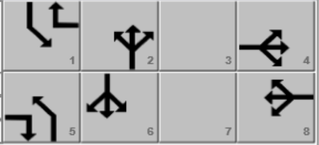


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	205	46	18	6	25	536	7	1512	6	140	527	43

Signal Information			
Cycle, s	170.0	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	1.8	58.9	12.0	27.8	35.1	0.0
Yellow	4.3	4.3	4.3	3.6	3.6	0.0
Red	3.0	2.7	3.0	2.8	2.8	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		11.0		11.0	1.2	3.0	1.3	3.0
Phase Duration, s		34.2		41.5	9.1	75.0	19.3	85.2
Change Period, (*Y+R* c), s		6.4		6.4	7.3	7.0	7.3	7.3
Max Allow Headway (*MAH*), s		5.1		5.4	5.0	0.0	5.0	0.0
Queue Clearance Time (*g* s), s		26.5		37.1	2.5		5.5	
Green Extension Time (*g* e), s		1.3		0.0	0.0	0.0	4.1	0.0
Phase Call Probability		1.00		1.00	0.29		1.00	
Max Out Probability		0.02		1.00	0.03		0.28	

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		264	19		33	564	7	1592	6	162	609	50
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1797			1852		1668	1795	1598	1730	1738	1610
Queue Service Time (*g* s), s		24.5			2.4		0.5	69.0	0.1	3.5	22.6	3.0
Cycle Queue Clearance Time (*g* c), s		24.5			2.4		0.5	69.0	0.1	3.5	22.6	3.0
Green Ratio (*g/C*)		0.16			0.21		0.37	0.41	0.61	0.41	0.46	0.46
Capacity (*c*), veh/h		294			382		223	1457	969	329	1594	738
Volume-to-Capacity Ratio (*X*)		0.899			0.085		0.033	1.092	0.007	0.492	0.382	0.067
Back of Queue (*Q*), ft/ln (90 th percentile)		438.8			52.9		9.7	1313.8	4.1	145.1	365.1	52.9
Back of Queue (*Q*), veh/ln (90 th percentile)		17.3			2.1		0.4	52.1	0.2	5.7	14.0	2.1
Queue Storage Ratio (*RQ*) (90 th percentile)		0.00			0.00		0.05	0.00	0.01	0.68	0.00	0.00
Uniform Delay (*d* 1), s/veh		69.7			54.5		35.8	50.5	7.3	75.3	37.9	26.0
Incremental Delay (*d* 2), s/veh		17.7			0.1		0.1	52.9	0.0	1.5	0.6	0.2
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		87.4	5.0		54.6	10.0	35.9	103.4	7.3	76.7	38.6	26.2
Level of Service (LOS)		F	A		D	A	D	F	A	E	D	C
Approach Delay, s/veh / LOS	81.9	F		12.4	B		102.7	F		45.3	D	
Intersection Delay, s/veh / LOS	70.4						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.47	B	2.63	C	2.16	B	1.93	B
Bicycle LOS Score / LOS	0.95	A	1.47	A	1.81	B	1.10	A

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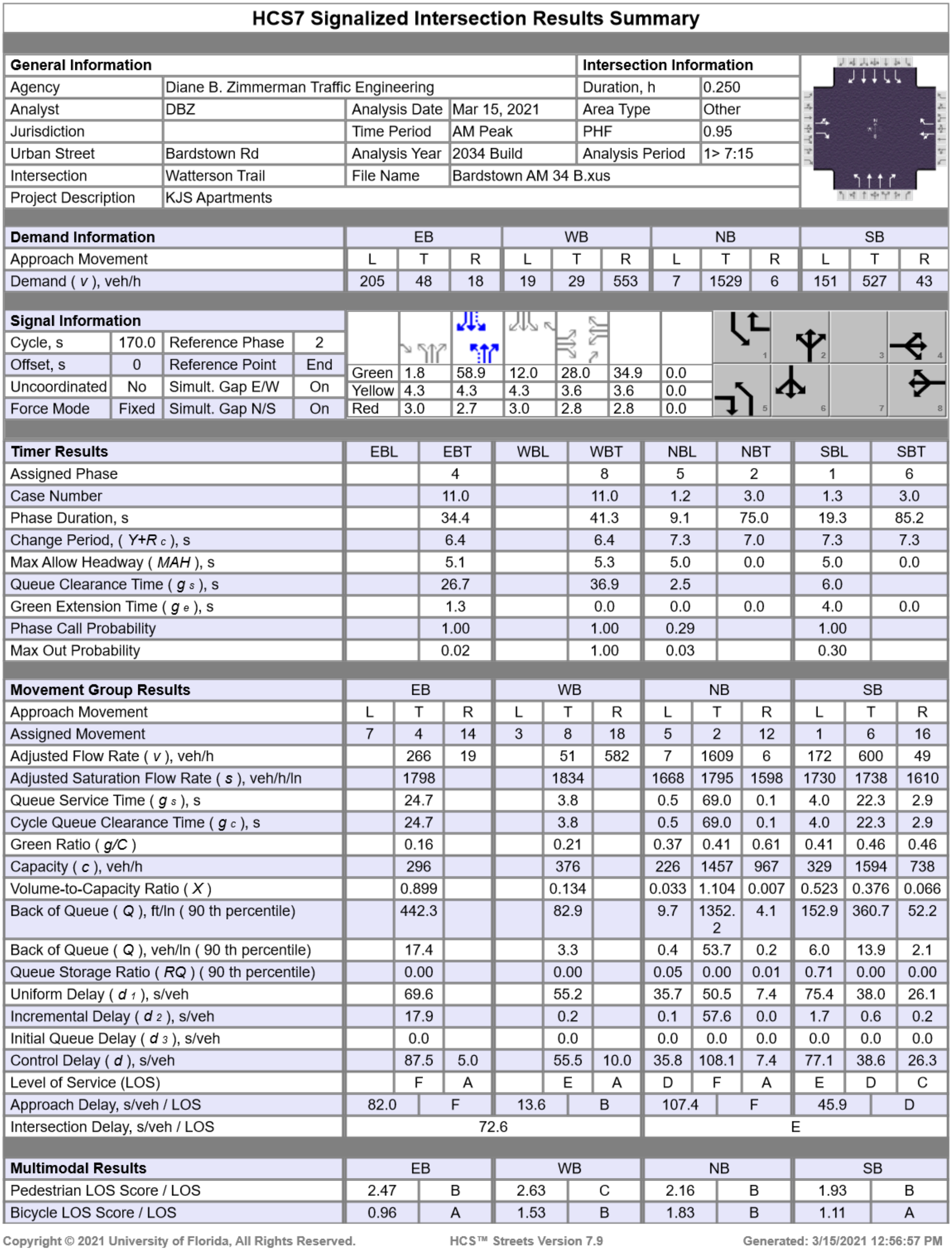

HCS7 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	Diane B. Zimmerman Traffic Engineering			Duration, h	0.250
Analyst	DBZ	Analysis Date	Mar 15, 2021	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.95
Urban Street	Bardstown Rd	Analysis Year	2034 Build	Analysis Period	1> 7:15
Intersection	Watterson Trail	File Name	Bardstown AM 34 B.xus		
Project Description	KJS Apartments				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	205	48	18	19	29	553	7	1529	6	151	527	43

Signal Information			
Cycle, s	170.0	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	1.8	58.9	12.0	28.0	34.9	0.0
Yellow	4.3	4.3	4.3	3.6	3.6	0.0
Red	3.0	2.7	3.0	2.8	2.8	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		11.0		11.0	1.2	3.0	1.3	3.0
Phase Duration, s		34.4		41.3	9.1	75.0	19.3	85.2
Change Period, (*Y+R* c), s		6.4		6.4	7.3	7.0	7.3	7.3
Max Allow Headway (*MAH*), s		5.1		5.3	5.0	0.0	5.0	0.0
Queue Clearance Time (*g* s), s		26.7		36.9	2.5		6.0	
Green Extension Time (*g* e), s		1.3		0.0	0.0	0.0	4.0	0.0
Phase Call Probability		1.00		1.00	0.29		1.00	
Max Out Probability		0.02		1.00	0.03		0.30	

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		266	19		51	582	7	1609	6	172	600	49
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1798			1834		1668	1795	1598	1730	1738	1610
Queue Service Time (*g* s), s		24.7			3.8		0.5	69.0	0.1	4.0	22.3	2.9
Cycle Queue Clearance Time (*g* c), s		24.7			3.8		0.5	69.0	0.1	4.0	22.3	2.9
Green Ratio (*g/C*)		0.16			0.21		0.37	0.41	0.61	0.41	0.46	0.46
Capacity (*c*), veh/h		296			376		226	1457	967	329	1594	738
Volume-to-Capacity Ratio (*X*)		0.899			0.134		0.033	1.104	0.007	0.523	0.376	0.066
Back of Queue (*Q*), ft/ln (90 th percentile)		442.3			82.9		9.7	1352.2	4.1	152.9	360.7	52.2
Back of Queue (*Q*), veh/ln (90 th percentile)		17.4			3.3		0.4	53.7	0.2	6.0	13.9	2.1
Queue Storage Ratio (*RQ*) (90 th percentile)		0.00			0.00		0.05	0.00	0.01	0.71	0.00	0.00
Uniform Delay (*d* 1), s/veh		69.6			55.2		35.7	50.5	7.4	75.4	38.0	26.1
Incremental Delay (*d* 2), s/veh		17.9			0.2		0.1	57.6	0.0	1.7	0.6	0.2
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		87.5	5.0		55.5	10.0	35.8	108.1	7.4	77.1	38.6	26.3
Level of Service (LOS)		F	A		E	A	D	F	A	E	D	C
Approach Delay, s/veh / LOS	82.0	F		13.6	B		107.4	F		45.9	D	
Intersection Delay, s/veh / LOS	72.6						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.47	B	2.63	C	2.16	B	1.93	B
Bicycle LOS Score / LOS	0.96	A	1.53	B	1.83	B	1.11	A

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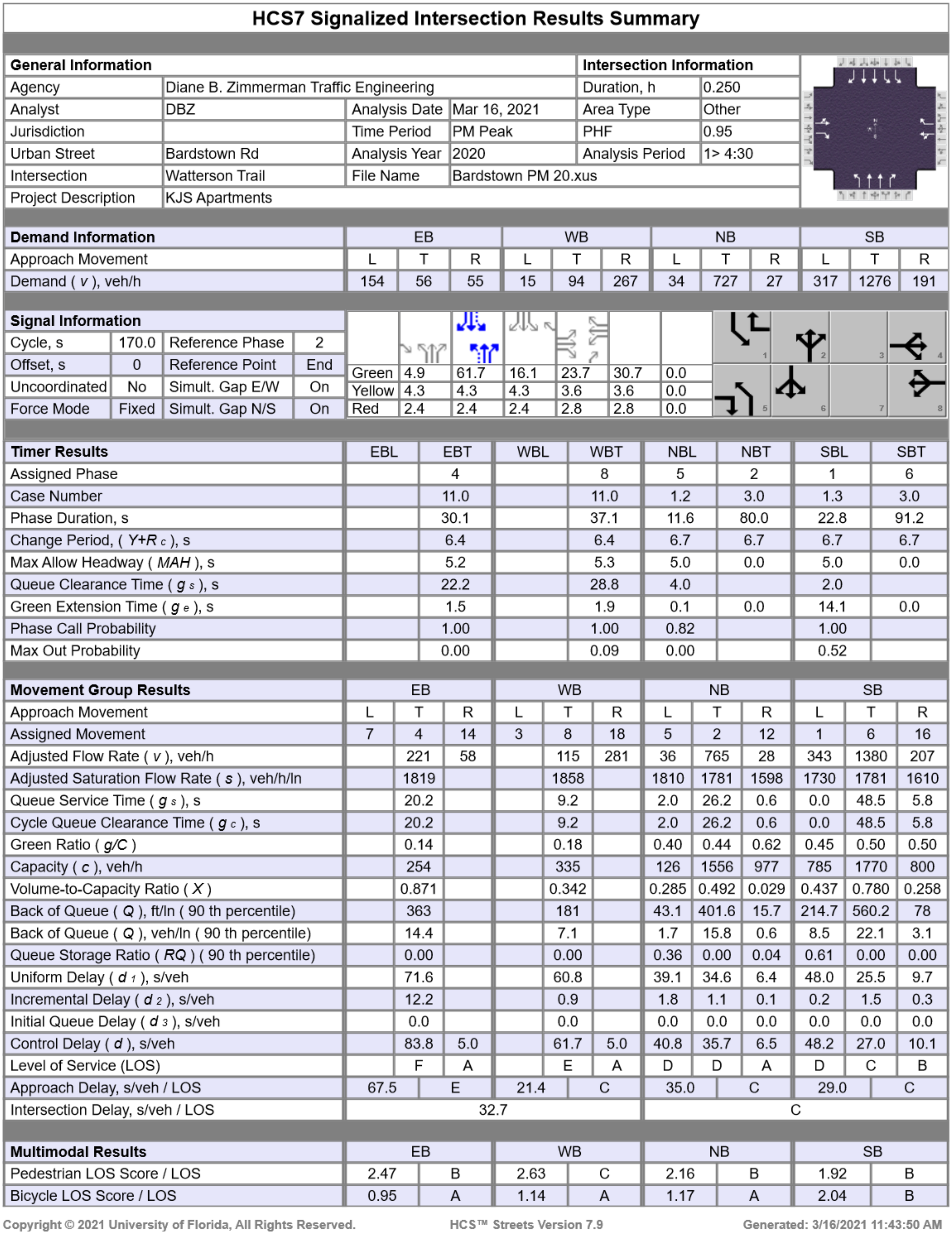

HCS7 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	Diane B. Zimmerman Traffic Engineering			Duration, h	0.250
Analyst	DBZ	Analysis Date	Mar 16, 2021	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.95
Urban Street	Bardstown Rd	Analysis Year	2020	Analysis Period	1> 4:30
Intersection	Watterson Trail	File Name	Bardstown PM 20.xus		
Project Description	KJS Apartments				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	154	56	55	15	94	267	34	727	27	317	1276	191

Signal Information			
Cycle, s	170.0	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	4.9	61.7	16.1	23.7	30.7	0.0
Yellow	4.3	4.3	4.3	3.6	3.6	0.0
Red	2.4	2.4	2.4	2.8	2.8	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		11.0		11.0	1.2	3.0	1.3	3.0
Phase Duration, s		30.1		37.1	11.6	80.0	22.8	91.2
Change Period, (*Y+R* *c*), s		6.4		6.4	6.7	6.7	6.7	6.7
Max Allow Headway (*MAH*), s		5.2		5.3	5.0	0.0	5.0	0.0
Queue Clearance Time (*g* *s*), s		22.2		28.8	4.0		2.0	
Green Extension Time (*g* *e*), s		1.5		1.9	0.1	0.0	14.1	0.0
Phase Call Probability		1.00		1.00	0.82		1.00	
Max Out Probability		0.00		0.09	0.00		0.52	

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		221	58		115	281	36	765	28	343	1380	207
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1819			1858		1810	1781	1598	1730	1781	1610
Queue Service Time (*g* *s*), s		20.2			9.2		2.0	26.2	0.6	0.0	48.5	5.8
Cycle Queue Clearance Time (*g* *c*), s		20.2			9.2		2.0	26.2	0.6	0.0	48.5	5.8
Green Ratio (*g/C*)		0.14			0.18		0.40	0.44	0.62	0.45	0.50	0.50
Capacity (*c*), veh/h		254			335		126	1556	977	785	1770	800
Volume-to-Capacity Ratio (*X*)		0.871			0.342		0.285	0.492	0.029	0.437	0.780	0.258
Back of Queue (*Q*), ft/ln (90 th percentile)		363			181		43.1	401.6	15.7	214.7	560.2	78
Back of Queue (*Q*), veh/ln (90 th percentile)		14.4			7.1		1.7	15.8	0.6	8.5	22.1	3.1
Queue Storage Ratio (*RQ*) (90 th percentile)		0.00			0.00		0.36	0.00	0.04	0.61	0.00	0.00
Uniform Delay (*d* *1*), s/veh		71.6			60.8		39.1	34.6	6.4	48.0	25.5	9.7
Incremental Delay (*d* *2*), s/veh		12.2			0.9		1.8	1.1	0.1	0.2	1.5	0.3
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		83.8	5.0		61.7	5.0	40.8	35.7	6.5	48.2	27.0	10.1
Level of Service (LOS)		F	A		E	A	D	D	A	D	C	B
Approach Delay, s/veh / LOS	67.5		E	21.4		C	35.0		C	29.0		C
Intersection Delay, s/veh / LOS	32.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.47	B	2.63	C	2.16	B	1.92	B
Bicycle LOS Score / LOS	0.95	A	1.14	A	1.17	A	2.04	B

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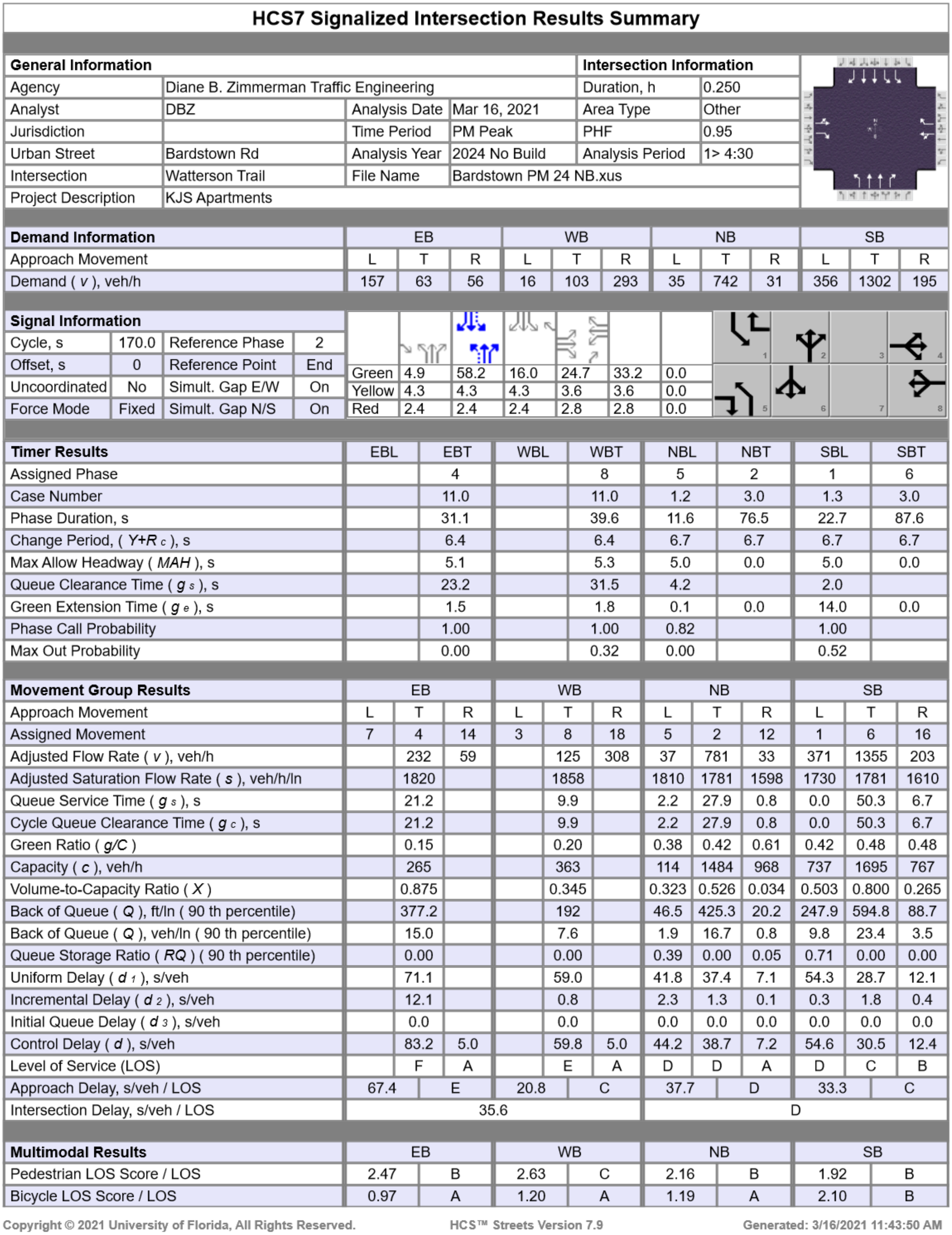

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	Diane B. Zimmerman Traffic Engineering			Duration, h	0.250
Analyst	DBZ	Analysis Date	Mar 16, 2021	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.95
Urban Street	Bardstown Rd	Analysis Year	2024 No Build	Analysis Period	1> 4:30
Intersection	Watterson Trail	File Name	Bardstown PM 24 NB.xus		
Project Description	KJS Apartments				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	157	63	56	16	103	293	35	742	31	356	1302	195

Signal Information										
Cycle, s	170.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	4.9	58.2	16.0	24.7	33.2	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.3	4.3	4.3	3.6	3.6	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.4	2.4	2.4	2.8	2.8	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		11.0		11.0	1.2	3.0	1.3	3.0
Phase Duration, s		31.1		39.6	11.6	76.5	22.7	87.6
Change Period, ($Y+R_c$), s		6.4		6.4	6.7	6.7	6.7	6.7
Max Allow Headway (*MAH*), s		5.1		5.3	5.0	0.0	5.0	0.0
Queue Clearance Time (g_s), s		23.2		31.5	4.2		2.0	
Green Extension Time (g_e), s		1.5		1.8	0.1	0.0	14.0	0.0
Phase Call Probability		1.00		1.00	0.82		1.00	
Max Out Probability		0.00		0.32	0.00		0.52	

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		232	59		125	308	37	781	33	371	1355	203
Adjusted Saturation Flow Rate (s), veh/h/ln		1820			1858		1810	1781	1598	1730	1781	1610
Queue Service Time (g_s), s		21.2			9.9		2.2	27.9	0.8	0.0	50.3	6.7
Cycle Queue Clearance Time (g_c), s		21.2			9.9		2.2	27.9	0.8	0.0	50.3	6.7
Green Ratio (g/C)		0.15			0.20		0.38	0.42	0.61	0.42	0.48	0.48
Capacity (c), veh/h		265			363		114	1484	968	737	1695	767
Volume-to-Capacity Ratio (X)		0.875			0.345		0.323	0.526	0.034	0.503	0.800	0.265
Back of Queue (Q), ft/ln (90 th percentile)		377.2			192		46.5	425.3	20.2	247.9	594.8	88.7
Back of Queue (Q), veh/ln (90 th percentile)		15.0			7.6		1.9	16.7	0.8	9.8	23.4	3.5
Queue Storage Ratio (*RQ*) (90 th percentile)		0.00			0.00		0.39	0.00	0.05	0.71	0.00	0.00
Uniform Delay (d_1), s/veh		71.1			59.0		41.8	37.4	7.1	54.3	28.7	12.1
Incremental Delay (d_2), s/veh		12.1			0.8		2.3	1.3	0.1	0.3	1.8	0.4
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		83.2	5.0		59.8	5.0	44.2	38.7	7.2	54.6	30.5	12.4
Level of Service (LOS)		F	A		E	A	D	D	A	D	C	B
Approach Delay, s/veh / LOS	67.4	E		20.8	C		37.7	D		33.3	C	
Intersection Delay, s/veh / LOS	35.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.47	B	2.63	C	2.16	B	1.92	B
Bicycle LOS Score / LOS	0.97	A	1.20	A	1.19	A	2.10	B

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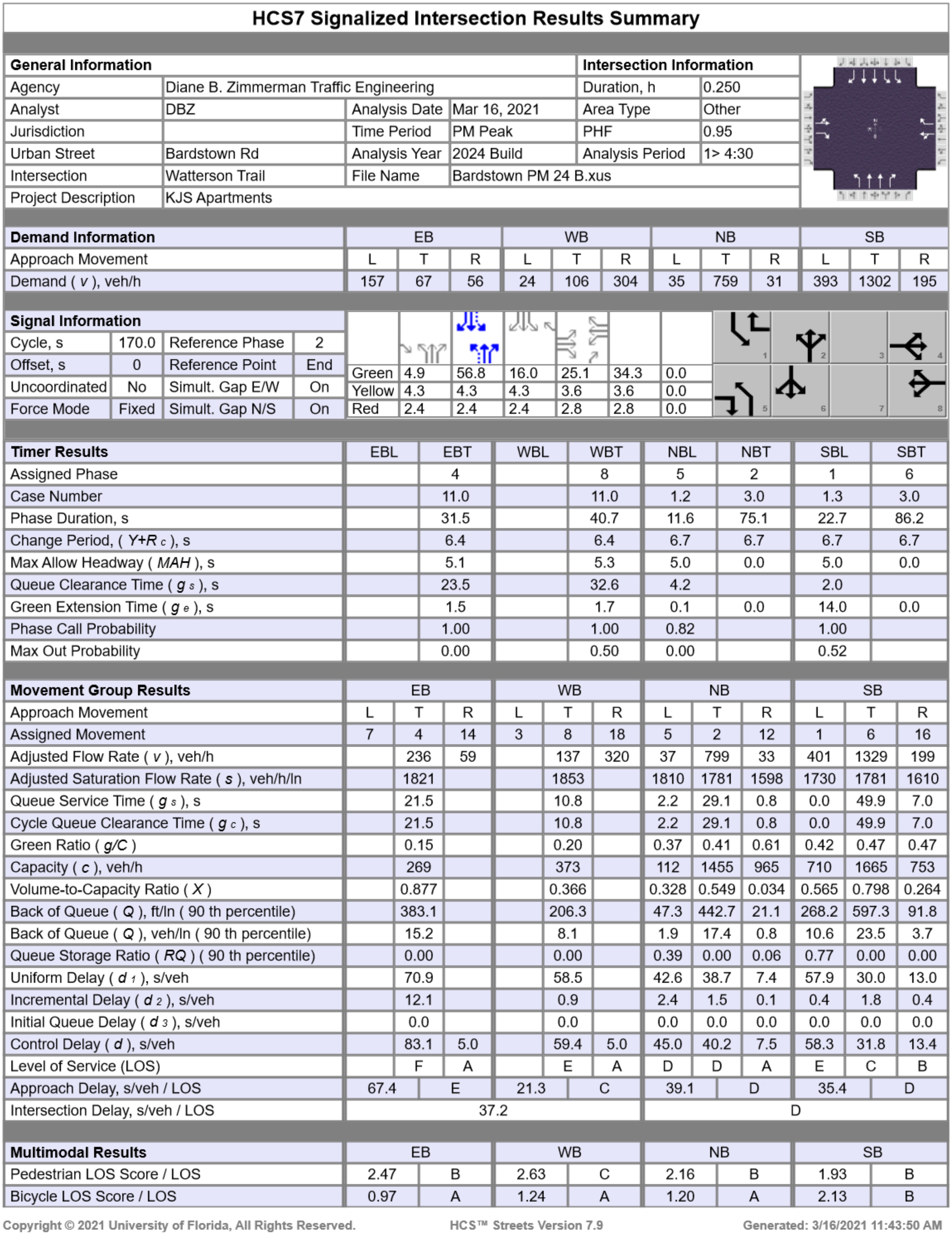

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	Diane B. Zimmerman Traffic Engineering			Duration, h	0.250
Analyst	DBZ	Analysis Date	Mar 16, 2021	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.95
Urban Street	Bardstown Rd	Analysis Year	2024 Build	Analysis Period	1> 4:30
Intersection	Watterson Trail	File Name	Bardstown PM 24 B.xus		
Project Description	KJS Apartments				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	157	67	56	24	106	304	35	759	31	393	1302	195

Signal Information										
Cycle, s	170.0	Reference Phase	2							
Offset, s	0	Reference Point	End							
Uncoordinated	No	Simult. Gap E/W	On	Green	4.9	56.8	16.0	25.1	34.3	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.3	4.3	4.3	3.6	3.6	0.0
				Red	2.4	2.4	2.4	2.8	2.8	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		11.0		11.0	1.2	3.0	1.3	3.0
Phase Duration, s		31.5		40.7	11.6	75.1	22.7	86.2
Change Period, (*Y+R* $_c$), s		6.4		6.4	6.7	6.7	6.7	6.7
Max Allow Headway (*MAH*), s		5.1		5.3	5.0	0.0	5.0	0.0
Queue Clearance Time (g_s), s		23.5		32.6	4.2		2.0	
Green Extension Time (g_e), s		1.5		1.7	0.1	0.0	14.0	0.0
Phase Call Probability		1.00		1.00	0.82		1.00	
Max Out Probability		0.00		0.50	0.00		0.52	

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		236	59		137	320	37	799	33	401	1329	199
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1821			1853		1810	1781	1598	1730	1781	1610
Queue Service Time (g_s), s		21.5			10.8		2.2	29.1	0.8	0.0	49.9	7.0
Cycle Queue Clearance Time (g_c), s		21.5			10.8		2.2	29.1	0.8	0.0	49.9	7.0
Green Ratio (*g/C*)		0.15			0.20		0.37	0.41	0.61	0.42	0.47	0.47
Capacity (*c*), veh/h		269			373		112	1455	965	710	1665	753
Volume-to-Capacity Ratio (*X*)		0.877			0.366		0.328	0.549	0.034	0.565	0.798	0.264
Back of Queue (*Q*), ft/ln (90 th percentile)		383.1			206.3		47.3	442.7	21.1	268.2	597.3	91.8
Back of Queue (*Q*), veh/ln (90 th percentile)		15.2			8.1		1.9	17.4	0.8	10.6	23.5	3.7
Queue Storage Ratio (*RQ*) (90 th percentile)		0.00			0.00		0.39	0.00	0.06	0.77	0.00	0.00
Uniform Delay (d_1), s/veh		70.9			58.5		42.6	38.7	7.4	57.9	30.0	13.0
Incremental Delay (d_2), s/veh		12.1			0.9		2.4	1.5	0.1	0.4	1.8	0.4
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		83.1	5.0		59.4	5.0	45.0	40.2	7.5	58.3	31.8	13.4
Level of Service (LOS)		F	A		E	A	D	D	A	E	C	B
Approach Delay, s/veh / LOS	67.4	E		21.3	C		39.1	D		35.4	D	
Intersection Delay, s/veh / LOS	37.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.47	B	2.63	C	2.16	B	1.93	B
Bicycle LOS Score / LOS	0.97	A	1.24	A	1.20	A	2.13	B

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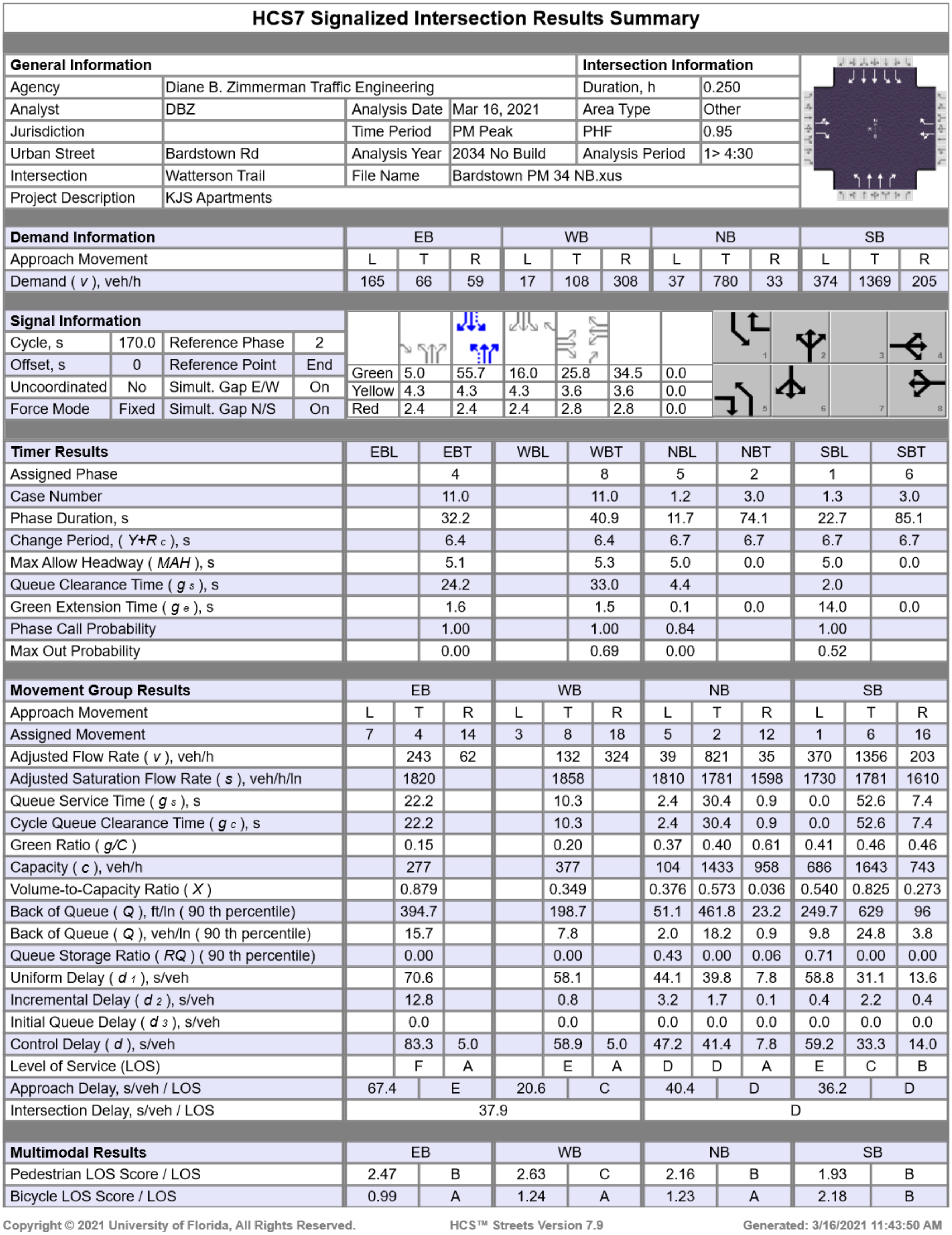

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	Diane B. Zimmerman Traffic Engineering			Duration, h	0.250
Analyst	DBZ	Analysis Date	Mar 16, 2021	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.95
Urban Street	Bardstown Rd	Analysis Year	2034 No Build	Analysis Period	1> 4:30
Intersection	Watterson Trail	File Name	Bardstown PM 34 NB.xus		
Project Description	KJS Apartments				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	165	66	59	17	108	308	37	780	33	374	1369	205

Signal Information			
Cycle, s	170.0	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	5.0	55.7	16.0	25.8	34.5	0.0
Yellow	4.3	4.3	4.3	3.6	3.6	0.0
Red	2.4	2.4	2.4	2.8	2.8	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		11.0		11.0	1.2	3.0	1.3	3.0
Phase Duration, s		32.2		40.9	11.7	74.1	22.7	85.1
Change Period, (*Y+R* c), s		6.4		6.4	6.7	6.7	6.7	6.7
Max Allow Headway (*MAH*), s		5.1		5.3	5.0	0.0	5.0	0.0
Queue Clearance Time (*g* s), s		24.2		33.0	4.4		2.0	
Green Extension Time (*g* e), s		1.6		1.5	0.1	0.0	14.0	0.0
Phase Call Probability		1.00		1.00	0.84		1.00	
Max Out Probability		0.00		0.69	0.00		0.52	

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		243	62		132	324	39	821	35	370	1356	203
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1820			1858		1810	1781	1598	1730	1781	1610
Queue Service Time (*g* s), s		22.2			10.3		2.4	30.4	0.9	0.0	52.6	7.4
Cycle Queue Clearance Time (*g* c), s		22.2			10.3		2.4	30.4	0.9	0.0	52.6	7.4
Green Ratio (*g/C*)		0.15			0.20		0.37	0.40	0.61	0.41	0.46	0.46
Capacity (*c*), veh/h		277			377		104	1433	958	686	1643	743
Volume-to-Capacity Ratio (*X*)		0.879			0.349		0.376	0.573	0.036	0.540	0.825	0.273
Back of Queue (*Q*), ft/ln (90 th percentile)		394.7			198.7		51.1	461.8	23.2	249.7	629	96
Back of Queue (*Q*), veh/ln (90 th percentile)		15.7			7.8		2.0	18.2	0.9	9.8	24.8	3.8
Queue Storage Ratio (*RQ*) (90 th percentile)		0.00			0.00		0.43	0.00	0.06	0.71	0.00	0.00
Uniform Delay (*d* 1), s/veh		70.6			58.1		44.1	39.8	7.8	58.8	31.1	13.6
Incremental Delay (*d* 2), s/veh		12.8			0.8		3.2	1.7	0.1	0.4	2.2	0.4
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		83.3	5.0		58.9	5.0	47.2	41.4	7.8	59.2	33.3	14.0
Level of Service (LOS)		F	A		E	A	D	D	A	E	C	B
Approach Delay, s/veh / LOS	67.4	E		20.6	C		40.4	D		36.2	D	
Intersection Delay, s/veh / LOS	37.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.47	B	2.63	C	2.16	B	1.93	B
Bicycle LOS Score / LOS	0.99	A	1.24	A	1.23	A	2.18	B

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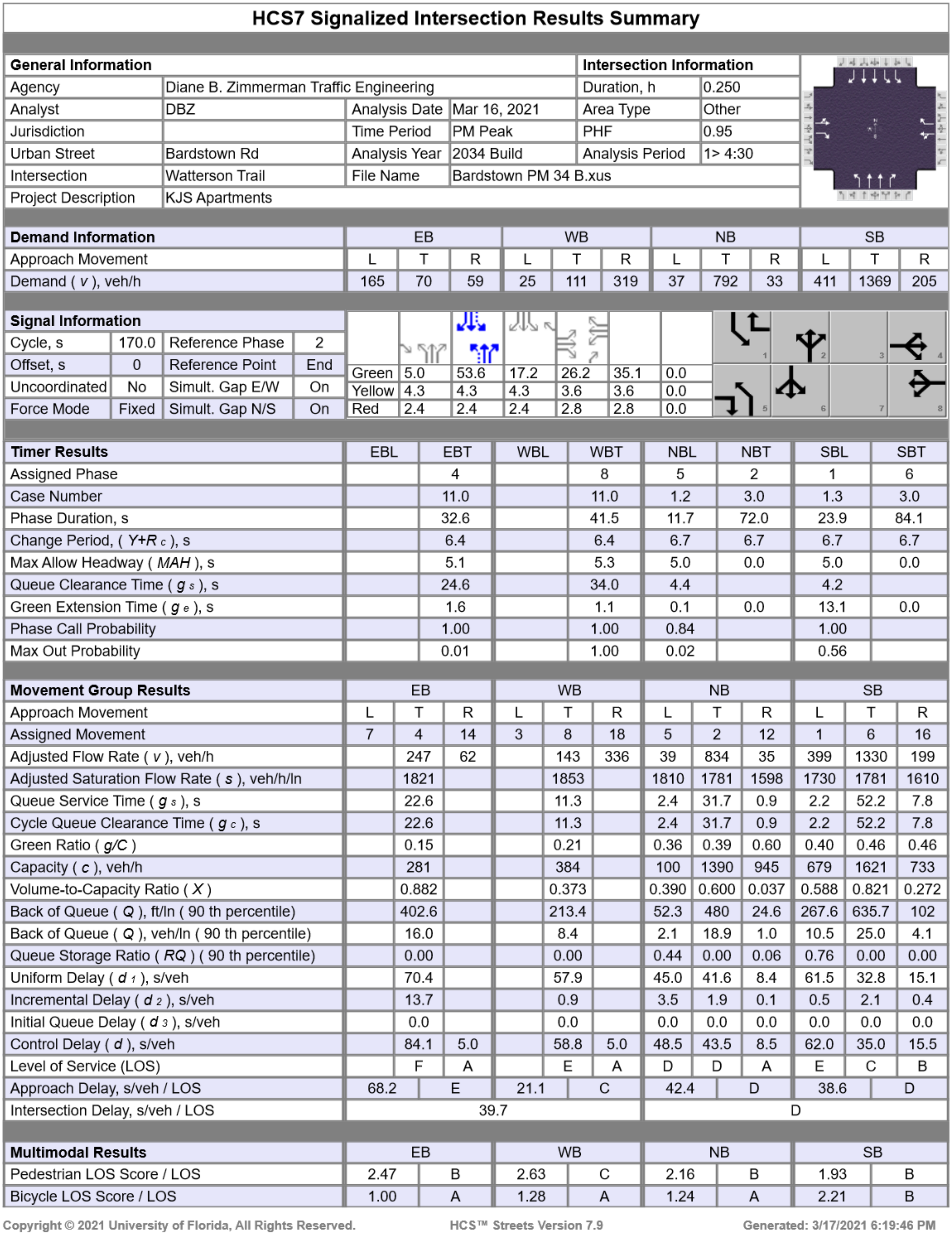

HCS7 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	Diane B. Zimmerman Traffic Engineering			Duration, h	0.250
Analyst	DBZ	Analysis Date	Mar 16, 2021	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.95
Urban Street	Bardstown Rd	Analysis Year	2034 Build	Analysis Period	1> 4:30
Intersection	Watterson Trail	File Name	Bardstown PM 34 B.xus		
Project Description	KJS Apartments				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	165	70	59	25	111	319	37	792	33	411	1369	205

Signal Information			
Cycle, s	170.0	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	5.0	53.6	17.2	26.2	35.1	0.0
Yellow	4.3	4.3	4.3	3.6	3.6	0.0
Red	2.4	2.4	2.4	2.8	2.8	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		11.0		11.0	1.2	3.0	1.3	3.0
Phase Duration, s		32.6		41.5	11.7	72.0	23.9	84.1
Change Period, ($Y+R_c$), s		6.4		6.4	6.7	6.7	6.7	6.7
Max Allow Headway (*MAH*), s		5.1		5.3	5.0	0.0	5.0	0.0
Queue Clearance Time (g_s), s		24.6		34.0	4.4		4.2	
Green Extension Time (g_e), s		1.6		1.1	0.1	0.0	13.1	0.0
Phase Call Probability		1.00		1.00	0.84		1.00	
Max Out Probability		0.01		1.00	0.02		0.56	

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		247	62		143	336	39	834	35	399	1330	199
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1821			1853		1810	1781	1598	1730	1781	1610
Queue Service Time (g_s), s		22.6			11.3		2.4	31.7	0.9	2.2	52.2	7.8
Cycle Queue Clearance Time (g_c), s		22.6			11.3		2.4	31.7	0.9	2.2	52.2	7.8
Green Ratio (*g/C*)		0.15			0.21		0.36	0.39	0.60	0.40	0.46	0.46
Capacity (*c*), veh/h		281			384		100	1390	945	679	1621	733
Volume-to-Capacity Ratio (*X*)		0.882			0.373		0.390	0.600	0.037	0.588	0.821	0.272
Back of Queue (*Q*), ft/ln (90 th percentile)		402.6			213.4		52.3	480	24.6	267.6	635.7	102
Back of Queue (*Q*), veh/ln (90 th percentile)		16.0			8.4		2.1	18.9	1.0	10.5	25.0	4.1
Queue Storage Ratio (*RQ*) (90 th percentile)		0.00			0.00		0.44	0.00	0.06	0.76	0.00	0.00
Uniform Delay (d_1), s/veh		70.4			57.9		45.0	41.6	8.4	61.5	32.8	15.1
Incremental Delay (d_2), s/veh		13.7			0.9		3.5	1.9	0.1	0.5	2.1	0.4
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		84.1	5.0		58.8	5.0	48.5	43.5	8.5	62.0	35.0	15.5
Level of Service (LOS)		F	A		E	A	D	D	A	E	C	B
Approach Delay, s/veh / LOS	68.2	E		21.1	C		42.4	D		38.6	D	
Intersection Delay, s/veh / LOS	39.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.47	B	2.63	C	2.16	B	1.93	B
Bicycle LOS Score / LOS	1.00	A	1.28	A	1.24	A	2.21	B

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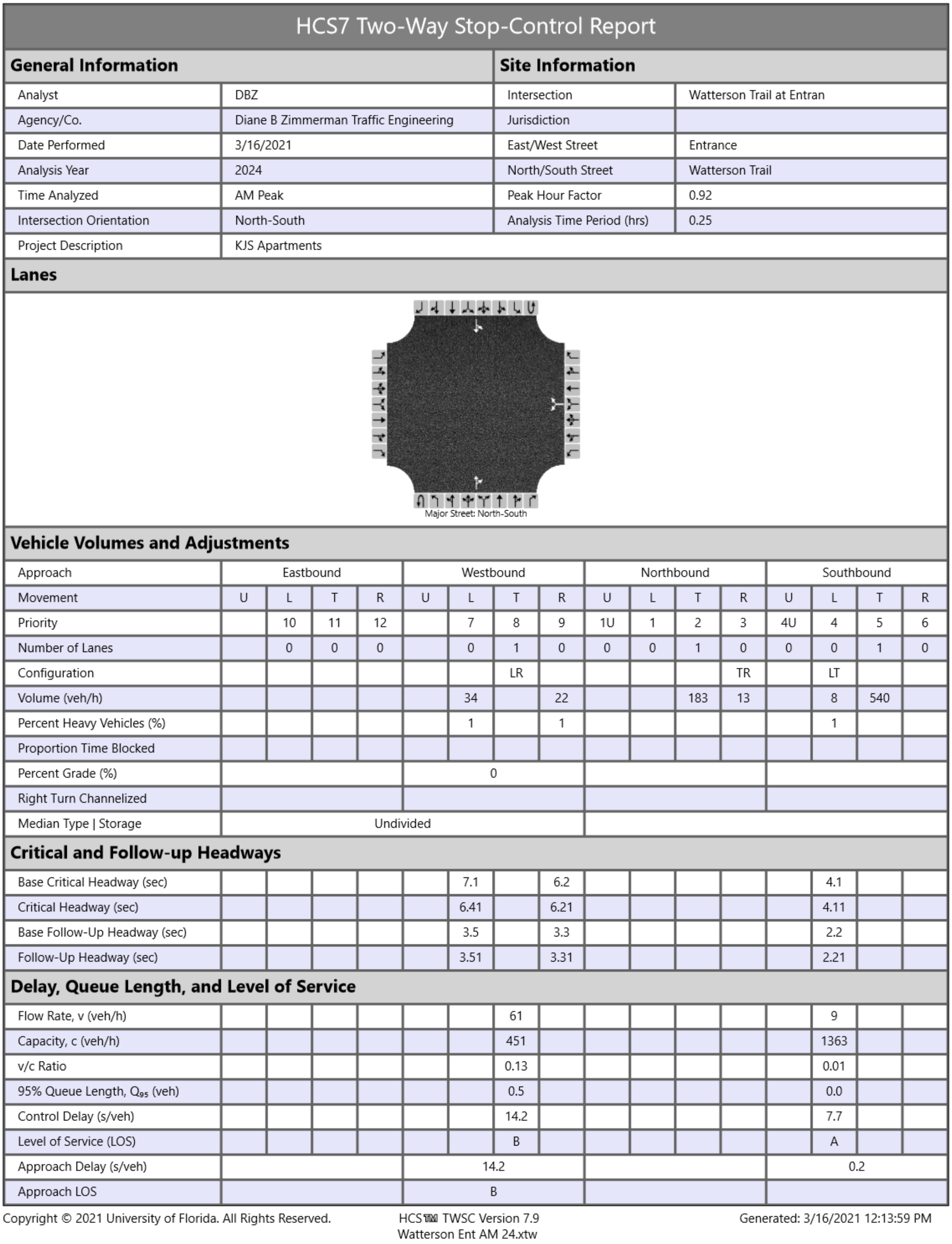

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	DBZ	Intersection	Watterson Trail at Entran
Agency/Co.	Diane B Zimmerman Traffic Engineering	Jurisdiction	
Date Performed	3/16/2021	East/West Street	Entrance
Analysis Year	2024	North/South Street	Watterson Trail
Time Analyzed	AM Peak	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	KJS Apartments		

Lanes

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	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR		LT		
Volume (veh/h)						34		22			183	13		8	540	
Percent Heavy Vehicles (%)						1		1						1		
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized																
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.41		6.21						4.11		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.51		3.31						2.21		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							61							9		
Capacity, c (veh/h)							451							1363		
v/c Ratio							0.13							0.01		
95% Queue Length, Q_{95} (veh)							0.5							0.0		
Control Delay (s/veh)							14.2							7.7		
Level of Service (LOS)							B							A		
Approach Delay (s/veh)					14.2								0.2			
Approach LOS					B											

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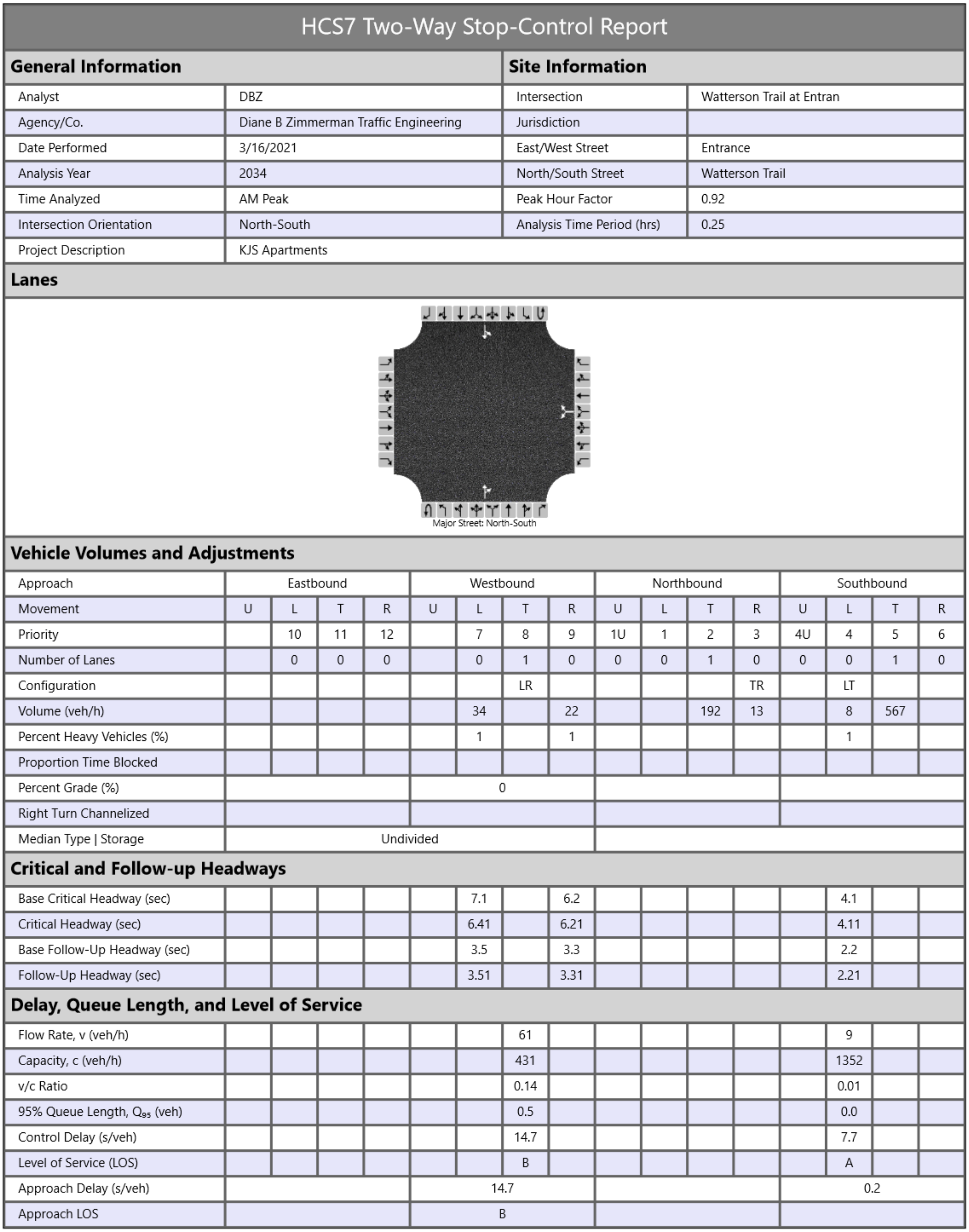

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	DBZ	Intersection	Watterson Trail at Entran
Agency/Co.	Diane B Zimmerman Traffic Engineering	Jurisdiction	
Date Performed	3/16/2021	East/West Street	Entrance
Analysis Year	2034	North/South Street	Watterson Trail
Time Analyzed	AM Peak	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	KJS Apartments		

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	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR		LT		
Volume (veh/h)						34		22			192	13		8	567	
Percent Heavy Vehicles (%)						1		1						1		
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized																
Median Type | Storage	Undivided															

Critical and Follow-up Headways

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.41		6.21						4.11		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.51		3.31						2.21		

Delay, Queue Length, and Level of Service

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Flow Rate, v (veh/h)							61							9		
Capacity, c (veh/h)							431							1352		
v/c Ratio							0.14							0.01		
95% Queue Length, Q_{95} (veh)							0.5							0.0		
Control Delay (s/veh)							14.7							7.7		
Level of Service (LOS)							B							A		
Approach Delay (s/veh)					14.7								0.2			
Approach LOS					B											

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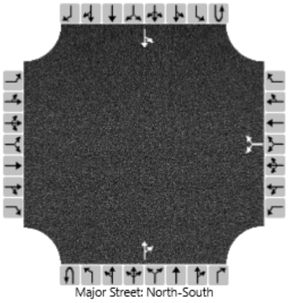
HCS7 Two-Way Stop-Control Report

General Information / Site Information

General Information		Site Information	
Analyst	DBZ	Intersection	Watterson Trail at Entran
Agency/Co.	Diane B Zimmerman Traffic Engineering	Jurisdiction	
Date Performed	3/16/2021	East/West Street	Entrance
Analysis Year	2024	North/South Street	Watterson Trail
Time Analyzed	PM Peak	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	KJS Apartments		

Lanes



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	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR		LT		
Volume (veh/h)						22		14			450	41		22	412	
Percent Heavy Vehicles (%)						1		1						1		
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized																
Median Type | Storage	Undivided															

Critical and Follow-up Headways

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.41		6.21						4.11		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.51		3.31						2.21		

Delay, Queue Length, and Level of Service

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Flow Rate, v (veh/h)							39							24		
Capacity, c (veh/h)							329							1039		
v/c Ratio							0.12							0.02		
95% Queue Length, Q_{95} (veh)							0.4							0.1		
Control Delay (s/veh)							17.4							8.5		
Level of Service (LOS)							C							A		
Approach Delay (s/veh)					17.4								0.7			
Approach LOS					C											

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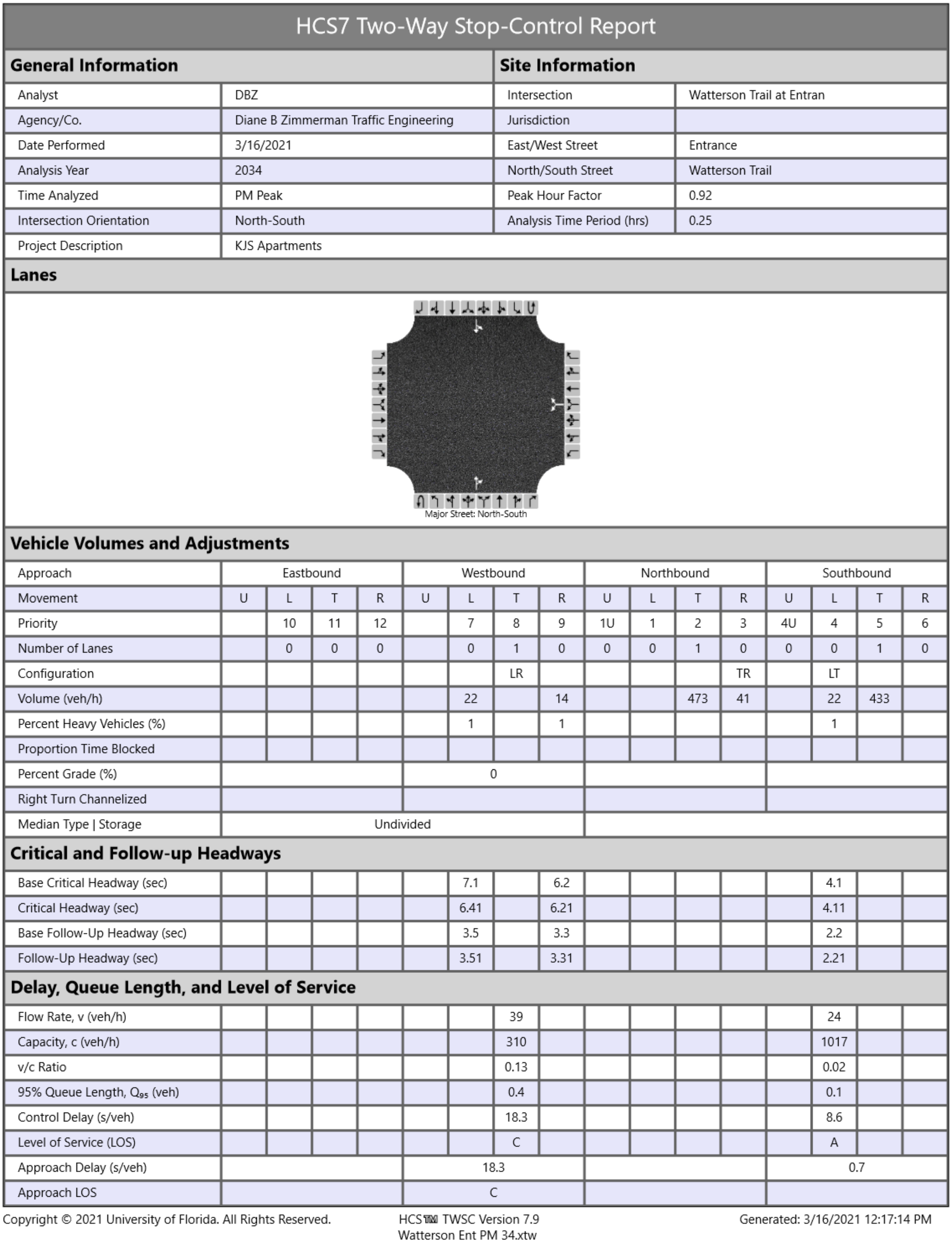

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	DBZ	Intersection	Watterson Trail at Entran
Agency/Co.	Diane B Zimmerman Traffic Engineering	Jurisdiction	
Date Performed	3/16/2021	East/West Street	Entrance
Analysis Year	2034	North/South Street	Watterson Trail
Time Analyzed	PM Peak	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	KJS Apartments		

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	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR		LT		
Volume (veh/h)						22		14			473	41		22	433	
Percent Heavy Vehicles (%)						1		1						1		
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized																
Median Type | Storage	Undivided															

Critical and Follow-up Headways

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.41		6.21						4.11		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.51		3.31						2.21		

Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)							39							24		
Capacity, c (veh/h)							310							1017		
v/c Ratio							0.13							0.02		
95% Queue Length, Q_{95} (veh)							0.4							0.1		
Control Delay (s/veh)							18.3							8.6		
Level of Service (LOS)							C							A		
Approach Delay (s/veh)					18.3								0.7			
Approach LOS					C											

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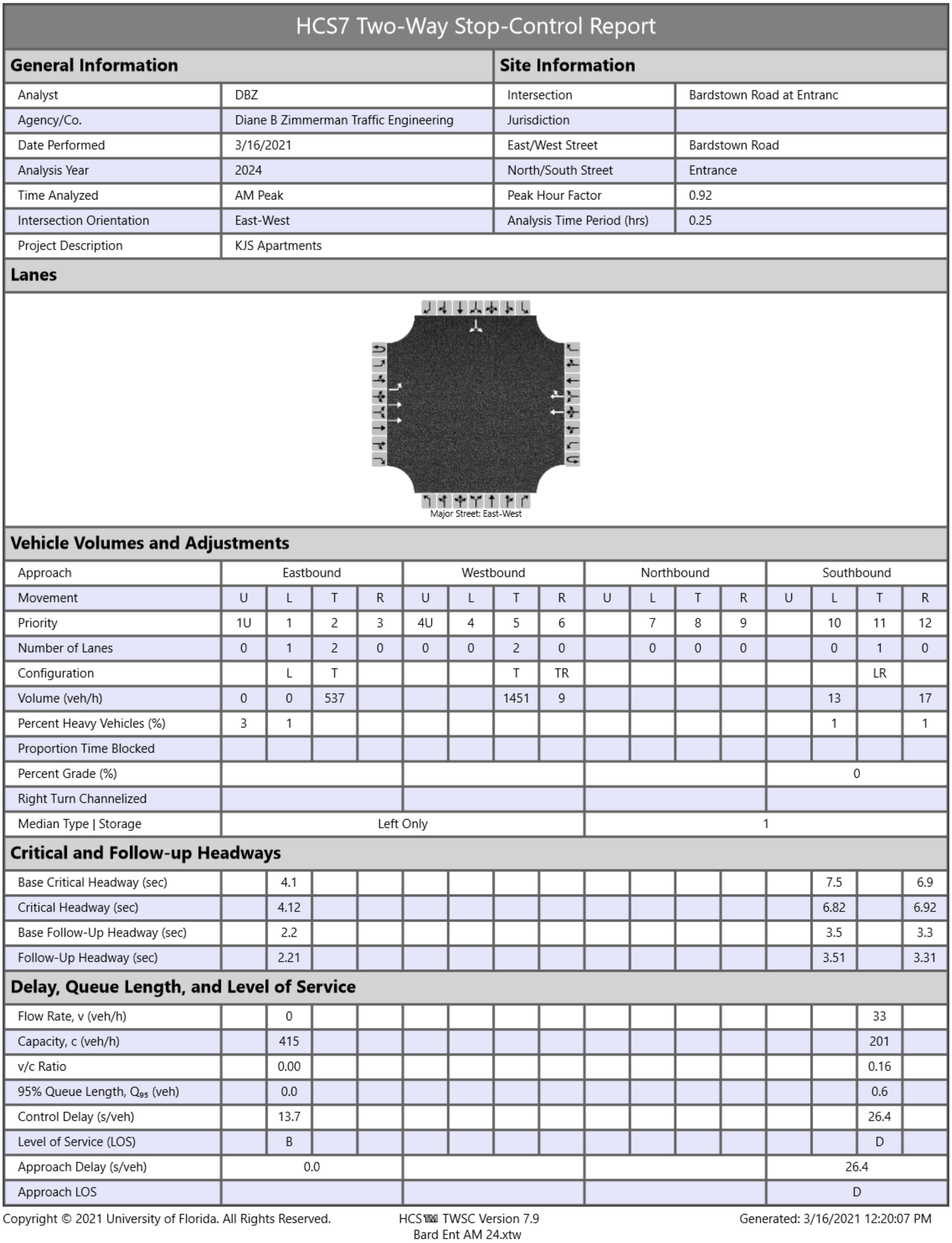

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	DBZ	Intersection	Bardstown Road at Entranc
Agency/Co.	Diane B Zimmerman Traffic Engineering	Jurisdiction	
Date Performed	3/16/2021	East/West Street	Bardstown Road
Analysis Year	2024	North/South Street	Entrance
Time Analyzed	AM Peak	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	KJS Apartments		

Lanes

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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	0	2	0		0	0	0		0	1	0
Configuration		L	T				T	TR							LR	
Volume (veh/h)	0	0	537				1451	9						13		17
Percent Heavy Vehicles (%)	3	1												1		1
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized																
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Base Critical Headway (sec)		4.1												7.5		6.9
Critical Headway (sec)		4.12												6.82		6.92
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.21												3.51		3.31

Delay, Queue Length, and Level of Service

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Flow Rate, v (veh/h)		0													33	
Capacity, c (veh/h)		415													201	
v/c Ratio		0.00													0.16	
95% Queue Length, Q_{95} (veh)		0.0													0.6	
Control Delay (s/veh)		13.7													26.4	
Level of Service (LOS)		B													D	
Approach Delay (s/veh)	0.0												26.4			
Approach LOS													D			

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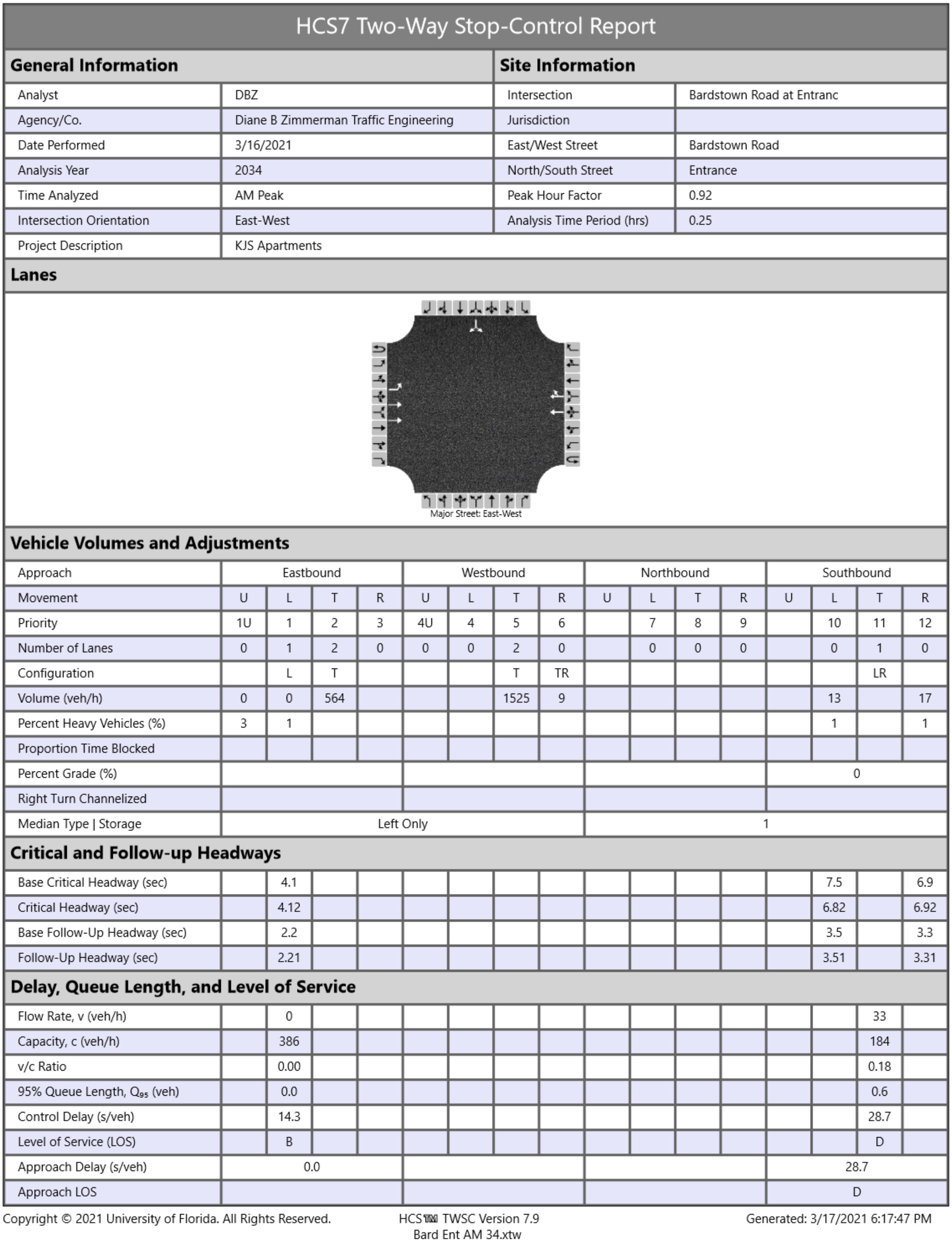

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	DBZ	Intersection	Bardstown Road at Entranc
Agency/Co.	Diane B Zimmerman Traffic Engineering	Jurisdiction	
Date Performed	3/16/2021	East/West Street	Bardstown Road
Analysis Year	2034	North/South Street	Entrance
Time Analyzed	AM Peak	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	KJS Apartments		

Lanes

Major Street: East-West

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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	0	2	0		0	0	0		0	1	0
Configuration		L	T				T	TR							LR	
Volume (veh/h)	0	0	564				1525	9						13		17
Percent Heavy Vehicles (%)	3	1												1		1
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized																
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Base Critical Headway (sec)		4.1												7.5		6.9
Critical Headway (sec)		4.12												6.82		6.92
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.21												3.51		3.31

Delay, Queue Length, and Level of Service

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Flow Rate, v (veh/h)		0													33	
Capacity, c (veh/h)		386													184	
v/c Ratio		0.00													0.18	
95% Queue Length, Q_{95} (veh)		0.0													0.6	
Control Delay (s/veh)		14.3													28.7	
Level of Service (LOS)		B													D	
Approach Delay (s/veh)	0.0												28.7			
Approach LOS													D			

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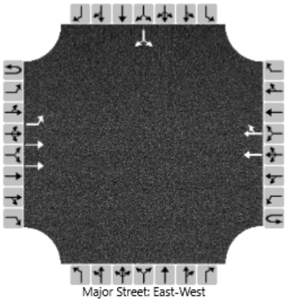
HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	DBZ	Intersection	Bardstown Road at Entranc
Agency/Co.	Diane B Zimmerman Traffic Engineering	Jurisdiction	
Date Performed	3/16/2021	East/West Street	Bardstown Road
Analysis Year	2024	North/South Street	Entrance
Time Analyzed	PM Peak	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	KJS Apartments		

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	0	2	0		0	0	0		0	1	0
Configuration		L	T				T	TR							LR	
Volume (veh/h)	0	0	1382				808	27						9		12
Percent Heavy Vehicles (%)	3	1												1		1
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized																
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.5		6.9
Critical Headway (sec)		4.12												6.82		6.92
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.21												3.51		3.31

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		0													23	
Capacity, c (veh/h)		752													337	
v/c Ratio		0.00													0.07	
95% Queue Length, Q_{95} (veh)		0.0													0.2	
Control Delay (s/veh)		9.8													16.5	
Level of Service (LOS)		A													C	
Approach Delay (s/veh)	0.0												16.5			
Approach LOS													C			

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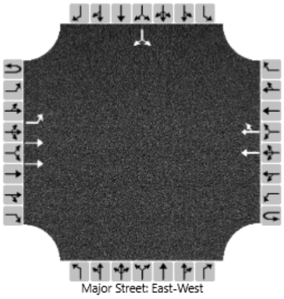
HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	DBZ	Intersection	Bardstown Road at Entranc
Agency/Co.	Diane B Zimmerman Traffic Engineering	Jurisdiction	
Date Performed	3/16/2021	East/West Street	Bardstown Road
Analysis Year	2034	North/South Street	Entrance
Time Analyzed	PM Peak	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	KJS Apartments		

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	0	2	0		0	0	0		0	1	0
Configuration		L	T				T	TR							LR	
Volume (veh/h)	0	0	1453				850	27						9		12
Percent Heavy Vehicles (%)	3	1												1		1
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized																
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.5		6.9
Critical Headway (sec)		4.12												6.82		6.92
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.21												3.51		3.31

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		0													23	
Capacity, c (veh/h)		723													319	
v/c Ratio		0.00													0.07	
95% Queue Length, Q_{95} (veh)		0.0													0.2	
Control Delay (s/veh)		10.0													17.2	
Level of Service (LOS)		A													C	
Approach Delay (s/veh)	0.0												17.2			
Approach LOS													C			

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