

Memo

Date: Thursday, June 29, 2023

Project: On Call Traffic Services

To: City of Brookings

From: HDR

Subject: 17th Avenue S & 20th Street S Intersection Multi-Way Stop-Control Warrant Review

Introduction

The purpose of this memo is to review multi-way stop-control application warrants at the intersection of 17th Avenue S & 20th Street S in Brookings, SD based on guidance outlined in the *Manual on Uniform Traffic Control Devices (MUTCD)*. Volume-based warrants were analyzed with traffic counts collected by HDR. Crash history-based warrants were reviewed with crash data derived from the South Dakota Department of Transportation (SDDOT).

The following intersection turning movements were utilized (provided in the **Appendix**):

- April 12, 2023
 - Total Duration: 10 hours
 - Time: 7:00 AM – 10:00 AM, 11:00 AM – 1 PM, 2 PM – 7 PM

Multi-Way Stop-Control Application Warrant Review

Multi-way stop-control application warrants for the 17th Avenue S & 20th Street S intersection were reviewed in accordance with *MUTCD* primary and optional criteria guidance. A summary of the warrant review results is shown in **Table 1**. Full descriptions of the reviewed criteria and summarized results are included in the **Appendix**.

Based on this review, multi-way stop-control is recommended due to the following considerations:

- Intersection traffic volumes are anticipated to increase due the opening of the I-29 Exit 130 (20th Street S) interchange and future development throughout the area, particularly along 20th Street S.
 - *Branch Creek Traffic Impact Study (TIS)* identified a long-range operational need for future intersection traffic control changes.
- Crashes correctable by multi-way stop-control were observed in the last 5 years.
- Safety benefits of providing pedestrians a controlled crossing of 20th Street S with crosswalks (optional Criterion B).
- Potential sight distance conflicts exist based on right angle crash history and dense, low-hanging street trees planted in the boulevard (optional Criterion C).
- Volume-based warrants are currently not met based on existing volumes, however:
 - Major approach volumes meet or exceed volume criteria
 - Minor approach volumes exceed volume criteria for up to a few hours (see **Figure 1**) and are expected to grow with continued development in the area
 - Northbound approach delay exceeds 30 seconds under two-way stop-control in 2023 Existing Conditions and 2025 Opening Day scenarios analyzed in *Branch Creek TIS*.
- Medary Avenue S & 20th Street S (0.5 miles to the west) and 17th Avenue S & 15th St S (0.4 miles to the north) are currently multi-way stop-control intersections.

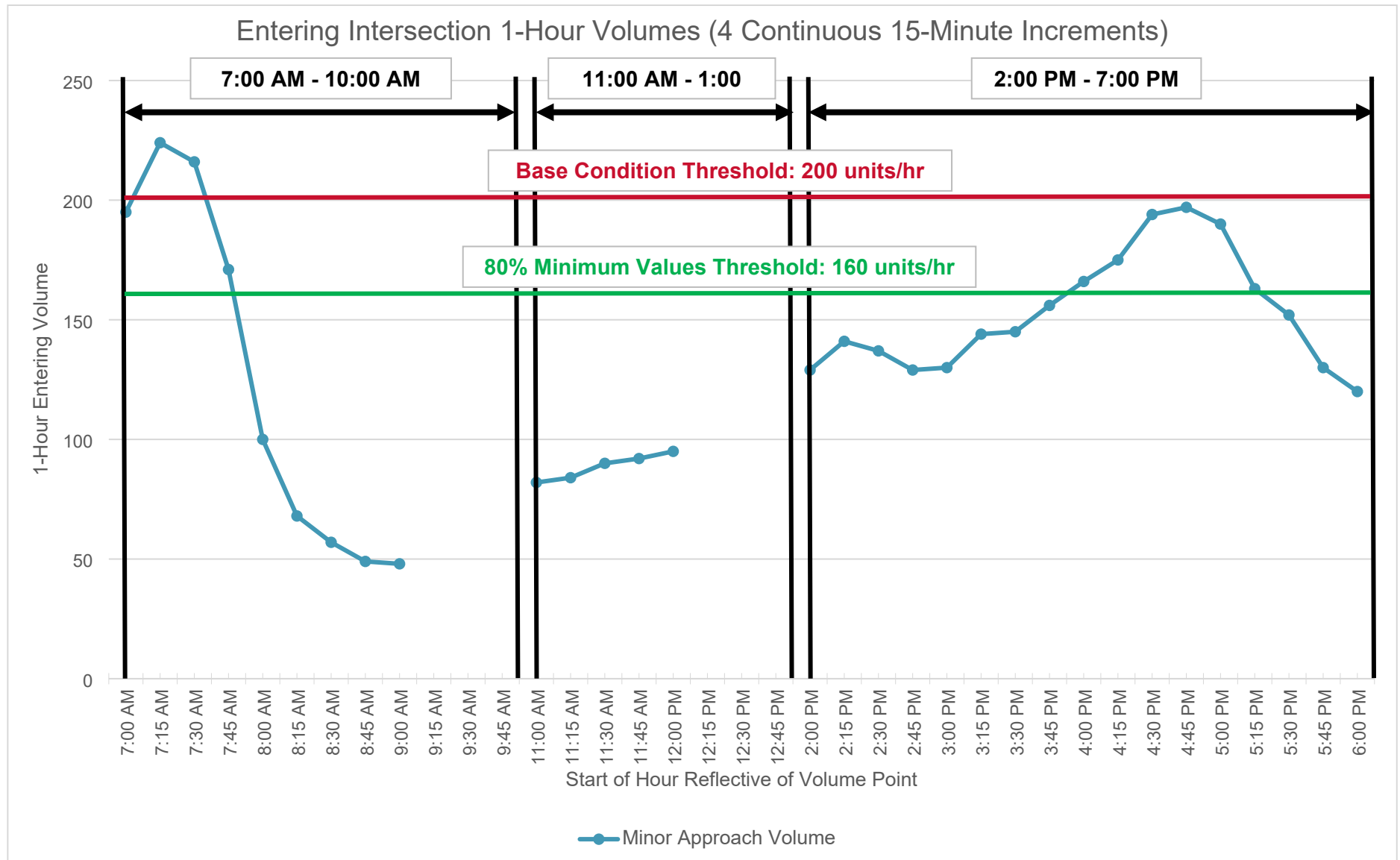


Figure 1: Minor Approach Volumes

Table 1: 17th Avenue S & 20th Street S Intersection Multi-Way Stop-Control Warrant Review Summary

Multi-Way Stop Control Warrant Criteria	Base Condition*		85 th -Percentile Speed**		80% Minimum Values***	
Primary Guidance						
Criterion A Interim Multi-Way Stop prior to Traffic Signal Installation	Not met	Based on <i>MUTCD</i> signal warrants, traffic volumes <u>do not meet</u> Warrant 1, 2, or 3 thresholds. See signal warrant report in the Appendix .	Not applicable	-	Not applicable	-
Criterion B Crash History	Not met	Crash history <u>does not meet</u> Criterion B of <u>5 or more</u> correctable crashes in a 12-month period. <u>Crash Data Summary</u> <ul style="list-style-type: none">Total Crashes: 5 (2018-2022)Correctable Crashes:<ul style="list-style-type: none">3 (5-year period)2 (12-month period)	Not applicable	-	Not met	Crash history <u>does not meet</u> Criterion B of <u>4 or more</u> correctable crashes in a 12-month period. <u>Crash Data Summary</u> <ul style="list-style-type: none">Total Crashes: 5 (2018-2022)Correctable Crashes:<ul style="list-style-type: none">3 (5-year period)2 (12-month period) <i>80% of B value in Base Condition</i>
Criterion C Minimum Volumes	Not met	Posted speed: 35 mph <u>Overall (C.1 and C.2): Not met</u> <ul style="list-style-type: none">Posted Speed: 1 of 8 hours met <u>C.1 (Major Approach Volume): Not met</u> <ul style="list-style-type: none">Posted Speed: 7 of 8 hours met <u>C.2 (Minor Approach Volume): Not met</u> <ul style="list-style-type: none">Posted Speed: 1 of 8 hours metNorthbound Approach Peak Hour Delay (<i>Branch Creek TIS</i>), AM / PM:<ul style="list-style-type: none">2023 Existing Conditions 33s / 21s2025 Opening Day : 44s / 43s	Not met	Sensitivity Speed: 42 mph <u>Overall (C.1 and C.2): Not met</u> <ul style="list-style-type: none">Sensitivity Speed: 3 of 8 hours met <u>C.1 (Major Approach Volume): Not met</u> <ul style="list-style-type: none">Sensitivity Speed: 9 of 8 hours met <u>C.2 (Minor Approach Volume): Not met</u> <ul style="list-style-type: none">Sensitivity Speed: 3 of 8 hours met <i>70% of C.1 and C.2 values in Base Condition</i> <i>Sensitivity Speed = posted speed + 7 mph (42 mph)</i>	Not met	Posted speed: 35 mph <u>Overall (C.1 and C.2): Not met</u> <ul style="list-style-type: none">Posted Speed: 3 of 8 hours met <u>C.1 (Major Approach Volume): Not met</u> <ul style="list-style-type: none">Posted Speed: 9 of 8 hours met <u>C.2 (Minor Approach Volume): Not met</u> <ul style="list-style-type: none">Posted Speed: 3 of 8 hours met <i>80% of C.1 and C.2 values in Base Condition</i>
Criterion D 80% of Minimum Criteria B, C.1, and C.2 Values	Not applicable	-	Not applicable	-	Not met	<u>D (80% of B, C.1, and C.2 Values): Not met</u>
Optional Guidance						
Criterion A Control Left-Turn Conflicts	Likely not applicable: Traffic volumes and crash history do not indicate a need to control left-turn conflicts.					
Criterion B Control Vehicle / Pedestrian Conflicts	Potentially applicable: Criterion <u>potentially applicable</u> due to the safety benefits of providing a controlled crossing, with crosswalks, for pedestrians to cross 20 th Street S. 17 th Avenue S is a desirable route for bicyclists and pedestrians, linking residential neighborhoods, Moriarty Park, and neighborhood schools. A controlled crossing at the intersection will be a beneficial connection linking the north and south sides of 20 th Street S.					
Criterion C Sight Distance Conflicts	Potentially applicable: Criterion <u>potentially applicable</u> due to right angle intersection crash history and potential sight distance issues with the low-hanging, dense street trees. Review intersection sight triangles with consideration to the street trees.					
Criterion D Two Intersecting Residential Collector Streets	Not applicable: 17 th Avenue S and 20 th Street S are functionally classified as a collector and arterial roadway, respectively, per the <i>Major Street Plan</i> included in the <i>City of Brookings 2040 Comprehensive Plan</i> .					

* Base Condition scenario reflects 20th Street S posted speed limit of 35 mph.
** 85th-Percentile Speed scenario reflects a sensitivity analysis with assumed 85th-percentile speed of 42 mph (35 mph (posted speed) + 7 mph) at 70% minimum vehicular volume values
*** 80% Minimum Values scenario reflects the Base Condition (35 mph) at 80% minimum values

Appendix

Appendix A: Traffic Counts

17th Avenue S & 20th Street S Intersection (10-Hr) [April 12, 2023]

Appendix B: MUTCD Multi-Way Stop-Control Application Warrant Criteria

Appendix C: MUTCD ASWC Primary Criteria Summary

17th Avenue S & 20th Street S Intersection

Base Condition

85th-Percentile Speed

Appendix D: Signal Warrant Report

17th Avenue S & 20th Street S Intersection (10-Hr) [April 12, 2023]

Appendix E: Intersection Crash Diagram

17th Avenue S & 20th Street S Intersection (2018-2022)



Appendix A: Traffic Counts

17th Avenue S & 20th Street S Intersection (10-Hr) [April 12, 2023]

Site Code 20234122
Project Brookings On-Call
Intersection 17th Avenue S & 20th Street S

Type Road
Classification Totals

	Southbound Approach Southbound					Westbound Approach Westbound					Northbound Approach Northbound					Eastbound Approach Eastbound					15-Min	1-Hr	PHF	Major Approach Traffic	Minor Approach Traffic
Start Time	Right	Thru	Left	U-Turn	Bike/Ped	Right	Thru	Left	U-Turn	Bike/Ped	Right	Thru	Left	U-Turn	Bike/Ped	Right	Thru	Left	U-Turn	Bike/Ped					
15-Minute Bins																									
7:00 AM	1	1	4	0	1	0	14	1	0	0	3	1	3	0	1	3	42	1	0	1	74				
7:15 AM	4	1	0	0	1	2	29	2	0	0	4	5	14	0	0	4	40	11	0	1	116				
7:30 AM	19	0	2	0	1	2	39	6	0	1	13	18	14	0	1	11	43	39	0	1	206				
7:45 AM	16	8	5	0	0	11	41	3	0	0	11	16	32	0	0	8	65	22	0	0	238	634		439	195
8:00 AM	8	3	1	0	1	1	23	1	0	0	9	9	12	0	0	7	64	16	0	0	154	714	0.75	490	224
8:15 AM	5	1	2	1	1	0	22	0	0	0	7	1	3	0	0	4	52	9	0	0	107	705		489	216
8:30 AM	1	2	1	1	0	1	16	0	0	0	7	4	5	0	0	4	27	3	0	0	72	571		400	171
8:45 AM	3	1	0	0	0	2	17	1	0	0	4	4	5	0	0	3	16	3	0	0	59	392		292	100
9:00 AM	0	1	3	0	1	2	10	4	0	0	2	2	2	0	0	4	23	1	0	0	54	292		224	68
9:15 AM	0	2	1	0	1	1	17	3	0	0	1	4	1	0	0	2	24	3	0	1	59	244		187	57
9:30 AM	4	0	1	0	0	3	15	2	0	0	2	4	2	0	0	1	25	2	0	0	61	233		184	49
9:45 AM	2	3	1	0	0	4	14	3	0	0	3	3	4	0	0	2	30	0	0	1	69	243		195	48
11:00 AM	4	4	1	0	1	2	18	4	0	0	3	4	5	0	0	4	20	6	0	0	75				
11:15 AM	4	7	1	0	0	3	20	1	0	0	0	4	2	0	0	4	18	2	0	0	66				
11:30 AM	3	3	5	0	0	7	29	2	0	0	3	5	2	0	0	4	22	5	0	0	90				
11:45 AM	3	5	2	0	1	2	32	1	0	0	2	5	5	0	0	4	26	4	0	0	91	322		240	82
12:00 PM	7	3	4	0	0	1	48	4	0	0	2	3	4	0	3	5	39	2	0	0	122	369		285	84
12:15 PM	3	4	0	0	0	2	41	5	0	1	5	3	9	0	0	7	35	3	0	0	117	420		330	90
12:30 PM	7	2	0	0	1	4	35	2	0	0	8	3	3	0	0	1	30	3	0	0	98	428		336	92
12:45 PM	3	5	0	0	0	1	25	8	0	0	3	8	6	0	0	4	31	6	0	0	100	437		342	95
2:00 PM	6	3	1	0	0	1	35	3	0	0	2	2	3	0	0	3	26	17	0	0	102				
2:15 PM	8	8	3	0	1	6	28	5	0	0	3	5	5	0	0	7	20	23	0	2	121				
2:30 PM	13	11	6	0	1	4	40	10	0	8	7	3	6	0	1	12	50	19	0	2	181				
2:45 PM	2	13	3	0	0	6	35	9	0	1	6	5	5	0	1	6	32	8	0	1	130	534		405	129
3:00 PM	2	10	2	0	0	3	37	2	0	0	6	5	4	0	0	5	31	1	0	0	108	540		399	141
3:15 PM	8	2	2	0	3	2	39	5	0	0	2	9	5	0	0	0	34	6	0	0	114	533		396	137
3:30 PM	3	9	3	0	0	3	48	7	0	0	7	9	7	0	0	8	40	7	0	0	151	503		374	129
3:45 PM	8	7	6	0	0	4	49	5	0	1	2	9	3	0	0	3	29	15	0	0	140	513		383	130
4:00 PM	14	6	6	0	0	5	44	6	0	2	4	6	7	0	0	10	37	14	0	0	159	564		420	144
4:15 PM	9	6	2	0	0	2	37	4	0	0	4	3	5	0	2	12	35	7	0	3	126	576		431	145
4:30 PM	16	10	3	0	2	4	64	5	0	1	8	5	7	0	0	8	43	7	0	0	180	605		449	156
4:45 PM	11	11	1	0	1	2	55	13	0	0	5	8	9	0	0	6	31	11	0	0	163	628		462	166
5:00 PM	17	10	4	0	1	11	60	14	0	0	4	6	11	0	0	18	42	11	0	1	208	677		502	175
5:15 PM	11	11	5	0	1	5	63	11	0	0	6	8	7	0	0	11	43	18	0	0	199	750		556	194
5:30 PM	20	9	1	0	0	2	64	13	0	2	4	9	9	0	1	12	44	10	0	3	197	767	0.92	570	197
5:45 PM	11	6	3	0	1	5	45	8	0	4	4	4	10	0	1	10	33	16	0	0	155	759		569	190
6:00 PM	6	4	2	0	0	2	56	4	0	1	5	3	5	0	0	4	31	9	0	0	131	682		519	163
6:15 PM	7	9	1	0	3	4	40	5	0	4	4	6	10	0	2	6	25	5	0	5	122	605		453	152
6:30 PM	4	8	1	0	2	2	25	5	0	3	3	10	4	0	3	12	38	5	0	5	117	525		395	130
6:45 PM	4	8	0	1	0	4	36	6	0	2	3	6	6	0	0	6	36	9	0	1	125	495		375	120
Total	277	217	89	3	26	128	1405	193	0	31	181	227	261	0	16	245	1372	359	0	28	4957				
AM & PM Peak Hours																									
AM Peak	47	12	8	0	3	16	132	12	0	1	37	48	72	0	1	30	212	88	0	2		714		4192	
PM Peak	59	41	11	0	3	20	242	51	0	2	19	31	36	0	1	47	160	50	0	4		767		1060	
Hour Bins																									
7:00 AM	40	10	11	0	3	15	123	12	0	1	31	40	63	0	2	26	190	73	0	3		634		439	200
8:00 AM	17	7	4	2	2	4	78	2	0	0	27	18	25	0	0	18	159	31	0	0		392		292	102
9:00 AM	6	6	6	0	2	10	56	12	0	0	8	13	9	0	0	9	102	6	0	2		243		195	50
11:00 AM	14	19	9	0	2	14	99	8	0	0	8	18	14	0	0	16	86	17	0	0		322		240	84
12:00 PM	20	14	4	0	1	8	149	19	0	1	18	17	22	0	3	17	135	14	0	0		437		342	99
2:00 PM	29	35	13	0	2	17	138	27	0	9	18	15	19	0	2	28	128	67	0	5		534		405	133
3:00 PM	21	28	13	0	3	12	173	19	0	1	17	32	19	0	0	16	134	29	0	0		513		383	133
4:00 PM	50	33	12	0	3	13	200	28	0	3	21	22	28	0	2	36	146	39	0	3		628		462	171
5:00 PM	59	36	13	0	3	23	232	46	0	6	18	27	37	0	2	51	162	55	0	4		759		569	195
6:00 PM	21	29	4	1	5	12	157	20	0	10	15	25	25	0	5	28	130	28	0	11		495		375	130
8-HR AVERAGE																								370	130



Appendix B: MUTCD Multi-Way Stop-Control Application Warrant Criteria

Multi-Way Stop-Control Application Warrants

Multi-way stop-control application warrants are reviewed in accordance with guidance from the Manual on Uniform Traffic Control Devices (MUTCD) and considers both primary and optional guidance criteria.

Primary Guidance Criteria

Primary guidance on the application of multi-way stop-control applications is detailed in Section 2B.07 of the MUTCD. The primary criteria that should be considered in the engineering study for a multi-way stop sign installation include:

- A. *Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.*
- B. *Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.*
- C. *Minimum volumes:*
 - 1. *The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and*
 - 2. *The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but*
 - 3. *If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.*
- D. *Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.*

Optional Criteria

Optional criteria that may be considered in a multi-way stop sign installation engineering study include:

- A. *The need to control left-turn conflicts;*
- B. *The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes*
- C. *Locations where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting traffic is also required to stop; and*
- D. *An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop-control would improve traffic operational characteristics of the intersection.*



Appendix C: MUTCD ASWC Criteria Summary

17th Avenue S & 20th Street S Intersection

Base Condition

85th-Percentile Speed

ASWC Warrant Criteria

MUTCD No

MUTCD

Met? Criteria

- No A. Is a signal justified? No
- No B. # of crashes in a 12 month period that can be corrected by multi-way stop control: 2
- No C. Minimum Volumes
1. Major road approach volume (total of both) at least 300 vph for min 8 hours?
 2. Combined ped, bike, and veh volume on minor approach (total of both) at least 200 units per hour for the same 8 hours as criteria C-1?
 3. If the 85th percentile speed on the major road exceeds 40 mph, may use 70% of the values in C-1 and C-2

Major Street 85th percentile mph: 35

Time Period	From	To	Major Road: Both App.	Minor Road: Both App. (VPH)	C-1	C-2	Both Met?	D (80%)		Both Met?
1	6:00	7:00								
2	7:00	8:00	439	200	Yes	Yes	Yes	Yes	Yes	Yes
3	8:00	9:00	292	102	No	No	No	Yes	No	No
4	9:00	10:00	195	50	No	No	No	No	No	No
5	10:00	11:00								
6	11:00	12:00	240	84	No	No	No	Yes	No	No
7	12:00	13:00	342	99	Yes	No	No	Yes	No	No
8	13:00	14:00								
9	14:00	15:00	405	133	Yes	No	No	Yes	No	No
10	15:00	16:00	383	133	Yes	No	No	Yes	No	No
11	16:00	17:00	462	171	Yes	No	No	Yes	Yes	Yes
12	17:00	18:00	569	195	Yes	No	No	Yes	Yes	Yes
13	18:00	19:00	375	130	Yes	No	No	Yes	No	No
14	19:00	20:00								
15	20:00	21:00								
16	21:00	22:00								

- No D. Use when previous criteria have not been met:
If 80% minimum values of Criteria B, C-1, and C-2 (C-3 excluded) are satisfied, warrant is met.

ASWC Warrant Criteria

MUTCD No

MUTCD

Met? Criteria

- No A. Is a signal justified? No
- No B. # of crashes in a 12 month period that can be corrected by multi-way stop control: 2
- No C. Minimum Volumes
1. Major road approach volume (total of both) at least 300 vph for min 8 hours?
 2. Combined ped, bike, and veh volume on minor approach (total of both) at least 200 units per hour for the same 8 hours as criteria C-1?
 3. If the 85th percentile speed on the major road exceeds 40 mph, may use 70% of the values in C-1 and C-2

Major Street 85th percentile mph: 42

Time Period	From	To	Major Road: Both App.	Minor Road: Both App. (VPH)	C-1 (70%)	C-2 (70%)	Both Met?	D (80%)		Both Met?
1	6:00	7:00								
2	7:00	8:00	439	200	Yes	Yes	Yes	Yes	Yes	Yes
3	8:00	9:00	292	102	Yes	No	No	Yes	No	No
4	9:00	10:00	195	50	No	No	No	No	No	No
5	10:00	11:00								
6	11:00	12:00	240	84	Yes	No	No	Yes	No	No
7	12:00	13:00	342	99	Yes	No	No	Yes	No	No
8	13:00	14:00								
9	14:00	15:00	405	133	Yes	No	No	Yes	No	No
10	15:00	16:00	383	133	Yes	No	No	Yes	No	No
11	16:00	17:00	462	171	Yes	Yes	Yes	Yes	Yes	Yes
12	17:00	18:00	569	195	Yes	Yes	Yes	Yes	Yes	Yes
13	18:00	19:00	375	130	Yes	No	No	Yes	No	No
14	19:00	20:00								
15	20:00	21:00								
16	21:00	22:00								

- No D. Use when previous criteria have not been met:
If 80% minimum values of Criteria B, C-1, and C-2 (C-3 excluded) are satisfied, warrant is met.



Appendix D: Signal Warrant Reports

17th Avenue S & 20th Street S Intersection (10-Hr) [April 12, 2023]

HCS Warrants Report

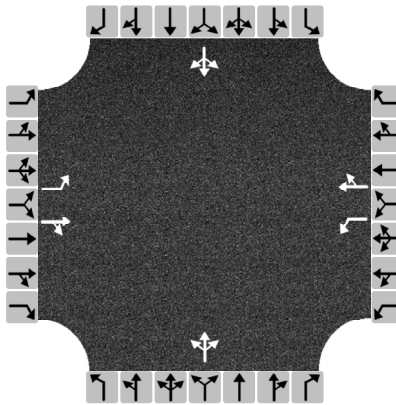
Project Information

Analyst	HDR	Date	6/2/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	City of Brookings	Time Period Analyzed	10 Hours
Project Description	17th Avenue S & 20th Street S Multi-Way Stop Review		

General

Major Street Direction	East-West	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	0	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Number of Lanes, N	1	1	0	1	1	0	0	1	0	0	1	0
Lane Usage	L	TR		L	TR			LTR			LTR	
Vehicle Volumes Averages (veh/h)	29	114	20	16	117	10	21	18	15	7	18	23
Pedestrian Averages (peds/h)	2			2			1			1		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	0
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

Volume Summary														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (100%)	1A (80%)	1B (100%)	1B (80%)	2 (100%)	3A (100%)	3B (80%)	4A (100%)	4B (80%)
07 - 08	439	134	634	8	0	No	No	No	No	No	No	No	No	No
08 - 09	292	70	390	1	0	No	No	No	No	No	No	No	No	No
09 - 10	195	30	243	2	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	240	42	322	0	0	No	No	No	No	No	No	No	No	No
12 - 13	342	57	437	5	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	405	77	534	18	0	No	No	No	No	No	No	No	No	No
15 - 16	383	68	513	4	0	No	No	No	No	No	No	No	No	No
16 - 17	462	95	628	11	0	No	No	No	No	No	No	No	No	No
17 - 18	569	108	759	15	0	No	No	No	No	No	No	No	No	No
18 - 19	375	65	494	31	0	No	No	No	No	No	No	No	No	No
Total	3702	746	4954	95	0	0	0	0	0	0	0	0	0	0

Warrants	
Warrant 1: Eight-Hour Vehicular Volume	
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	
80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	
Warrant 2: Four-Hour Vehicular Volume	
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)	
Warrant 3: Peak Hour	
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--	
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	
Warrant 4: Pedestrian Volume	
A. Four Hour Volumes --or--	
B. One-Hour Volumes	
Warrant 5: School Crossing	
Gaps Same Period --and--	
Student Volumes	
Nearest Traffic Control Signal (optional)	
Warrant 6: Coordinated Signal System	
Degree of Platooning (Predominant direction or both directions)	
Warrant 7: Crash Experience	
A. Adequate trials of alternatives, observance and enforcement failed --and--	
B. Reported crashes susceptible to correction by signal (12-month period) --and--	
C. 80% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied	
Warrant 8: Roadway Network	
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--	
B. Weekend Volume (Five hours total)	
Warrant 9: Grade Crossing	
A. Grade Crossing within 140 ft --and--	
B. Peak-Hour Vehicular Volumes	



Appendix E: Intersection Crash Diagram

17th Avenue S & 20th Street S Intersection (2018-2022)



↓ → P P ☒ 03/19/22 15:07
☀ D 2203356

← → P P ○ 07/27/18 17:57
☀ D 📱 1808871

↩ ← P M ☒ 05/21/21 14:09
☀ D 2106804

← Vehicle Path ↩ U Turn
▢ Parked Vehicle ➡ Unknown dir.
↔ Backing Vehicle 🚶 Ran off road
←| Rear End + More Units
→| Head On 🚶 Pedestrian
↺ Sideswipe 🚶 Fixed Object
↩ Left Turn 🐾 Wild Animal
↪ Right Turn

○ PDO
☒ Injury
● Fatal

☀ Clear
☁ Cloudy
🌫 Fog
🌧 Rain
❄ Snow
💨 Wind

D- Dry
W- Wet
S- Winter
O- Other

💊 Drugs
🍷 Alcohol
📱 Distracted
🚗 Speed
😴 Fatigue
🚧 Work Zone

T-Truck
M-Motorcycle
P-Passenger
A-ATV
R-Tractor
E-Equipment
B-Bicycle
L-Railway

↑ ← P P ○ 02/20/19 07:32
☁ S 1902406

↑ → P P ○ 05/03/22 17:21
☀ D 2206424

17TH AVE S and 20TH ST S