



Ohio Department of Transportation, District 3

2021 Signal Evaluation

Lorain SR 82, SLM 9.05

Boone Rd Intersection

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Signal Evaluation Background

The Ohio Manual of Uniform Traffic Control Devices (OMUTCD) requires that the operation of existing traffic signals to be analyzed every five years. The following report considers whether an existing signal is still warranted per OMUTCD signal warrants, and if any operational changes are required to ensure the signal is performing well.

Existing Signal

The following features are present at the existing signal, constructed in 2016:

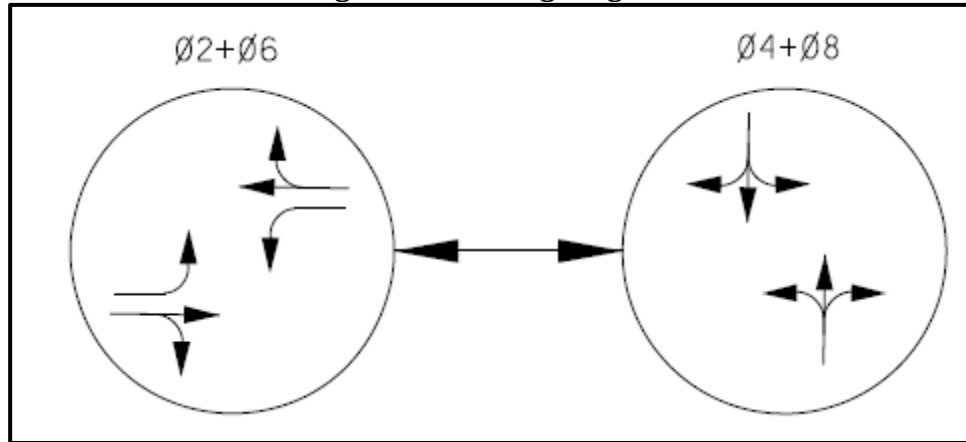
- Signal Type: Mast Arms (4 supports)
- Signal Heads: Black Polycarbonate 12-inch LEDs with Reflective Backplates
- Controller: Cobalt with Ground-Mounted Cabinet and Battery Backup
- Turn Lanes: 350 ft Left Turn Lanes Eastbound and Westbound
- Detection: Loops – Fully Actuated with Stop Bar and Advance Detection on All Approaches
- Timing: See **Table 1** below.

Table 1 – Traffic Signal Timing

DATE: 9/29/2017		OVERLAP				A	B	C	D
FLASH MODE: ALL RED		PHASES							
INTERVAL OR FEATURE		CONTROLLER MOVEMENT No.							
		1	2	3	4	5	6	7	8
INTERSECTION MOVEMENT			EB		SB		WB		NB
MINIMUM GREEN (INITIAL)	(SEC)		10		10		10		10
PASSAGE TIME (GAP)	(SEC)		5.0		4.0		5.0		4.0
MAXIMUM GREEN I	(SEC)		45		30		45		30
MAXIMUM GREEN II	(SEC)		45		30		45		30
YELLOW CHANGE	(SEC)		5.0		5.0		5.0		5.0
ALL RED CLEARANCE	(SEC)		1.0		1.0		1.0		1.0
WALK	(SEC)		-		-		-		-
PEDESTRIAN CLEARANCE	(SEC)		-		-		-		-
RECALL	MINIMUM (ON/OFF)		ON		OFF		ON		OFF
	MAXIMUM (ON/OFF)		OFF		OFF		OFF		OFF
	PEDESTRIAN (ON/OFF)		OFF		OFF		OFF		OFF
NON-LOCK	(ON/OFF)		OFF		ON		OFF		ON
ADDED INITIAL	(SEC)		2.3		-		2.3		-
MAXIMUM INITIAL	(SEC)		20		-		20		-
TIME TO REDUCE	(SEC)		20		-		20		-
TIME BEFORE REDUCTION	(SEC)		10		-		10		-
MINIMUM GAP	(SEC)		5.0		-		5.0		-

- Phasing: See **Figure 1** below.

Figure 1 – Phasing Diagram



- Photo: See **Image 1** below for a photograph of the intersection.

Image 1 – SR 82 & Boone Rd Signal from the Southwest (December 2021)



- Speeds: 45 mph on SR 82 and Boone Rd North, 55 mph on Boone Rd South
- Traffic: Mid-morning traffic was generally light, detection and volume-density appeared to be functioning.

Crash Data

Crashes were analyzed at the SR 82 & Boone Rd intersection from January 1, 2016 through December 31, 2020. The reported crashes are summarized in **Table 2** below.

Table 2 – Crash Data

YEAR		SEVERITY		TYPE		ROAD CONDITION	
2016	5 (36%)	Fatal	0 (0%)	Angle	6 (43%)	Dry	10 (71%)
2017	3 (21%)	Injury	6 (43%)	Rear End	4 (29%)	Wet	3 (21%)
2018	2 (14%)	PDO	8 (57%)	Backing	1 (7%)	Snow	1 (7%)
2019	3 (21%)			SS-Passing	1 (7%)		
2020	1 (7%)			Right Turn	1 (7%)		
				Left Turn	1 (7%)		
TOTAL	14 (100%)						

- Of the 6 angle crashes, 3 were red light-running, 2 were undetermined because the intersection was mistaken for stop-controlled, and 1 was failure to yield because it occurred before the signal was installed
- All 4 rear end crashes were westbound

Supplemental Evaluations

The following additional studies were performed to ensure safe and efficient operation of the signal:

1. **Turning Movements:** A traffic count was requested to obtain updated traffic volumes for the intersection. The traffic count was performed on June 29, 2021 between the hours of 7:00 AM – 7:00 PM. The count information can be found in in **Table 3** below:

Table 3 – Turning Movement Count

Peak Hour (Start Time)	Boone Rd Southbound				SR 82 Westbound				Boone Rd Northbound				SR 82 Eastbound				Total
	R	T	L	Tot	R	T	L	Tot	R	T	L	Tot	R	T	L	Tot	
Total Count	166	161	320	647	413	5133	179	5725	194	165	280	639	233	4998	153	5384	12395
AM Peak (07:15)	12	13	33	58	16	331	1	348	22	19	36	77	15	591	4	610	1093
PM Peak (16:15)	13	32	37	82	52	731	30	813	18	16	26	60	36	442	12	490	1445

2. **Signal Warrant:** The signal warrant was analyzed at this intersection to verify if the existing signal should be retained. The OMUTCD Section 4C lists nine warrants for the installation of a signal. Warrants 1–3 (8-Hour Volume, 4-Hour Volume, Peak Hour Volume) were all analyzed based on the Turning Movement Count data. The intersection met the following signal warrants using the 70 percent volumes for signal retention as shown in **Table 4** below:

Table 4 – Signal Warrants

Warrant	Hours Needed	Hours Met	Warrant Met
1 - Eight Hour Vehicular Volumes	8	0	No
1B - Interruption of Continuous Traffic	8	9	Yes
1 A&B - Combination of Warrants	1A	8	No
	1B	8	
2 - Four Hour Volumes	4	6	Yes
3 - Peak Hour Volumes	-	-	Yes

3. **Clearance Interval Calculation:** Appropriate yellow and all-red clearance intervals are important to safe operation of a signal. Using the clearance interval calculation method provided by the ODOT Office of Traffic Operations, the calculated clearance intervals are shown in **Table 5** below:

Table 5 – Updated Clearance Intervals

INTERVAL OR FEATURE	CONTROLLER MOVEMENT No.							
	1	2	3	4	5	6	7	8
INTERSECTION MOVEMENT		EB		NB		WB		SB
YELLOW CHANGE (SEC)		5.0		6.0		5.0		6.0
ALL RED CLEARANCE (SEC)		1.0		1.0		1.0		1.0
PEDESTRIAN CLEARANCE (SEC)		15.7		14.6		12.3		14.9

Pedestrian clearance intervals are met for all movements except eastbound because the minimum green time plus yellow change interval is greater than the calculated required pedestrian clearance.

4. **Capacity Analysis:** Highway Capacity Software (HCS 7) was used to analyze the Level of Service (LOS) of each approach for existing timing at the intersection. The LOS is based on the calculated seconds of delay for each approach at an intersection the Highway Capacity Manual (HCM) methodology. The results are summarized in **Table 6** below:

Table 6 – Existing Intersection Level of Service by Approach

Existing Delay s/veh and (LOS)	Intersection Approach				Intersection Combined Delay
	SR 82		Boone Rd		
	EB	WB	NB	SB	
AM Peak	9.9 (A)	7.1 (A)	12.7 (B)	12.5 (B)	9.4 (A)
PM Peak	6.9 (A)	10.0 (A)	16.8 (B)	17.1 (B)	9.6 (A)

Signal Evaluation Recommendations

- Update northbound and southbound yellow change intervals from 5.0 to 6.0 seconds
- Increase eastbound and westbound minimum green time to 12 seconds to accommodate pedestrian clearance intervals
- Install radar detection so that the volume-density timings can be removed, and the passage times can be reduced

The signal is currently operating well, but the minor road volume is light, especially compared to the major road volume. It would operate optimally if the passage time on the minor road could be reduced from 4.0 seconds to 2.0 seconds to maximize green time on the major road.