ALLIANT PROJ. NO. 111-0118

MEMORANDUM

DATE: February 9, 2012

TO: Kirk Roberts

City of Bloomington Traffic Engineer

FROM: Ken Levin, PE

SUBJECT: **86th Street Delay & Gap Study**

As requested, Alliant Engineering has completed a field study of the 86th Street corridor. Prior to the summer of 2010, 86th Street was a four-lane undivided roadway with two lanes for motor vehicles each way. 86th Street was converted to a three lane street that had one lane for motor vehicles each way, one bike lane each way, and a shared center left turn lane. Due to the change in lane configuration, area residents expressed concern to the city that there was a longer wait time to access 86th Street. The purpose of the field study is to provide quantifiable traffic data to help the City assess the quality of access along 86th Street and to help discern if the three lane conversion negatively impacted traffic conditions.

This memorandum is organized into the following sections:

1. Data Collection
2. Study Results
3. Conclusions

1. Data Collection

The ability to access 86th Street from any one of the north/south residential streets is dependent upon the availability and length of traffic gaps. When many gaps are present, a motorist should experience a short delay before crossing or entering 86th Street; and vice versa, the lack of traffic gaps should result in longer delays. To measure the performance of 86th Street, Alliant Engineering conducted a traffic gap study and a corresponding stop controlled approach delay study at eight locations along 86th Street. The following eight locations were selected at key representative locations along the corridor:

1. 86th Street & Knox Avenue S.
2. 86th Street & Emerson Avenue S.
3. 86th Street & Pillsbury Avenue S.
4. 86th Street & 3rd Avenue S.
5. 86th Street & Chicago Avenue S.
6. 86th Street & 14th Avenue S.
7. 86th Street & 17th Avenue S.
8. 86th Street & 22nd Avenue S.

Since the City of Bloomington did not have similar available data to represent the four-lane undivided condition along 86th Street prior to the three-lane conversion, two locations along 90th Street were studied for comparison. Based on a comparison of traffic volumes along both 86th Street and 90th Street, the following two locations were selected.

1. 90th Street & Chicago Avenue S.
2. 90th Street & 18th Avenue S.

The 90th Street at Chicago Avenue had similar peak hour volumes to each of the 86th Street at Knox Avenue, 86th Street at 3rd Avenue, and 86th Street at Chicago Avenue intersections. The second location, 90th Street at 18th Avenue, had similar peak hour volumes to 86th Street at 14th Avenue and 86th Street at 17th Avenue. Figure 1 shows the 10 locations studied and also illustrates the traffic volume data along the corridor.

Alliant Engineering conducted on-site field observations and the traffic gap and stopped approach delay data collection at the ten locations listed above during January of 2012. The delay study data consisted of timestamps of every vehicle's arrival and departure time. The vehicle volume, vehicle minimum delay, vehicle maximum delay, and average vehicle delay are calculated using this information. The gap study data consisted of timestamps of every vehicle traveling along the major road as it passed the minor road. East/West vehicle volume, average gap, and the number of gaps in the traffic flow were determined from this data. The field collected data was analyzed and conclusions were made from the analysis.

The field studies were conducted between January 5th, 2012 and January 19th, 2012. All data was collected from 5:00 p.m. to 6:00 p.m. on a Tuesday, Wednesday, or Thursday, which is the highest hourly traffic volume that occurs. Delay studies were performed for both the northbound and southbound approaches at all intersections where data was gathered unless there was only one approach to study. Gap studies were performed for both the eastbound and westbound traffic at all intersections where data was gathered.

2. Study Results

Table 1 shows the northbound and southbound vehicle volume, minimum delay, maximum delay, and average delay for vehicles trying to access or cross 86th Street and 90th Street.

Table 1. Delay Study Results

Site Code	Intersection	Time Period	Northbound Approach				Southbound Approach			
			Volume	Min. Delay [s]	Max. Delay [s]	Avg. Delay [s]	Volume	Min. Delay [s]	Max. Delay [s]	Avg. Delay [s]
1	86th Street at Knox Ave S	5:00-6:00 pm	-	-	-	-	12	3	26	7
2	86th Street at Emerson Ave S	5:00-6:00 pm	9	4	23	12	10	3	48	13
3	86th Street at Pillsbury Ave S	5:00-6:00 pm	-	-	-	-	26	2	19	5
4	86th Street at 3rd Ave S	5:00-6:00 pm	8	3	17	8	2	3	5	4
5	86th Street at Chicago Ave S	5:00-6:00 pm	7	3	17	7	5	5	12	8
6	86th Street at 14th Ave S	5:00-6:00 pm	22	3	35	11	7	3	8	5
7	86th Street at 17th Ave S	5:00-6:00 pm	-	-	-	-	12	3	34	9
8	86th Street at 22nd Ave	5:00-6:00 pm	13	3	14	5	28	3	32	8
9	90th Street at Chicago Ave S	5:00-6:00 pm	5	4	15	7	2	4	5	5
10	90th Street at 18th Ave S	5:00-6:00 pm	8	2	9	5	27	3	24	7

Table 2 shows the eastbound and westbound vehicle volume, average gap time, number of gaps greater than 7.5 seconds, number of gaps greater than 11.5 seconds, and number of gaps greater than 17 seconds along 86th Street and 90th Street. Acceptable passenger car gap (7.5 seconds) and acceptable combination truck gap (11.5 seconds) values were taken from A Policy on Geometric Design of Highways and Streets (AASHTO Green Book), 2011, 6th Edition, page 9-37, Table 9-5. Acceptable pedestrian gap (17 s) was calculated based on the widest section of roadway along 86th Street and a pedestrian walking at 3.5 ft/s.

Table 2. Gap Study Results

Site Code	Intersection	Time Period	East/West Volume	Average Gap [s]	> 7.5 [s] Gaps Acceptable Passenger Car Gap	> 11.5 [s] Gaps Acceptable Combination Truck Gap	> 17.0 [s] Gaps Acceptable Pedestrian Gap
1	86th Street at Knox Ave S	5:00-6:00 pm	624	5.8	147	79	38
2	86th Street at Emerson Ave S	5:00-6:00 pm	680	4.5	107	56	23
3	86th Street at Pillsbury Ave S	5:00-6:00 pm	813	4.4	135	67	35
4	86th Street at 3rd Ave S	5:00-6:00 pm	710	5.1	135	73	41
5	86th Street at Chicago Ave S	5:00-6:00 pm	745	4.7	132	69	36
6	86th Street at 14th Ave S	5:00-6:00 pm	665	5.4	168	83	32
7	86th Street at 17th Ave S	5:00-6:00 pm	571	6.3	163	96	46
8	86th Street at 22nd Ave	5:00-6:00 pm	416	8.5	158	98	60
9	90th Street at Chicago Ave S	5:00-6:00 pm	598	6.0	150	95	52
10	90th Street at 18th Ave S	5:00-6:00 pm	459	7.8	142	99	58

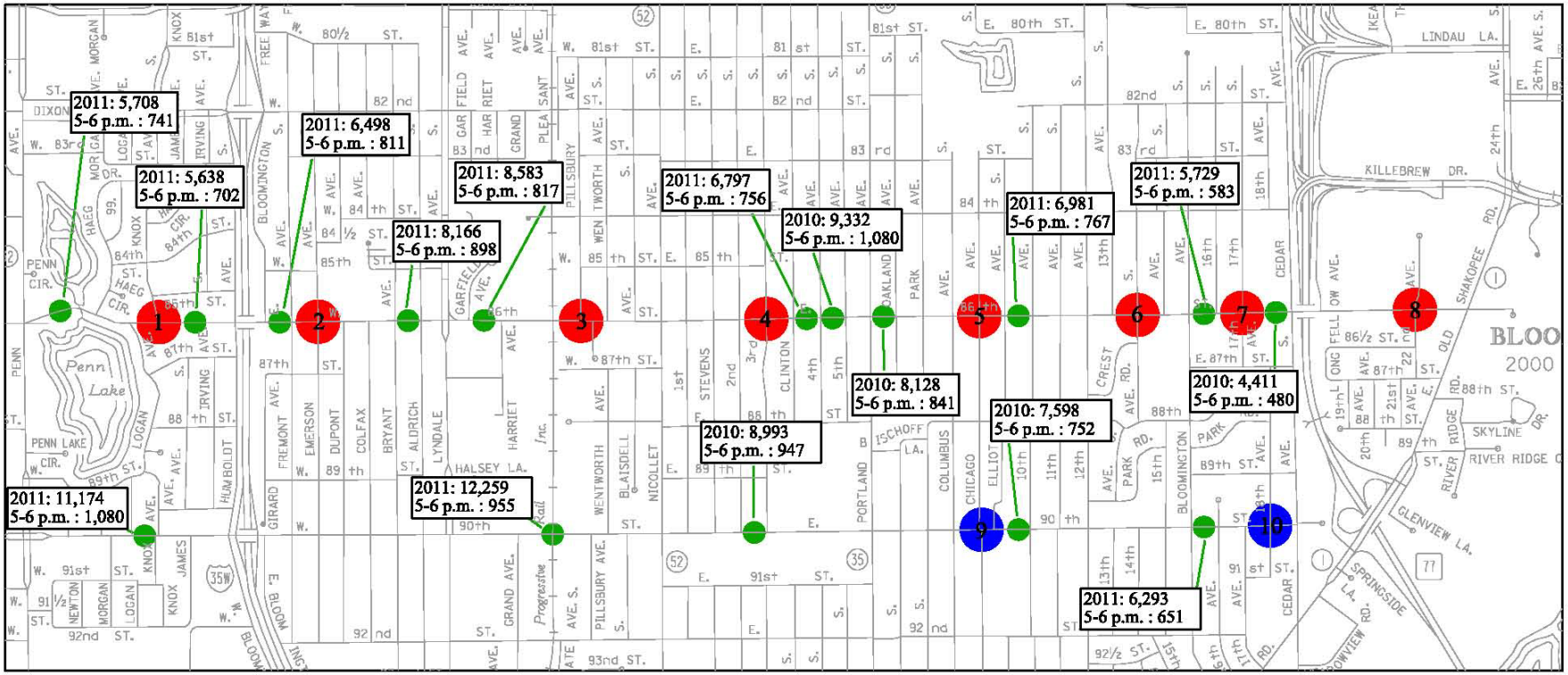
3. Conclusions

The delay studies performed show that approach volumes on the minor streets studied ranged from two vehicles to 28 vehicles during the p.m. peak hour. Delay values ranged from two seconds to 48 seconds. Average delay for all of the approaches studied during the peak hour had a maximum value of 13 seconds.

Level of Service (LOS) is a measurement that traffic engineers use to define how well an intersection approach is operating. LOS A represents an approach with very little vehicle delay while LOS F would represent an approach that has a lot of vehicle delay. Transportation industry standards define LOS D or better as acceptable. According to the Highway Capacity Manual, page 19-2, Exhibit 19-1, LOS B is between 10 and 15 seconds and LOS A is 10 seconds or less. Three of the approaches studied were LOS B and the remaining 14 approaches were found to be LOS A. The LOS A and LOS B measurements are acceptable levels of delay for the motoring public.

The gap studies performed had east/west p.m. peak hour volumes ranging from 416 to 813 vehicles per hour. Average gaps in traffic ranged from 4.4 seconds to 8.5 seconds. Over the course of the peak hour there were anywhere from 107 to 168 acceptable passenger car gaps (greater than 7.5 seconds). Acceptable combination truck gaps (greater than 11.5 seconds) ranged from 56 to 99. Acceptable pedestrian gaps (greater than 17 seconds) ranged from 23 to 60. At 86th Street and Emerson Avenue the number of gaps was somewhat lower than the remainder of the intersections studied. This is also reflected by the slightly higher stop delays found at this location.

The comparison between the 90th Street study locations (four-lane undivided) and the 86th Street study locations (three lane section) found no discernible difference between average stop delays or the number of traffic gaps greater than 7.5 seconds (acceptable traffic gap for a passenger car to safely enter roadway). The difference between 86th Street and 90th Street might be best reflected in the longer gap times needed for a pedestrian or a large truck to enter or cross the roadway. To be specific there were an average of 143 gaps on 86th Street and 146 on 90th Street greater than 7.5 seconds during the p.m. peak hour. However, the number of gaps longer than 17 seconds is less on 86th Street than found on 90th Street. On average there were 78 traffic gaps on 86th Street and 97 traffic gaps on 90th Street greater than 11.5 seconds (acceptable traffic gap for a larger truck to safely enter roadway) during the p.m. peak hour. On average there were 39 traffic gaps on 86th Street and 55 traffic gaps on 90th Street greater than 17 seconds (acceptable traffic gap for a pedestrian to safely cross roadway) during the p.m. peak hour. Even though there are a smaller number of 11.5 second and 17 second gaps on 86th Street, there are still an adequate number of gaps for a truck or pedestrian to enter or cross 86th Street without waiting an unreasonable amount of time.



Node Locations:

1 86th Street & Knox Avenue S.
2 86th Street & Emerson Avenue S.
3 86th Street & Pillsbury Avenue S.
4 86th Street & 3rd Avenue S.
5 86th Street & Chicago Avenue S.
6 86th Street & 14th Avenue S.
7 86th Street & 17th Avenue S.
8 86th Street & 22nd Avenue S.
9 90th Street & Chicago Avenue S.
10 90th Street & 18th Avenue S.

86th Street (3-lane) delay and gap study location (5-6 p.m.)

90th Street (4-lane) delay and gap study location comparable (5-6 p.m.)

Year: East/West daily traffic volume
5-6 p.m. : East/West p.m. peak hour traffic volume

Figure 1. Study Location