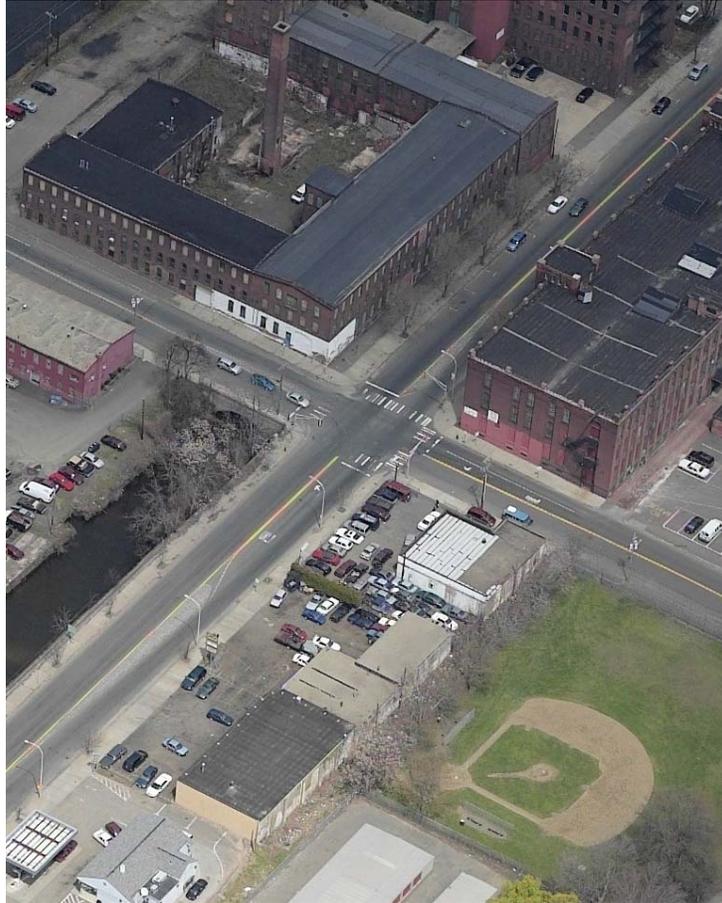


# **Main and Jackson Intersection Transportation Safety Study**

## **Final Report**



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**Prepared under the direction of the Pioneer Valley Metropolitan Planning  
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City of Holyoke**

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## **I. INTRODUCTION**

The City of Holyoke requested that the Pioneer Valley Planning Commission (PVPC) include the intersection of Main Street with Jackson Street as a candidate for a safety study as part of the federal fiscal year 2006 Unified Planning Work Program (UPWP). This study will review the recent crash history of the intersection of Main Street with Jackson Street to identify the factors which contribute to safety problems in this area. Potential improvement alternatives will be identified and analyzed in order to give the Massachusetts Highway Department (MassHighway) and the City of Holyoke a variety of options on how to reduce the number of crashes at this intersection.

### **A. STUDY AREA**

Main Street is an arterial roadway serving a variety of commercial land uses and providing access to Interstate 391 and the center of Holyoke, with a speed limit of 30 miles per hour traveling in both directions. The lane width at the east end of the intersection measures at 17 feet in the eastbound direction and 22 feet in the westbound direction. At the west end of the intersection, the eastbound approach of Main Street measures 23 feet in width for the westbound direction and 22 feet in the eastbound direction. Cobblestone center medians are provided on both approaches and a crosswalk is provided at the traffic lights, on all four sides of the intersection.

Jackson Street serves a variety of residential and commercial traffic. At the north end of the intersection, the lane width is 15 feet for Jackson Street northbound, and 20 feet for the southbound direction. At the time of the field inventory of this intersection, it was noted that the pavement markings were very faded. On street parking is allowed on the eastern end of the intersection on Main Street eastbound. Both sidewalks and crosswalks were available for all sides of the intersection. A small cobblestone median separates entering and exiting traffic. At the north end of the intersection, Jackson Street provides one lane of traffic in the southbound direction, however smaller vehicles were observed to form two lanes of traffic. Exclusive left turn lanes were provided at the western end of the intersection for the Eastbound traffic on Main Street as well as at the southern end of the intersection for the Northbound traffic on Jackson Street.

Main Street intersects Jackson Street to form a four way intersection operating under traffic signal control. This signal operates under full actuation. No pedestrian phase is provided. Exclusive left turn lanes are located on the Eastbound approach of Main Street and the Northbound approach of Jackson Street, but there are not exclusive (protective) phases for left turning vehicles in the existing signal timing plan. A variety of commercial site driveways intersect with Main Street and Jackson Street in the vicinity of the intersection. Currently, the auto sales and repair shops located at the corner between Jackson Street Southbound and Main Street Eastbound have driveways in close proximity to the intersection.

## II. EXISTING TRANSPORTATION CONDITIONS

This section provides a technical evaluation of the transportation conditions at the intersection of Main Street at Jackson Street. It includes a presentation of the data collected, crash experience, and recommendations to the overall performance and safety of the intersection.

### A. DATA COLLECTION

#### 1. *Hourly Vehicle Volumes*

Hourly traffic counts were taken in the study area during the month of November 2005. Known as manual turning movement counts, the hourly counts were taken by PVPC staff during the morning (7-9 AM) and afternoon (4-6 PM) peak hours. Copies of all traffic counts are attached to this document. The adjusted weekday morning and afternoon peak hour traffic volumes are shown in Figure II-1.

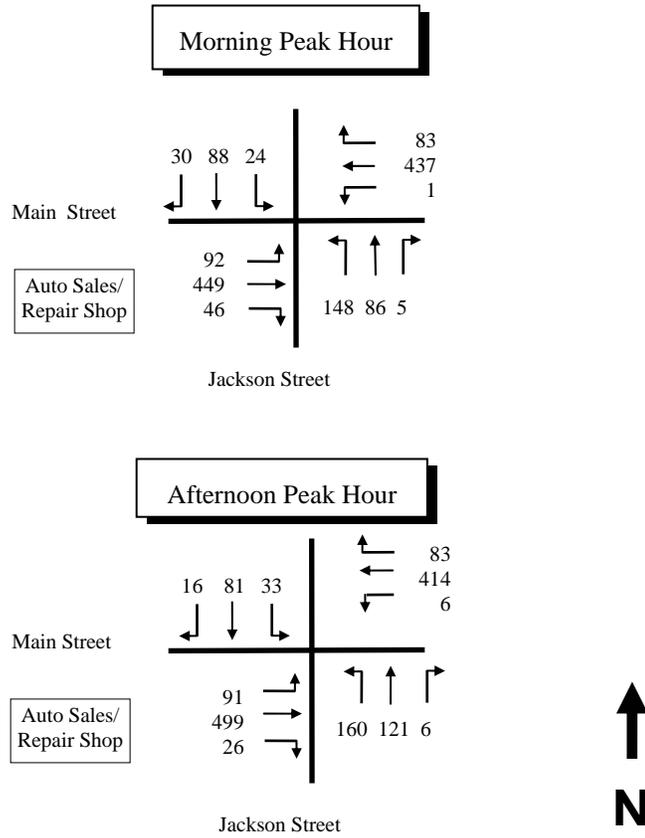
The Massachusetts Highway Department (MassHighway) develops traffic volume adjustment factors to reflect monthly variations as traffic volumes tend to fluctuate over the course of the year. These factors were examined to determine how traffic conditions during the different months compare to average month conditions. For example, based on the MassHighway data, traffic volumes during the month of November were found to be slightly higher than the annual average. Therefore, all traffic count volumes were adjusted to reflect average month conditions.

#### 2. *Crash Experience*

A crash history of the intersection of Main Street with Jackson Street was provided by the Holyoke Police Department from January 2001 through December 2005. This intersection averaged 12.8 crashes a year over this five-year period. Based on this data we decided to check the MassHighway crash data to gather more specific information on the types of crashes experienced at the intersection. This information is summarized in Table II-1.

The crash rate per million entering vehicles was also calculated for the intersection. In theory, the number of crashes can increase as traffic volumes and the potential for conflict is increased. The crash rate per million entering vehicles considers the daily entering volumes at an intersection and the average number of annual crashes. The crash rate at the intersection of Main Street with Jackson Street was calculated to be 2.02, which is significantly higher than the statewide average of 0.94 for signalized intersections.

**Figure II-1 - Morning and Afternoon Peak Hour Traffic Volumes**



Source: PVPC

**Table II-1 Crash History Summary**

Year	Number of Crashes	Type	Number of Crashes	Fatality		Weather		Road Condition		
				Property	Injury					
2003	9	Angle	5	5		Clear	5	Wet	4	
		Sideswipe			4		Rain	4	Dry	5
		Rear End	2				Snow		Ice	
		Fixed Object	1				Fog			
		Head On	1				Overcast	1		
2004	10	Angle	6	6		Clear	8	Wet	2	
		Sideswipe			4		Rain		Dry	8
		Rear End	2				Snow		Ice	0
		Fixed Object	2				Fog			
		Head On					Overcast	2		

Source: MassHighway Crash Report for Holyoke 2003 and 2004

As can be seen from the crash history, over fifty percent of all crashes were of the “angle” type. This is largely a function of the high traffic volumes in this area and vehicles attempting to accept smaller gaps in the travel stream. The lack of protected phasing for left turning vehicles clearly contributes to an increase in angle type collisions at this intersection.

The intersection experienced a little under half of the crashes resulting in a personal injury, and no fatalities were reported over the two-year period. Roadway conditions were also identified as being “wet” for a third of all crashes. A fifth of the crashes were rear-end type collisions. The five year crash data received from the Holyoke police shows that forty-two percent of all crashes occurred during the hours of darkness, six p.m. to five a.m.

**B. ANALYSIS PROCEDURES**

*1. Capacity Analysis*

The intersection of Main Street with Jackson Street was examined with regard to capacity and delay characteristics to determine the existing Level of Service (LOS). LOS is an indicator of the operating conditions which occur on a roadway under different volumes of traffic and is defined in the 2000 Highway Capacity Manual by six levels, “A” through “F”. A number of operational factors can influence the LOS including geometry, travel speeds, delay, and the number of pedestrians.

Depending on the time of day and year, a roadway may operate at varying levels. Level of Service “A” represents the best operating conditions and is an indicator of ideal travel conditions with vehicles operating at or above posted speed limits with little or no delays. Conversely, LOS “F”, or failure, generally indicates forced flow conditions illustrated by long delays and vehicle queues. Level of Service “C” indicates a condition of stable flow and is generally considered satisfactory in rural areas. Under LOS “D” conditions, delays are considerably longer than under LOS “C”, but are considered acceptable in urban areas. At LOS “E” the roadway begins to operate at unstable flow conditions as the facility is operating at or near its capacity. A summary of the LOS at a signalized intersection is shown in Table II-2.

**Table II-2 Level of Service for Signalized Intersections**

Average Control Delay (seconds/vehicle)	LOS	Expected Delay To Minor Street
0.0 to 10.0	A	Little or no delay
>10.0 to 20.0	B	Short traffic delays
>20.0 to 35.0	C	Average traffic delays
>35.0 to 55.0	D	Long traffic delays
>55.0 to 80.0	E	Very long delays
>80.0	F	Extreme delays

The intersection of Main Street with Jackson Street currently operates at LOS “B” during both morning and afternoon peak hours. A summary of the existing operations of this intersection is shown in Table II-3.

**Table II-3 Level of Service Summary of Existing Signalized Intersection**

Location	AM Peak		PM Peak	
	Delay*	LOS**	Delay*	LOS**
Jackson Street NB All Directions	29.3	C	23.4	C
Jackson Street NB Left Turns	37.4	D	27.8	C
Jackson Street NB Through Movement	18.0	B	18.7	B
Jackson Street SB All Directions	19.6	B	18.9	B
Main Street EB All Directions	8.1	A	8.0	A
Main Street EB Left Turns	5.9	A	5.8	A
Main Street EB Through Movement	8.6	A	8.4	A
Main Street WB All Directions	8.1	A	8.1	A
OVERALL	13	B	12	B

\* Measured in seconds per vehicle

\*\* LOS - Level of Service

NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound

Based on the results of the analysis, the left turn movement from Jackson Street Northbound to Main Street operates at LOS “D” during the morning peak hour and LOS “C” during the afternoon peak hour. Left turning traffic from Main Street Eastbound to Jackson was calculated to operate at LOS “A” during both peak periods.

## 2. Protected Left Turn Phasing Analysis

The intersection of Main Street with Jackson Street was examined to determine alternatives available for improving the safety of the intersection and reducing the number of crashes. The installation of protected left turn phasing can improve the safety and operation of the location under study. This section studies traffic signal timing alternatives for this scenario and its associated level of service changes.

Two alternatives for the traffic signal timing were identified to improve safety at the intersection of Main Street with Jackson Street. Both alternatives involve the addition of a protected left turn phase for traffic coming from the west on Main Street and turning left onto Jackson Street Northbound, and a protected left turn phase for traffic coming from the south on Jackson Street and turning left on Main Street Westbound. The two alternatives consisted of an upgrade to the traffic signal control equipment at the intersection to allow it to operate with protected left turn movements. In addition, both alternatives would provide better visibility by adding signal faces with red, yellow and green left arrows for each of above mentioned left lanes.

In the first alternative, the left lane traffic was allowed to yield on green after the protected left turn phase was completed, while in the second alternative the traffic in the left lane was required to stop after the protected left turn phase was completed so as to eliminate any traffic movement conflict. In addition, the second alternative proposed converting the existing single wide lane into two narrow lanes for Main Street Westbound and Jackson Street Southbound as they approach the intersection. These two lanes can return to a single lane as traffic moves away from the intersection. The addition of a second lane will allow traffic to clear the intersection faster and reduce vehicle queues. The right lane can accommodate both right turns and through traffic, and the left lane can accommodate both left turns and through traffic. This will help reduce congestion by reducing the green time needed to properly serve this approach, which in turn results in shorter cycle length and a more efficient operation.

Under the first alternative the overall intersection level of service decreased from the existing condition as a result of the addition of leading protected phases for the eastbound approach of Main Street and northbound approach of Jackson Street. By allowing both a protected left turn phase then a permitted left turn phase for both of these approaches, the intersection operations were improved over those realized under the second alternative. While the overall intersection level of service improved under this alternative in comparison to the second alternative, the crash history of the intersection suggests that continuing to allow permitted left turns will not improve the safety of this intersection. This is due to the limited effects of a short protected left turn phase followed by a permitted left turn phase. Permitted left turns will continue to conflict with through moving traffic. This conflict, which potentially causes angle type crashes, is eliminated with the removal of the permitted left turns in the second alternative. A summary of the proposed operations of the intersection under Alternative 1 is shown in Table II-4.

**Table II-4 Level of Service Summary of Proposed Signalized Intersection: First Alternative**

Location	AM Peak		PM Peak	
	Delay*	LOS**	Delay*	LOS**
Jackson Street NB All Directions	25.3	C	22.5	C
Jackson Street NB Left Turns	29.6	C	24.8	C
Jackson Street NB Through Movement	19.0	B	20.0	B
Jackson Street SB All Directions	33.2	C	30.2	C
Main Street EB All Directions	10.6	B	10.5	B
Main Street EB Left Turns	9.2	A	9.1	A
Main Street EB Through Movement	10.9	B	10.7	B
Main Street WB All Directions	21.4	C	21.6	C
OVERALL	19.1	B	18.2	B

\* Measured in seconds per vehicle

\*\* LOS - Level of Service

NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound

In the second alternative, additional capacity would be added to the westbound approach of Main Street and southbound approach of Jackson Street by converting the existing

wide single lane into two narrow lanes. It should be noted that many vehicles were observed to utilize these approach in this manner at the time of the field inventory.

This conversion would require that traffic be tapered back to one travel lane after they have cleared the intersection. This alternative results in an overall intersection level of service of “C”. While the intersection is expected to operate with slightly higher delays for some of the approaches, under Alternative 2, the elimination of permitted left turns from the eastbound approach of Main Street and northbound approach of Jackson Street would help increase the safety of the intersection by eliminating traffic conflict with left turns. A summary of the proposed operations of this intersection under Alternative 1 is shown in Table II-5.

**Table II-5 Level of Service Summary of Proposed Signalized Intersection: Second Alternative (Two-Lanes)**

Location	AM Peak		PM Peak	
	Delay*	LOS**	Delay*	LOS**
Jackson Street NB All Directions	24.4	C	23.1	C
Jackson Street NB Left Turns	31.1	C	30.4	C
Jackson Street NB Through Movement	15.0	B	15.5	B
Jackson Street SB All Directions	32.5	C	31.3	C
Main Street EB All Directions	25.5	C	24.5	C
Main Street EB Left Turns	34.8	C	33.4	C
Main Street EB Through Movement	23.6	C	22.9	C
Main Street WB All Directions	29.0	C	29.3	C
OVERALL	27.2	C	26.5	C

\* Measured in seconds per vehicle

\*\* LOS - Level of Service

NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound

### III. SUMMARY OF RECOMMENDATIONS

Based on the analysis of the existing conditions and observations from visiting the site, the following recommendations were developed to address existing traffic deficiencies at the intersection of Main Street with Jackson Street.

- Many of the pavement markings in the vicinity of the intersection were noted to be faded at the time of the field inventory. The City of Holyoke should consider restriping all existing pavement markings in the vicinity of the intersection to improve their effectiveness.
- At the time of the field inventory the green traffic light was noted to be burnt out on the post mounted traffic signal for the southbound approach of Main Street. This should be checked and replaced.
- It is recommended that the City of Holyoke examine the existing loop detectors at the intersection to ensure they are working properly. This is critical to the efficient operation of traffic at the intersection.
- Based on the results of this analysis, Alternative 2 is deemed to be more beneficial as it will increase safety by reducing angle collisions at this intersection.
- It is recommended that the City of Holyoke consider obtaining the services of a licensed professional engineer prior to the implementation of any changes to the traffic signal timing and phasing. A licensed professional engineer will also be able to evaluate the effectiveness of the existing traffic control equipment and the need for updates. It is also recommended that the existing traffic signal equipment be upgraded to conform with the Manual on Uniform Traffic Control Devices (MUTCD).
- The elimination of permitted left turns from the eastbound approach of Main Street and northbound approach of Jackson Street would help increase the safety of the intersection. This will reduce the overall operations of the intersection; however it could be offset by converting the westbound approach of Main Street and southbound approach of Jackson Street from an existing wide single lane into two narrow lane