

**CITYWIDE TRAFFIC SAFETY PLANNING STUDY**  
**Phase 2 – Superior Road and Forest Hill Avenue Intersection**

**(City of East Cleveland)**

**Cuyahoga County, Ohio**

**Prepared For:**

**Honorable Mayor Eric J. Brewer  
City of East Cleveland  
14340 Euclid Avenue  
East Cleveland, Ohio 44112**

**AND**

**Northeast Ohio Areawide Coordinating Agency  
1299 Superior Avenue  
Cleveland, Ohio 44114**

**March 2009**

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Cleveland, Ohio 44114**

**March 2009**

**ENGINEER'S SEAL**

**PREPARED BY:**

\_\_\_\_\_  
**Gerald J. Babroski, P.E.  
Registration No. 46674**

**Date:** \_\_\_\_\_



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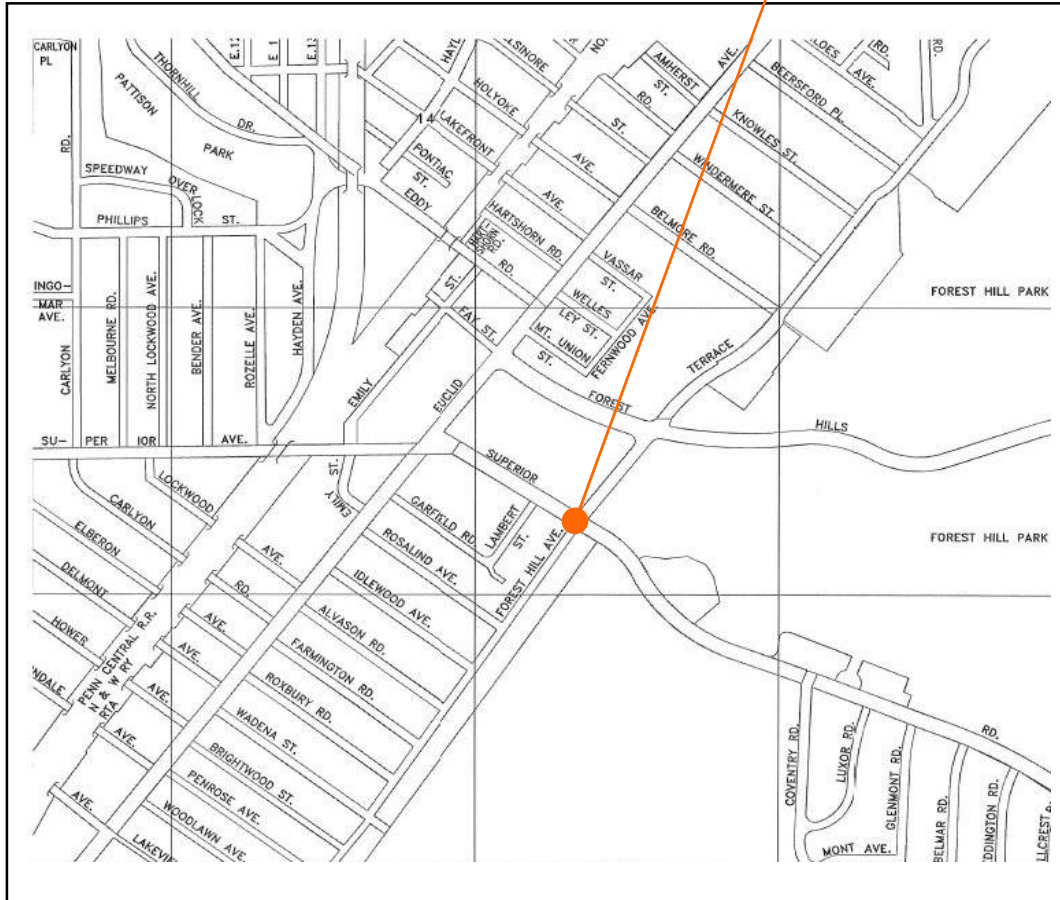
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**Study Area:**

**SAFETY STUDY  
CITY OF EAST CLEVELAND  
SUPERIOR ROAD AND FOREST HILL AVENUE INTERSECTION**

**STUDY LOCATION**



**COMPLETED BY:  
GPD GROUP**

**COMPLETION DATE:  
March 2009**



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## II. Executive Summary:

### Purpose and Need:

This Traffic Safety Study was performed for the Intersection of Superior Road and Forest Hill Avenue in the City of East Cleveland, Ohio. (Note: the northerly approach is Terrace Road, but for purpose of this study the intersection is named the Superior Road and Forest Hill Avenue Intersection.) A comprehensive study of all intersections in the City determined that this intersection was the site of the largest number of vehicle crashes in the three years of the investigation (2005-2007). This intersection topped the list with a total of 39 crashes.

The purpose of this study is to analyze the existing conditions and crash history of this intersection in order to identify actions and improvements which will enhance its safety.

### Background:

This report and study is the result of the Northeast Ohio Areawide Coordinating Agency (NOACA) Resolution No. 2007-028 in support of the Transportation for Livable Community Initiative (TLCI). NOACA uses a federal grant under the U.S. Department of Transportation, Federal Highway Administration (FHWA) Surface Transportation Program Funds to assist local communities and agencies for planning transportation improvements

### Brief Overview of Possible Causes:

Currently there are a high number of angle crashes, most of which are associated with vehicles making left turns from Superior Road. The existing median along Superior Road results in a wide offset for opposing left-turners on Superior Road, sometimes blocking each other's view of oncoming traffic. Also by observation, the existing pavement markings are worn and are essentially non-existent. Parking is allowed along Superior Road west of Forest Hill, blocking the path of any motorists approaching the intersection from the east in the right lane. Through traffic from this lane must shift one lane to the left to clear the parking lane.

### Recommended Countermeasures and Related Costs:

Note: Optimizing the phasing and timing is recommended in all proposed alternatives and in each alternative, the elimination of the protected, northbound, left turn phase is recommended.

Short Term: The short term improvement is to install new pavement markings, including parking lines, channelizing lines, lane lines, stop lines,



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transverse/diagonal lines, crosswalk lines and lane arrows. These markings will include those needed to designate the right lane on the westbound approach as a right turn only lane. Also recommended is to retime the signals to optimize the phasing and timings and reduce delay. (See Figure 5 on Page 14.) The estimated cost for this improvement is about \$6,900 with a rate of return of about 606% rate of return.

Medium Term: The medium term improvement includes the upgrades of the pavement markings and signs detailed in the short term improvement above. This improvement also includes adding a new traffic signal controller and new signal heads, in order to change the operation of the signals to split phasing, where the westbound and eastbound legs of the intersection operate independently, rather than concurrently. (See Figure 6 on Page 15.) The estimated cost for this improvement is \$40,700 with a rate of return of 410%.

Long Term: The long term improvement is to remove portions of the existing median to provide dedicated left-turn lanes along Superior Road which are directly opposite of each other. Included with this alternate is the replacement the entire traffic signal installation with new mast arm poles and state of the art equipment to make the intersection fully actuated. The phasing of the intersection could allow leading left-turns for Superior Road. New pavement markings are also included in this scheme. (See Figure 7 on Page 16.) The estimated cost for this improvement is \$192,000 with a rate of return of 98%.



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### III. Purpose and Background:

#### Purpose and Need:

This Traffic Safety Study was performed for the Intersection of Superior Avenue and Forest Hill Avenue in the City of East Cleveland, Ohio. A comprehensive study of all intersections in the City determined that this intersection was the site of the largest number of vehicle crashes in the three years of the investigation (2005-2007). This intersection topped the list with a total of 39 crashes.

The purpose of this study is to analyze the existing conditions and crash history of this intersection in order to identify actions and improvements which will enhance its safety.

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- Enhance the economic viability of existing communities within the region,
- Enhance the region's quality of life,
- Enhance a community's identity,
- Foster compact land use development/redevelopment,
- Facilitate accessibility by improving the range of transportation choices by adding or improving pedestrian, transit or bicycle facilities,
- Preserve and enhance farmland, forests and open spaces,
- Assist in redevelopment of urban core communities,
- Result in projects that can compete at the regional level for capital funds through NOACA's regional transportation investment process,
- Enhance the historic, archaeological, scenic and environmental elements of the transportation system, and
- Improve the safety and efficiency of the existing transportation system.



#### IV. Existing Conditions:

The Superior Road and Terrace Avenue intersection is located in the southerly central area of the City within an area of high density housing (multi-level apartments.) Forest Hill Park is located on the northeasterly corner of the intersection. Superior Middle School is located one block west of the intersection. This is the first signalized intersection on Superior Road east of Euclid Avenue.

Superior Road is an east/west multilane roadway divided by a curbed median with a grassed surface and street lights (see Conditions Diagram, Figure 1 on Page 7 and photographs on Appendix C). Three lanes of traffic approach the intersection from the east within a curbed roadway width of 30 feet. There are no mandatory turn lanes, therefore the intersection functions as the left lane being a combination thru-left, the center lane is a thru lane and the right curb lane is a combination thru-right lane, however, beyond the intersection the westbound roadway allows parking and at times the right curb lane functions as a defacto right-turn lane. There are no signs associated with the lanes. The west approach is also 30 feet in width and curbed. Parking occurs in the curb lane adjacent to the apartment building, so there are two traffic lanes approaching the intersection. The lane combinations are a combination thru-left and a combination thru-right. Minimum preferred through-lane widths are 11 feet with at least 1 foot offset from the curb. The existing pavement widths are less than the preferred minimum, and may contribute to crashes especially the sideswipe type.

The posted speed limits of Superior Road are 25 MPH west of the intersection and 35 MPH east of the intersection.

The southerly approach is Forest Hill Avenue which is 24 feet wide between curbs. There is one lane in each direction without any posted speed limits. The one lane approaching the intersection is a combination left-thru-right lane. There is no street lighting on this approach.

The northerly approach is Terrace Road. It is 36 feet wide between curbs and has three lanes. The southbound lanes are signed for a left-only and a combination thru-right turn lane. This portion of Terrace Road is posted at 35 MPH with street lighting.

The intersection is currently signalized, with no vehicular detection and a three-phase, fixed time operation consisting of an east-west movement, a leading left/thru southbound movement and finally a north-south movement. There is a moderate change in green times from morning peak hour to evening peak hour which indicates a possible time of day operation. Although there are some pedestrian signals, there are no pedestrian push buttons and the pedestrian



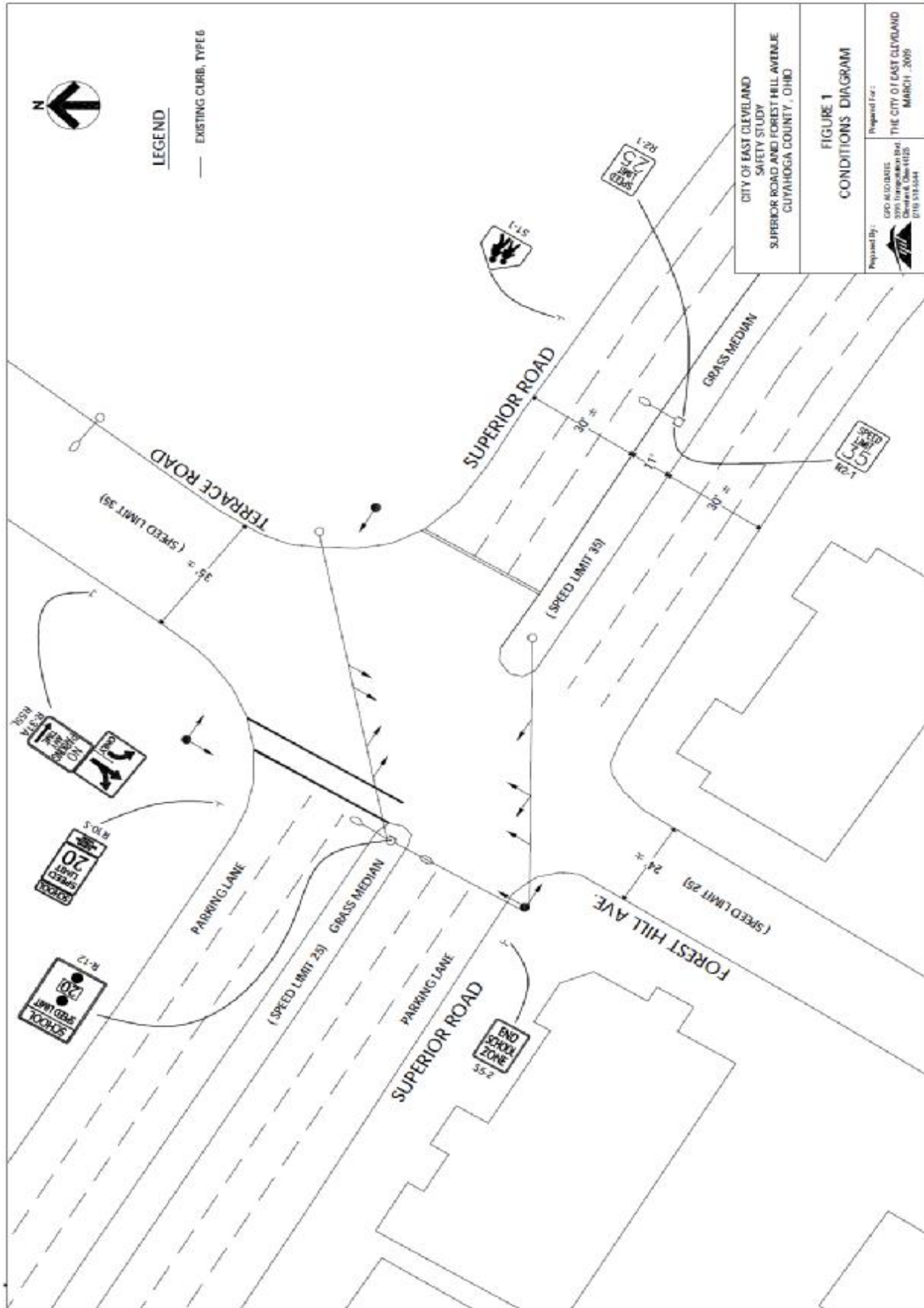
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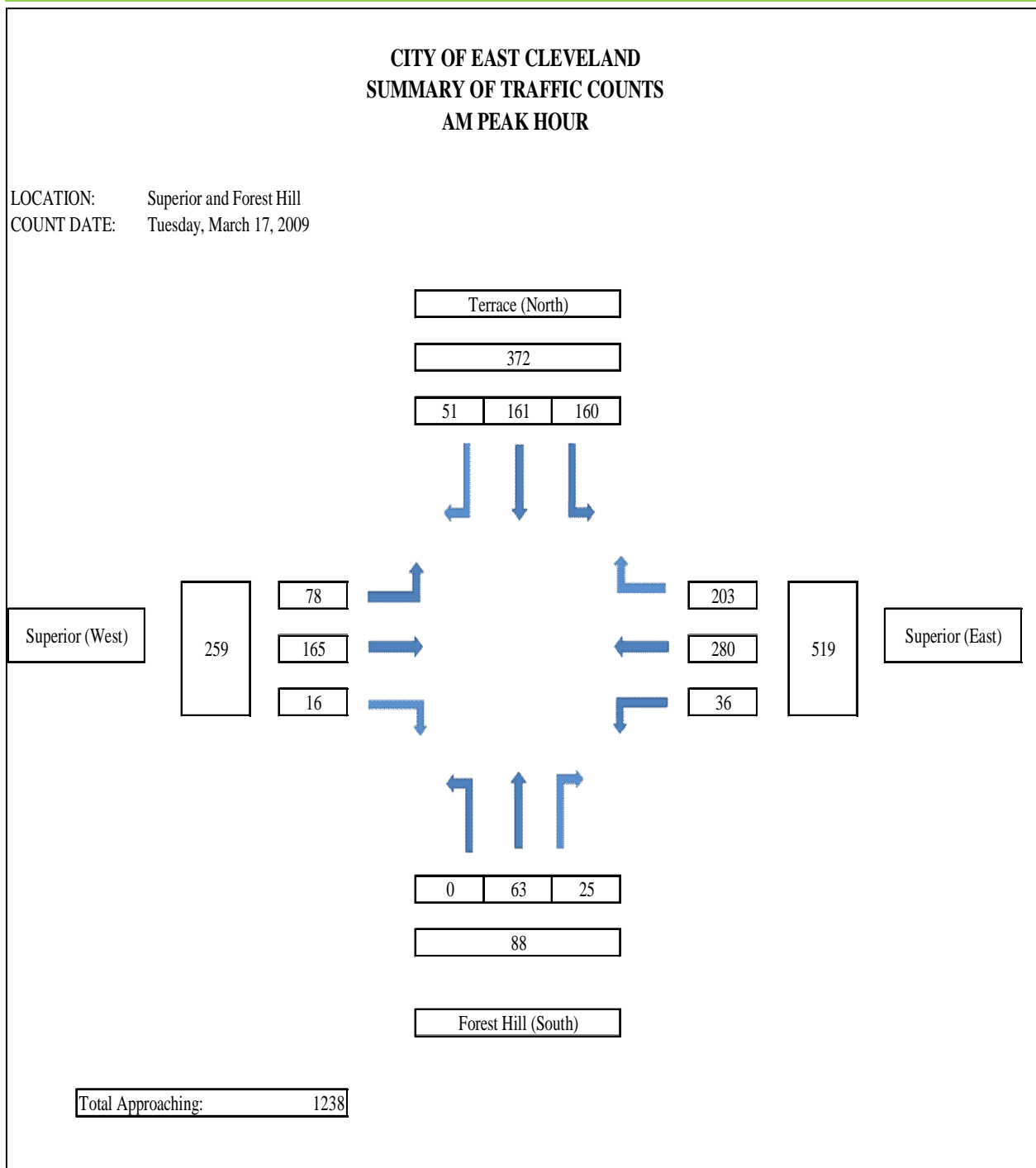
indications are coordinated with the appropriate. The signal is not part of a coordinated system.



There are pedestrian signal heads and marked crosswalks for the Superior eastbound approach and the Terrace southbound approach. There appears to be foundation remains indicating a broken-off pedestrian pedestal in the southeast quadrant of Forest Hill and Superior. Although there is a curb ramp in this area to receive pedestrians across Forest Hill, there is no evidence of a striped crosswalk. One can deduce that the intent is for this approach to accommodate pedestrian traffic. There is no evidence of any cross walk in the westbound approach of Superior Road.

Twelve hour traffic counts were made in March of 2009 from 7:00 am to 7:00 pm. Each approach movement was counted for left, through and right vehicles and each vehicle was classified as passenger/light truck or large truck. Traffic count volumes are shown in a summary table in Appendix A. A total of 1,238 vehicles approached the intersection in the am peak hour and 1,559 vehicles in the pm peak hour. These counts are summarized in Figures 2 and 3 on Pages 8 and 9. Based on the existing signal phasing and timings it was determined that the morning peak hour operated at a level of service of B and the evening peak hour operated at a level of service of C. Highway Capacity Software output worksheets can be found in Appendix K.

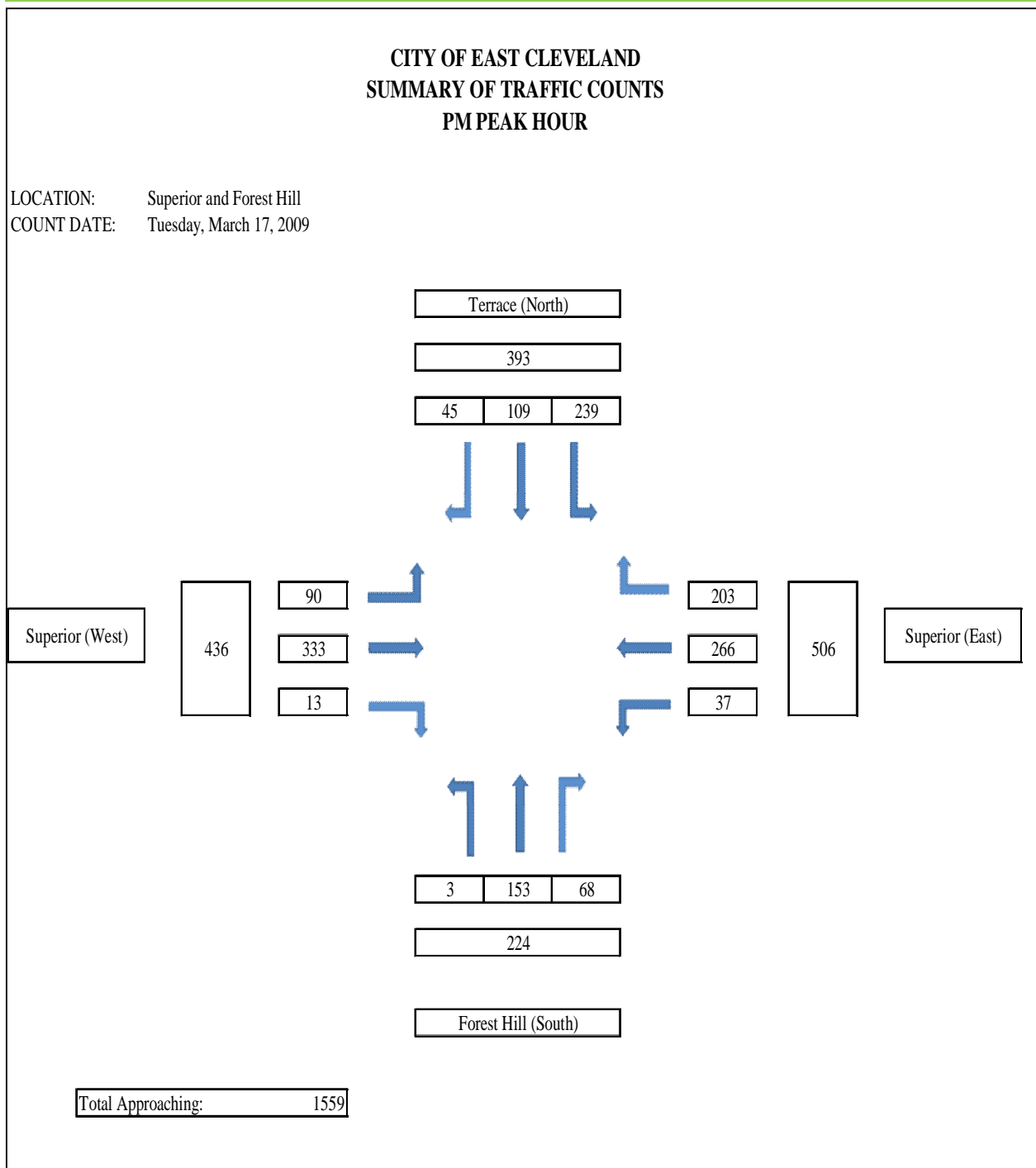








 <b>N.T.S.</b>	<p><b>FIGURE 2</b></p> <p><b>TRAFFIC COUNT SUMMARY</b></p> <p><b>MARCH, 2009</b></p>	 <small>GILLESPIE + SCHOMER SURNS &amp; ASSOCIATES, INC.</small> <b>GPD GROUP</b> <small>5553 TRANSPORTATION BLVD, SUITE 100, CLEVELAND, OH 44123 216.318.5544, Fax 216.578.5543</small>
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 <b>N.T.S.</b>	<p><b>FIGURE 3</b></p> <p><b>TRAFFIC COUNT SUMMARY</b></p> <p><b>MARCH, 2009</b></p>	 <p><b>GPD GROUP</b>  <small>5553 TRANSPORTATION BLVD, SUITE 100, CLEVELAND, OH 44123                  216.318.5544, Fax 216.578.5543</small></p>
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 N.T.S.	FIGURE 4	 GILLESPIE, SCHOMER, SURIN & GILLESPIE, INC. <b>GPD GROUP</b> 5563 TRANSPORTATION BLVD, SUITE 100, CLEVELAND, OH 44123 216.318.5344   Fax: 216.578.5543
	AERIAL PHOTOGRAPH	
	MARCH, 2009	



## V. Crash Analysis:

Crash data information for the years 2005-2007 in the form of the Standard OH-1 Forms, were provided by the City Safety forces. For this period there were a total of 39 crashes at this intersection: 12 in 2005, 16 in 2006 and 11 in 2007. This was the highest number of crashes at an intersection in the City for this study period. A collision diagram with the dates, times and other pertinent information is included in Appendix D. This information is further summarized with charts in Appendices E and F.

Of the 39 crashes, 12 or 31% involved injuries and 27 or 69% were property damage only (PDO). There were no fatal injuries at this intersection within this time frame. The numbers of crashes with injuries, fatalities and property damage only are used to calculate a value referred to as the Severity Index. This index is calculated by assigning weighting factors to the crashes: with fatalities, a factor of twelve is used; with injuries a factor of three is used and for property damage only, a factor of one is used. These values are totaled and then divided by the total number of crashes to determine the Severity Index. For this intersection over the three years of study, the Severity Index was found to be 1.62. For comparison, the City-Wide Severity index for the year 2005 was 1.49.

The annual crash rate was also calculated. This is the average yearly crashes divided by the average daily traffic for the year. For this intersection the annual crash rate was determined to be 2.31 crashes per million approach vehicles (MAV). This was the second highest rate for an intersection area within the City for this study period. The highest intersection was Noble Terrace with a rate of 3.13 MAV.

Fifteen of the crashes involved motorists turning left from Superior Road into the path of an oncoming vehicle. Twelve of these 15 crashes involved a westbound left turner and 6 of them were injury crashes. The westbound approach to the intersection also produced the only other crash patterns of note. There were 6 rear-end collisions and 3 sideswipes on this approach. Seventy-two percent of the crashes occurred during the daylight hours and most occurred on dry pavement.

Table 1: Crash Data Analysis Summary Chart

Intersection	Fatal	Injury	PDO	Total	Approach ADT	Annual Crash Rate	Severity Index
Superior & Forest Hills	0	12	27	39	15,391	2.31	1.62



## VI. Rate of Return Analysis:

The rate of return was calculated for the Superior Road and Forest Hills Avenue Intersection. Included for analysis are three (3) countermeasures of varying costs and improvements described below. The average property damage cost (PDO) and injury-fatality cost were obtained for the ODOT Highway Safety Program's website. Also, the Estimates of Countermeasure Effectiveness Reduction (CRF) Factors were obtained from the same website. See Appendix H for Estimates of Countermeasure Effectiveness Reduction (CRF) Factors printouts and Appendix I for the Rate of Return analysis for each improvement option

Short Term Improvement: (See Figure 5 on Page 14)

In accordance with the Ohio Department of Transportation Safety Studies guidelines, the Index of Strategies-Spot Countermeasures was used. Field visits and historic photographs indicate that markings are barely visible. Work will include the striping of the approach lanes as well as the stop lines and crosswalk lines. Because of the allowable parking on the west side of the intersection along Superior Road, the right curb lane of the westbound approach is recommended to be marked for a right turn only lane. Appropriate signing will also be included to identify the westbound right lane as a right turn lane. It is recommended that the pavement markings include striping for the parking lanes. In an effort to improve traffic flow and optimize the signal timings, it is also recommended that the southbound, Terrace Road left turn phase be eliminated from the signal operation. While the number of left turning vehicles is relatively high, the opposing traffic volume is low and permissive left turns are being permitted on this approach now, with no apparent operational problems.

Under this scenario the intersection level of service (LOS) is anticipated to operate at a B rating with the signals adjusted and optimized for both the AM and PM peak hours. See Appendix K for printouts of the LOS calculations.

The estimated cost for this improvement is \$6,900 with a rate of return of approximately 606%. See Appendix J for worksheet of the estimated cost and Appendix I for rate of return worksheet.

Medium Term Improvement: (See Figure 6 on Page 15)

The Medium Term Improvement is one anticipated to be installed between 1 and 5 years. Alternate phasing schemes were reviewed to introduce protected left turn movements for Superior Road motorists. The alternates explored were leading lefts and split phasing. The analysis indicated that split phasing operation provided the safer and more efficient operation for the intersection. This alternate not only eliminates the potential conflict occurring during permissive left turns but



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also eliminates simultaneous left turns from opposing directions whose travel paths overlap. Also recommended is to make the intersection fully actuated to reduce delay. As explained previously in the short term alternative, the southbound, Terrace Road left turn phase should be eliminated from the signal operation. This alternative anticipates utilizing the existing strain poles, but includes a new traffic controller, new signal heads and wiring. The same pavement markings proposed for the short term improvement will apply here as well. Existing pedestrian movements and cross walks across Terrace, Forest Hill and Superior will remain. The pedestrian signal heads will be replaced in this alternative as well.

The level of service for this intersection with this proposed phasing is calculated as being C for both the AM and PM peak hours. Highway Capacity Software printouts of the LOS calculations are attached in Appendix K.

The estimated cost for this improvement is \$40,700 with a rate of return of 410%. See Appendix J for worksheet of the estimated cost and Appendix I for rate of return worksheet.

Long Term Improvement: (See Figure 7 on Page 16)

The recommended long term improvement for the Superior and Forest Hill intersection is to reconstruct the intersection to provide head-to-head left turn lanes on Superior Road in place of the center median. The proposed turn lanes are calculated to be 100 feet long based on the ODOT methods. See Appendix L for worksheets of storage lane length calculations. As a part of this improvement, the entire traffic signal, including strain poles, controller, wiring and all incidentals is to be replaced. Existing pedestrian movements and cross walks across Terrace, Forest Hill and Superior will be retained. With the addition of the left turn lanes, conventional, protected left turn phasing can be introduced for Superior Road motorists in this scenario. Again, as explained previously in the short term alternative, the southbound, Terrace Road left turn phase should be eliminated from the signal operation.

By adding these lanes the eastbound approach will consist of a left-turn lane, a through lane and a combination thru-right line adjacent to a parking lane. The westbound lanes will consist of a left-turn lane, two through lanes and a right-turn lane.

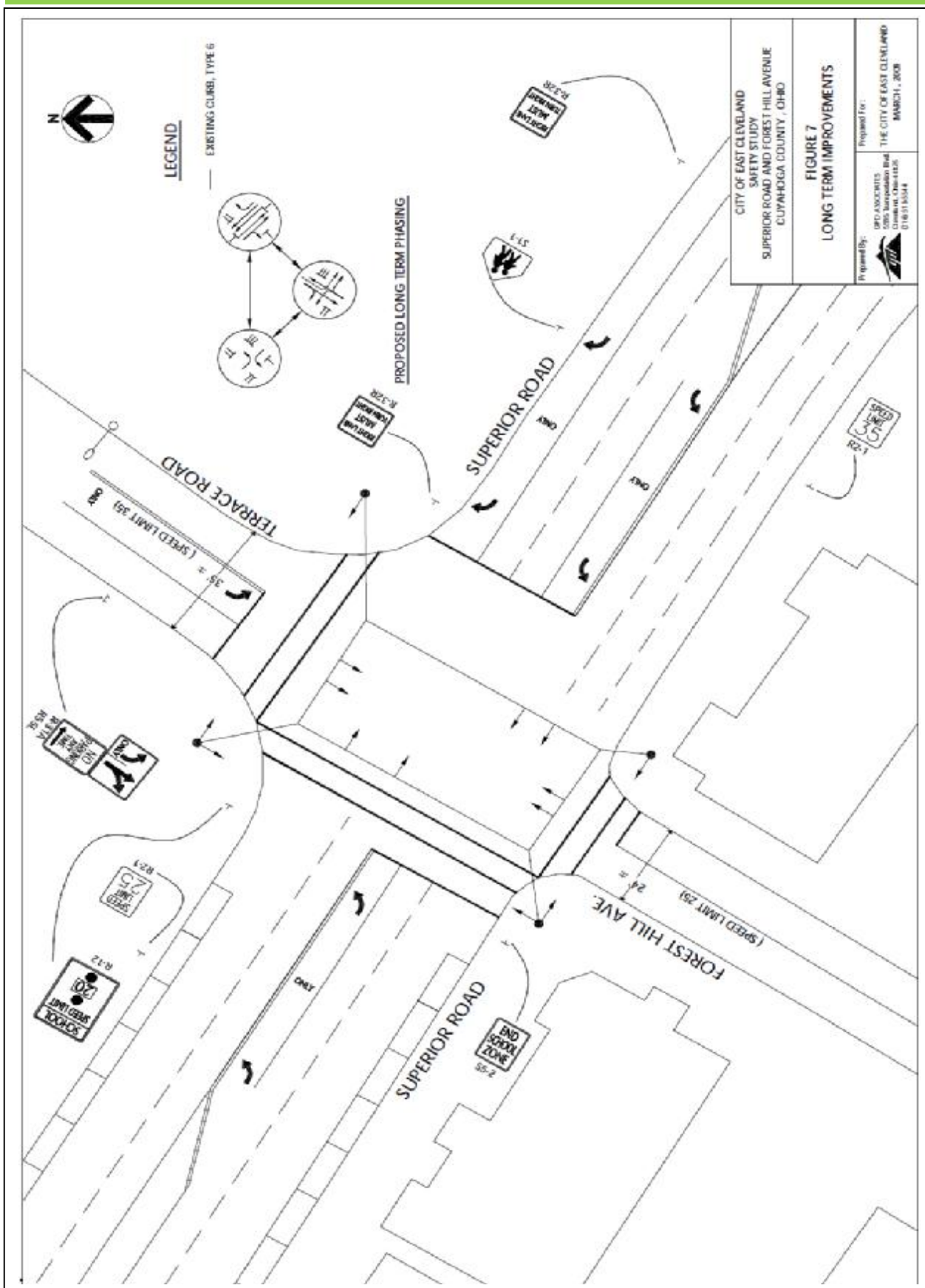
The level of service for the intersection with this proposed reconstruction and phasing is calculated as being C for both the AM and PM peak hours. Copies of the Highway Capacity Software worksheets are attached in Appendix K.

The estimated cost for this improvement is \$192,000 with a rate of return of 98%. See Appendix J for worksheet of the estimated cost and Appendix I for rate of return worksheet.









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## VII. Other Traffic Studies:

In order to properly investigate the operation and safety deficiencies of the Superior and Forest Hill intersection, the following studies/analyses have been conducted: Traffic Signal Warrant Analysis, Capacity Analysis, Queue Length Analysis and Turning Path Study.

### Traffic Signal Warrant Analysis:

In accordance with the Ohio Manual of Uniform Traffic Control Devices (OMUTCD) all traffic signals must meet at least one warrant to justify its use as a traffic control measure at an intersection. Currently there are eight different conditions which may warrant a signal, they are:

- Warrant 1, Eight-Hour Vehicular Volume.
- Warrant 2, Four-Hour Vehicular Volume.
- Warrant 3, Peak Hour.
- Warrant 4, Pedestrian Volume.
- Warrant 5, School Crossing.
- Warrant 6, Coordinated Signal System.
- Warrant 7, Crash Experience.
- Warrant 8, Roadway Network.

Traffic counts were conducted on March 17, 2009 for the purpose of determining if the volumetric warrants support the signalization of this intersection. Based on the count data it was determined that the basic minimum eight hourly volumes at the 100% level were met for Warrant 1. The intersection also met warrants for signals under Warrant 2 – Four Hour Volume, and Warrant 3 – Peak Hour. Therefore the traffic volumes justify the use of traffic signals at this location. A copy of the signal warrants worksheets are included in Appendix B.

### Intersection Capacity Analysis:

Intersection capacity analyses are performed in order to determine the performance of an intersection based on the traffic demand and its physical characteristics. The quality of the operating condition experienced by an intersection is measured in terms of Level of Service (LOS) and is a calculation of vehicle delay. Levels of Service range from LOS A to LOS F. Level of Service ratings of A, B, and C are considered to be in the acceptable range. Level of Service D may be acceptable in highly urban settings but generally is considered undesirable as traffic volumes are approaching capacity limits. Levels of Service E and F are considered unacceptable with a LOS F representing a failure state of the intersection, or gridlock. Based on criteria established by ODOT, Highway Capacity Software (HCS) is used to determine the required number of lanes and the lane assignments at intersections (i.e. the needed intersection capacity). The



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software is also used to optimize the operation of the intersection by determining the best phasing patterns and timings for the traffic demand given the fixed geometrics and characteristics of the study site.

Intersection capacity analyses were performed utilizing the computer program HCS-Plus, developed by the McTrans Corporation based on the Highway Capacity Manual and the 2003 Edition of the Manual of Uniform Traffic Control Devices (MUTCD). Signalized intersection capacity analyses were performed in the AM and PM Peak Hours for the Superior and Forest Hill intersection for the following conditions: existing phasing, timing and geometry; Short Term Improvement, Medium Term Improvement and Long Term Improvement. All of these analyses were performed using the existing traffic volumes acquired in the traffic count conducted on March 17, 2009. The Level of Service results of the HCS analyses are summarized in the Tables 2 and 3 on Page 18. All HCS output is presented in Appendix K.

A review of the Capacity Analyses indicates that for all cases an acceptable level of service is possible for the proposed phasings and timings for all recommended improvements with most movements and all approaches in the LOS B and C categories



Table 2 HCS Capacity Analysis Summary - AM Peak Hour				
Movement	Existing	Short Term	Medium Term	Long Term
Eastbound	B	B	C	C
Left-Thru-Right	B	B	C	
Left				C
Thru-Right				C
Westbound	B	B	C	C
Left-Thru	B	B	C	
Left				C
Through				C
Right	B	B	C	C
Northbound	C	B	C	C
Left-Thru-Right	C	B	C	C
Southbound	C	B	C	C
Left	C	B	C	C
Thru-Right	C	B	C	C
Overall	B	B	C	C

Table 3 HCS Capacity Analysis Summary - PM Peak Hour				
Movement	Existing	Short Term	Medium Term	Long Term
Eastbound	C	B	C	C
Left-Thru-Right	C	B	C	
Left				C
Thru-Right				C
Westbound	C	B	C	C
Left-Thru	C	B	C	
Left				C
Through				C
Right	C	B	D	C
Northbound	D	B	C	C
Left-Thru-Right	D	B	C	C
Southbound	B	B	C	C
Left	B	B	D	C
Thru-Right	B	B	C	C
Overall	C	B	C	C



**Queue Length Analysis:**

Storage length calculations are performed in order to determine the required amount of storage length for each lane movement group at an intersection as determined by the proposed lane assignments. The required storage length is a function of the signal cycle length (if a signalized intersection is being analyzed), lane assignments, and individual movement vehicular demand. The required storage length at a signalized intersection can be minimized by utilizing the shortest, most reasonable signal cycle length.

The ODOT Location and Design Manual, Volume I specifies that a storage length must provide enough storage to contain the number of vehicles per lane group per signal cycle. An additional scenario includes a consideration for adjacent thru lane stacking. Left turn lane storage lengths, according to the ODOT Location and Design Manual, should be at a minimum 100 feet and a maximum of 600 feet.

Table 4: Storage lengths (ft) Superior and Forest Hill Intersection			
APPROACH	STORAGE LENGTH	DIVERGING TAPER	TOTAL LENGTH REQUIRED
LONG TERM – ADD OFFSET LEFT TURN LANES AND UPGRADE SIGNAL			
SOUTHBOUND	150	50	200
NORTHBOUND (N/A)			
WESTBOUND	100	50	150
EASTBOUND	100	50	150

**Turning Path Study:**

A Turning Path Study was performed for the intersection to evaluate the paths of left-turning vehicles because of the high percentage of left turn accidents. Left turning vehicles from Superior Road begin their movement from the median curb lane. These lanes are not directly offset from each other by the width of the median of about 11 feet. Should two vehicles make left turns simultaneously; their turning paths bring them in very close proximity. For this intersection, two types of vehicles were considered as being most likely to make these left turns; Passenger Cars (P) and Single Unit (SU) trucks (small trucks, buses utility vans, etc.). AASHTO – Geometric Design of Highways and Streets recommend the minimum design turning radius for Passenger Cars is 24 feet and for Single Units is 42 feet. Under the existing conditions, P vehicles making simultaneous left



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turns could clear each other by about 7 feet if both followed the turning template. Of course, vehicles within the intersection are going to use whatever space they find since there are no pavement markings delineating these paths, and the offset of the median contributes to these random vehicle movements. When SU vehicles were tested, it was found that their paths overlapped by about 5 feet. Although none of the recorded accidents involved SU vehicles, it is considered to be the minimum design vehicle for these left turn movements.

Based on these studies this deficiency in geometrics can be improved as follows: The Medium Term improvement recommend a split phase operation in which the opposing left turn vehicles are restricted from occurring simultaneously. The Long Term improvement which is to remove the median and align the left turn lanes directly opposed to each other eliminates all turning path conflicts for these movements. The Short Term improvement will not compensate for this deficiency.



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## VIII. Conclusions and Recommendations:

This Traffic Safety Study was performed for the Intersection of Superior Road and Forest Hill Avenue in the City of East Cleveland, Ohio. A comprehensive study of all intersections in the City determined that this intersection was the site of the largest number of vehicle crashes in the three years of the investigation (2005-2007). This intersection topped the list with a total of 39 crashes. It was studied to determine what, if any, safety concerns exist and to determine appropriate mitigating measures.

Based on the results of the crash data analysis, rate of return analysis and traffic studies, GPD Group concludes the following:

1. Of the 39 crashes at this intersection: 12 occurred in 2005, 16 in 2006 and 11 in 2007.
2. Of the 39 crashes, 12 or 31% involved injuries and 27 or 69% were property damage only (PDO).
3. Eighteen of the crashes were associated with left turns from Superior Road to Terrace or Forest Hill.
4. The Severity Index was found to be 1.62. For comparison, the City-Wide Severity index for the year 2005 was 1.49.
5. For this intersection the annual crash rate was determined to be 2.37 crashes per million approach vehicles (MAV). This was the second highest rate for an intersection area within the City for this study period.
6. The most applicable Short Term Countermeasure is for the improvement of pavement markings.
7. A Medium Term improvement that can be applied to this intersection is the reconstruction of the signal and the introduction of split phasing for Superior Road traffic. This solution, while eliminating left turn conflicts on Superior Road, does so at the expense of operational efficiency.
8. Long Term improvements for the Superior and Forest Hill intersection include the reconstruction of the intersection to provide head-to-head left turn lanes in place of the center median and new traffic signals.
9. A review of the Capacity Analyses indicates that for all cases an acceptable level of service is possible.

Based on the results of the crash data analysis, rate of return analysis and traffic studies, GPD Group recommends the following:

1. The City of East Cleveland should implement the Short Term improvements within the next three months.
2. The Intermediate Term improvements could be implemented if the short term improvements do not reduce the frequency of collisions at the intersection. Because this alternative reduces conflicts by degrading the operation of the intersection, this improvement should be viewed strictly as a "band-aid".



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3. The construction of the Long Term Improvements is the most efficient and effective solution and will reduce crashes, and improve the safety and operation of the existing transportation system. Although the short and medium term improvements will provide varying degrees of relief in the frequencies of crashes, it is highly recommended that this long term improvement be implemented and planned for as soon as possible. It is further recommended the City of East Cleveland apply for safety funding for this option.



**APPENDIX A**  
**TRAFFIC COUNTS**



Superior Road / Forest Hill Avenue / Terrace Road Intersection

Project Number: 2008113.00  
 Project Name: City Wide Safety Study  
 Project Location: East Cleveland, OH  
 Client Name: City of East Cleveland

File Name : superior and terrace rd 3-17-09  
 Site Code : 36015555  
 Start Date : 3/17/2009  
 Page No : 1

**Groups Printed- Passenger Vehicles - Trucks - Buses**

Start Time	Superior Road Eastbound					Superior Road Westbound					Forest Hill Avenue Northbound					Terrace Road Southbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
07:00 AM	7	19	1	0	27	3	29	21	1	54	0	7	3	0	10	12	25	7	0	44	135
07:15 AM	7	33	1	1	42	3	45	35	3	86	0	10	5	1	16	26	37	10	0	73	217
07:30 AM	9	32	1	0	42	5	68	34	2	109	0	22	4	4	30	30	39	7	0	76	257
07:45 AM	15	41	3	1	60	8	63	62	11	144	0	19	7	3	29	43	36	12	3	94	327
<b>Total</b>	<b>38</b>	<b>125</b>	<b>6</b>	<b>2</b>	<b>171</b>	<b>19</b>	<b>205</b>	<b>152</b>	<b>17</b>	<b>393</b>	<b>0</b>	<b>58</b>	<b>19</b>	<b>8</b>	<b>85</b>	<b>111</b>	<b>137</b>	<b>36</b>	<b>3</b>	<b>287</b>	<b>936</b>
08:00 AM	21	42	1	2	66	10	68	50	23	151	0	16	4	0	20	42	43	15	19	119	356
08:15 AM	16	54	4	0	74	8	78	47	8	141	0	16	10	0	26	45	48	11	3	107	348
08:30 AM	25	41	4	3	73	8	68	55	4	135	0	15	5	0	20	32	33	10	0	75	303
08:45 AM	14	46	3	0	63	8	61	46	2	117	0	14	9	0	23	46	32	7	0	85	288
<b>Total</b>	<b>76</b>	<b>183</b>	<b>12</b>	<b>5</b>	<b>276</b>	<b>34</b>	<b>275</b>	<b>198</b>	<b>37</b>	<b>544</b>	<b>0</b>	<b>61</b>	<b>28</b>	<b>0</b>	<b>89</b>	<b>165</b>	<b>156</b>	<b>43</b>	<b>22</b>	<b>386</b>	<b>1295</b>
09:00 AM	10	51	0	2	63	5	43	35	7	90	1	7	10	0	18	32	22	4	0	58	229
09:15 AM	6	36	2	1	45	5	46	42	2	95	0	6	6	0	12	32	24	5	0	61	213
09:30 AM	20	37	2	2	61	4	45	40	4	93	0	15	8	2	25	42	20	8	0	70	249
09:45 AM	11	35	2	1	49	4	39	23	2	68	2	11	4	2	19	28	20	9	0	57	193
<b>Total</b>	<b>47</b>	<b>159</b>	<b>6</b>	<b>6</b>	<b>218</b>	<b>18</b>	<b>173</b>	<b>140</b>	<b>15</b>	<b>346</b>	<b>3</b>	<b>39</b>	<b>28</b>	<b>4</b>	<b>74</b>	<b>134</b>	<b>86</b>	<b>26</b>	<b>0</b>	<b>246</b>	<b>884</b>
10:00 AM	11	35	2	1	49	4	40	23	2	69	2	10	4	2	18	27	19	8	0	54	190
10:15 AM	14	36	2	2	54	5	43	24	3	75	3	10	4	2	19	25	19	8	0	52	200
10:30 AM	17	35	2	2	56	6	47	24	3	80	3	9	5	2	19	23	18	9	0	50	205
10:45 AM	18	35	2	3	58	7	48	25	2	82	4	8	5	2	19	22	18	9	0	49	208
<b>Total</b>	<b>60</b>	<b>141</b>	<b>8</b>	<b>8</b>	<b>217</b>	<b>22</b>	<b>178</b>	<b>96</b>	<b>10</b>	<b>306</b>	<b>12</b>	<b>37</b>	<b>18</b>	<b>8</b>	<b>75</b>	<b>97</b>	<b>74</b>	<b>34</b>	<b>0</b>	<b>205</b>	<b>803</b>
11:00 AM	19	36	3	4	62	7	49	26	2	84	5	8	5	2	20	22	19	11	0	52	218
11:15 AM	12	35	3	0	50	8	54	35	3	100	0	14	6	0	20	37	24	11	0	72	242
11:30 AM	8	33	1	1	43	7	42	36	3	88	0	14	4	0	18	42	14	12	0	68	217
11:45 AM	13	36	2	3	54	7	45	36	3	91	2	14	7	2	25	33	15	9	0	57	227
<b>Total</b>	<b>52</b>	<b>140</b>	<b>9</b>	<b>8</b>	<b>209</b>	<b>29</b>	<b>190</b>	<b>133</b>	<b>11</b>	<b>363</b>	<b>7</b>	<b>50</b>	<b>22</b>	<b>4</b>	<b>83</b>	<b>134</b>	<b>72</b>	<b>43</b>	<b>0</b>	<b>249</b>	<b>904</b>
12:00 PM	13	44	11	2	70	4	59	35	1	99	3	13	6	0	22	41	24	13	0	78	269
12:15 PM	11	47	4	3	65	8	55	35	5	103	4	13	7	0	24	55	21	8	0	84	276
12:30 PM	23	45	2	3	73	8	61	39	7	115	0	19	10	0	29	34	21	9	0	64	281
12:45 PM	13	54	3	1	71	7	53	38	6	104	0	21	7	5	33	43	25	7	0	75	283
<b>Total</b>	<b>60</b>	<b>190</b>	<b>20</b>	<b>9</b>	<b>279</b>	<b>27</b>	<b>228</b>	<b>147</b>	<b>19</b>	<b>421</b>	<b>7</b>	<b>66</b>	<b>30</b>	<b>5</b>	<b>108</b>	<b>173</b>	<b>91</b>	<b>37</b>	<b>0</b>	<b>301</b>	<b>1109</b>
01:00 PM	16	57	0	3	76	3	63	26	4	96	0	13	10	0	23	36	17	6	0	59	254
01:15 PM	15	57	2	2	76	5	62	36	0	103	1	17	10	1	29	32	17	11	0	60	268
01:30 PM	13	59	1	0	73	5	55	39	6	105	2	23	15	0	40	46	12	9	1	68	286
01:45 PM	19	53	2	2	76	14	56	47	1	118	2	18	5	0	25	36	35	12	2	85	304
<b>Total</b>	<b>63</b>	<b>226</b>	<b>5</b>	<b>7</b>	<b>301</b>	<b>27</b>	<b>236</b>	<b>148</b>	<b>11</b>	<b>422</b>	<b>5</b>	<b>71</b>	<b>40</b>	<b>1</b>	<b>117</b>	<b>150</b>	<b>81</b>	<b>38</b>	<b>3</b>	<b>272</b>	<b>1112</b>
02:00 PM	19	56	3	2	80	13	55	47	2	117	2	20	6	0	28	40	31	10	0	81	306
02:15 PM	19	59	4	3	85	12	55	50	2	119	2	22	7	1	32	44	28	9	0	81	317
02:30 PM	18	62	5	2	87	11	56	52	3	122	2	24	8	0	34	48	25	8	0	81	324
02:45 PM	18	64	6	2	90	10	57	54	3	124	2	26	9	0	37	52	24	7	0	83	334
<b>Total</b>	<b>74</b>	<b>241</b>	<b>18</b>	<b>9</b>	<b>342</b>	<b>46</b>	<b>223</b>	<b>203</b>	<b>10</b>	<b>482</b>	<b>8</b>	<b>92</b>	<b>30</b>	<b>1</b>	<b>131</b>	<b>184</b>	<b>108</b>	<b>34</b>	<b>0</b>	<b>326</b>	<b>1281</b>
03:00 PM	19	70	7	2	98	9	60	55	4	128	2	28	9	6	45	58	23	7	0	88	359
03:15 PM	18	71	3	1	93	9	48	43	2	102	1	13	14	0	28	53	41	10	3	107	330
03:30 PM	14	78	1	1	94	5	68	42	10	125	0	24	14	1	39	53	46	12	9	120	378
03:45 PM	21	79	4	4	108	8	72	46	4	130	2	41	10	1	54	55	35	13	0	103	395
<b>Total</b>	<b>72</b>	<b>298</b>	<b>15</b>	<b>8</b>	<b>393</b>	<b>31</b>	<b>248</b>	<b>186</b>	<b>20</b>	<b>485</b>	<b>5</b>	<b>106</b>	<b>47</b>	<b>8</b>	<b>166</b>	<b>219</b>	<b>145</b>	<b>42</b>	<b>12</b>	<b>418</b>	<b>1462</b>



Superior Road / Forest Hill Avenue / Terrace Road Intersection

Project Number: 2008113.00  
 Project Name: City Wide Safety Study  
 Project Location: East Cleveland, OH  
 Client Name: City of East Cleveland

File Name : superior and terrace rd 3-17-09  
 Site Code : 36015555  
 Start Date : 3/17/2009  
 Page No : 2

**Groups Printed- Passenger Vehicles - Trucks - Buses**

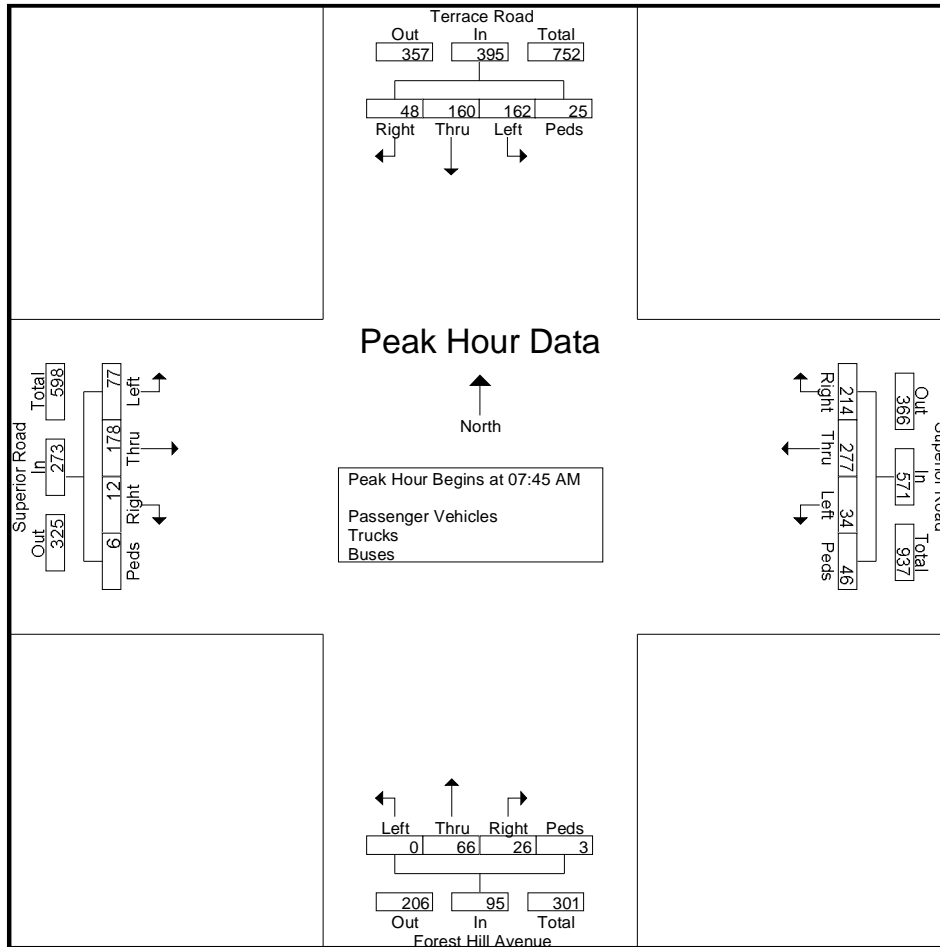
Start Time	Superior Road Eastbound					Superior Road Westbound					Forest Hill Avenue Northbound					Terrace Road Southbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
04:00 PM	22	80	5	3	110	6	83	47	3	139	0	41	15	0	56	45	26	9	0	80	385
04:15 PM	15	85	4	2	106	16	58	42	7	123	0	33	12	1	46	55	24	10	0	89	364
04:30 PM	25	105	4	10	144	12	73	39	0	124	0	32	5	1	38	62	24	7	0	93	399
04:45 PM	27	94	4	0	125	7	70	36	2	115	0	56	15	0	71	53	26	9	0	88	399
<b>Total</b>	<b>89</b>	<b>364</b>	<b>17</b>	<b>15</b>	<b>485</b>	<b>41</b>	<b>284</b>	<b>164</b>	<b>12</b>	<b>501</b>	<b>0</b>	<b>162</b>	<b>47</b>	<b>2</b>	<b>211</b>	<b>215</b>	<b>100</b>	<b>35</b>	<b>0</b>	<b>350</b>	<b>1547</b>
05:00 PM	22	81	2	4	109	10	83	41	2	136	2	34	13	0	49	64	25	9	1	99	393
05:15 PM	27	94	0	1	122	11	60	65	5	141	0	45	29	0	74	59	30	14	0	103	440
05:30 PM	20	79	2	4	105	7	75	60	2	144	2	26	15	0	43	62	26	15	0	103	395
05:45 PM	14	89	3	1	107	9	76	39	1	125	3	25	8	0	36	51	27	9	0	87	355
<b>Total</b>	<b>83</b>	<b>343</b>	<b>7</b>	<b>10</b>	<b>443</b>	<b>37</b>	<b>294</b>	<b>205</b>	<b>10</b>	<b>546</b>	<b>7</b>	<b>130</b>	<b>65</b>	<b>0</b>	<b>202</b>	<b>236</b>	<b>108</b>	<b>47</b>	<b>1</b>	<b>392</b>	<b>1583</b>
06:00 PM	14	87	3	3	107	7	87	42	1	137	1	27	11	0	39	44	23	5	0	72	355
06:15 PM	14	63	1	2	80	8	64	36	0	108	0	14	13	2	29	45	20	7	0	72	289
06:30 PM	18	56	1	2	77	16	53	46	1	116	0	26	3	0	29	38	27	10	2	77	299
06:45 PM	17	62	0	1	80	11	76	42	2	131	1	22	8	0	31	38	24	11	2	75	317
<b>Total</b>	<b>63</b>	<b>268</b>	<b>5</b>	<b>8</b>	<b>344</b>	<b>42</b>	<b>280</b>	<b>166</b>	<b>4</b>	<b>492</b>	<b>2</b>	<b>89</b>	<b>35</b>	<b>2</b>	<b>128</b>	<b>165</b>	<b>94</b>	<b>33</b>	<b>4</b>	<b>296</b>	<b>1260</b>
<b>Grand Total</b>	<b>777</b>	<b>2678</b>	<b>128</b>	<b>95</b>	<b>3678</b>	<b>373</b>	<b>2814</b>	<b>1938</b>	<b>176</b>	<b>5301</b>	<b>56</b>	<b>961</b>	<b>409</b>	<b>43</b>	<b>1469</b>	<b>1983</b>	<b>1252</b>	<b>448</b>	<b>45</b>	<b>3728</b>	<b>14176</b>
<b>Apprch %</b>	<b>21.1</b>	<b>72.8</b>	<b>3.5</b>	<b>2.6</b>		<b>7</b>	<b>53.1</b>	<b>36.6</b>	<b>3.3</b>		<b>3.8</b>	<b>65.4</b>	<b>27.8</b>	<b>2.9</b>		<b>53.2</b>	<b>33.6</b>	<b>12</b>	<b>1.2</b>		
<b>Total %</b>	<b>5.5</b>	<b>18.9</b>	<b>0.9</b>	<b>0.7</b>	<b>25.9</b>	<b>2.6</b>	<b>19.9</b>	<b>13.7</b>	<b>1.2</b>	<b>37.4</b>	<b>0.4</b>	<b>6.8</b>	<b>2.9</b>	<b>0.3</b>	<b>10.4</b>	<b>14</b>	<b>8.8</b>	<b>3.2</b>	<b>0.3</b>	<b>26.3</b>	
<b>Passenger Vehicles</b>	<b>724</b>	<b>2635</b>	<b>127</b>	<b>95</b>	<b>3581</b>	<b>372</b>	<b>2762</b>	<b>1919</b>	<b>176</b>	<b>5229</b>	<b>55</b>	<b>958</b>	<b>405</b>	<b>43</b>	<b>1461</b>	<b>1957</b>	<b>1234</b>	<b>408</b>	<b>45</b>	<b>3644</b>	<b>13915</b>
<b>% Passenger Vehicles</b>	<b>93.2</b>	<b>98.4</b>	<b>99.2</b>	<b>100</b>	<b>97.4</b>	<b>99.7</b>	<b>98.2</b>	<b>99</b>	<b>100</b>	<b>98.6</b>	<b>98.2</b>	<b>99.7</b>	<b>99</b>	<b>100</b>	<b>99.5</b>	<b>98.7</b>	<b>98.6</b>	<b>91.1</b>	<b>100</b>	<b>97.7</b>	<b>98.2</b>
<b>Trucks</b>	<b>5</b>	<b>13</b>	<b>1</b>	<b>0</b>	<b>19</b>	<b>0</b>	<b>17</b>	<b>3</b>	<b>0</b>	<b>20</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>8</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>11</b>	<b>52</b>
<b>% Trucks</b>	<b>0.6</b>	<b>0.5</b>	<b>0.8</b>	<b>0</b>	<b>0.5</b>	<b>0</b>	<b>0.6</b>	<b>0.2</b>	<b>0</b>	<b>0.4</b>	<b>0</b>	<b>0.1</b>	<b>0.2</b>	<b>0</b>	<b>0.1</b>	<b>0.4</b>	<b>0.2</b>	<b>0</b>	<b>0</b>	<b>0.3</b>	<b>0.4</b>
<b>Buses</b>	<b>48</b>	<b>30</b>	<b>0</b>	<b>0</b>	<b>78</b>	<b>1</b>	<b>35</b>	<b>16</b>	<b>0</b>	<b>52</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>0</b>	<b>6</b>	<b>18</b>	<b>15</b>	<b>40</b>	<b>0</b>	<b>73</b>	<b>209</b>
<b>% Buses</b>	<b>6.2</b>	<b>1.1</b>	<b>0</b>	<b>0</b>	<b>2.1</b>	<b>0.3</b>	<b>1.2</b>	<b>0.8</b>	<b>0</b>	<b>1</b>	<b>1.8</b>	<b>0.2</b>	<b>0.7</b>	<b>0</b>	<b>0.4</b>	<b>0.9</b>	<b>1.2</b>	<b>8.9</b>	<b>0</b>	<b>2</b>	<b>1.5</b>

**Superior Road / Forest Hill Avenue / Terrace Road Intersection**

Project Number: 2008113.00  
 Project Name: City Wide Safety Study  
 Project Location: East Cleveland, OH  
 Client Name: City of East Cleveland

File Name : superior and terrace rd 3-17-09  
 Site Code : 36015555  
 Start Date : 3/17/2009  
 Page No : 3

Start Time	Superior Road Eastbound					Superior Road Westbound					Forest Hill Avenue Northbound					Terrace Road Southbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
Peak Hour Analysis From 07:00 AM to 09:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	15	41	3	1	60	8	63	62	11	144	0	19	7	3	29	43	36	12	3	94	327
08:00 AM	21	42	1	2	66	10	68	50	23	151	0	16	4	0	20	42	43	15	19	119	356
08:15 AM	16	54	4	0	74	8	78	47	8	141	0	16	10	0	26	45	48	11	3	107	348
08:30 AM	25	41	4	3	73	8	68	55	4	135	0	15	5	0	20	32	33	10	0	75	303
Total Volume	77	178	12	6	273	34	277	214	46	571	0	66	26	3	95	162	160	48	25	395	1334
% App. Total	28.2	65.2	4.4	2.2		6	48.5	37.5	8.1		0	69.5	27.4	3.2		41	40.5	12.2	6.3		
PHF	.770	.824	.750	.500	.922	.850	.888	.863	.500	.945	.000	.868	.650	.250	.819	.900	.833	.800	.329	.830	.937



# GPD Group

520 South Main Street, Suite 2531  
Akron, Ohio 44311  
Telephone: 330.572.2100

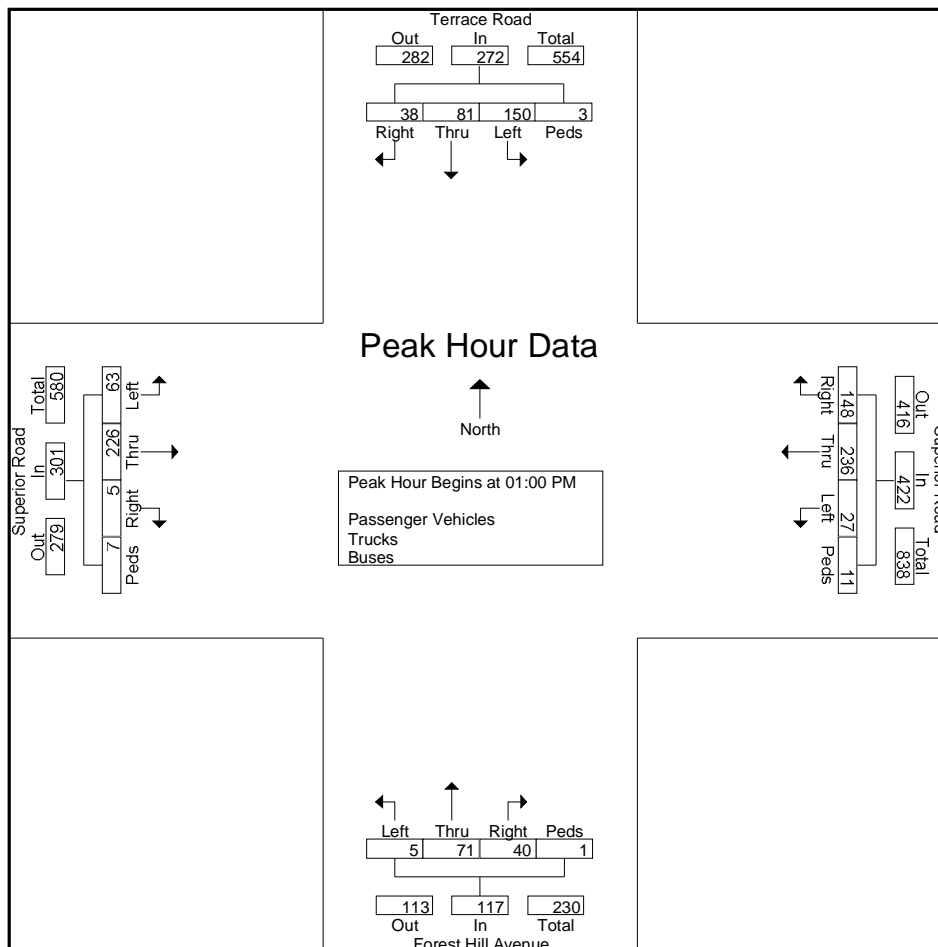


## Superior Road / Forest Hill Avenue / Terrace Road Intersection

Project Number: 2008113.00  
Project Name: City Wide Safety Study  
Project Location: East Cleveland, OH  
Client Name: City of East Cleveland

File Name : superior and terrace rd 3-17-09  
Site Code : 36015555  
Start Date : 3/17/2009  
Page No : 4

Start Time	Superior Road Eastbound					Superior Road Westbound					Forest Hill Avenue Northbound					Terrace Road Southbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
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	16	57	0	3	76	3	63	26	4	96	0	13	10	0	23	36	17	6	0	59	254
01:15 PM	15	57	2	2	76	5	62	36	0	103	1	17	10	1	29	32	17	11	0	60	268
01:30 PM	13	59	1	0	73	5	55	39	6	105	2	23	15	0	40	46	12	9	1	68	286
01:45 PM	19	53	2	2	76	14	56	47	1	118	2	18	5	0	25	36	35	12	2	85	304
Total Volume	63	226	5	7	301	27	236	148	11	422	5	71	40	1	117	150	81	38	3	272	1112
% App. Total	20.9	75.1	1.7	2.3		6.4	55.9	35.1	2.6		4.3	60.7	34.2	0.9		55.1	29.8	14	1.1		
PHF	.829	.958	.625	.583	.990	.482	.937	.787	.458	.894	.625	.772	.667	.250	.731	.815	.579	.792	.375	.800	.914



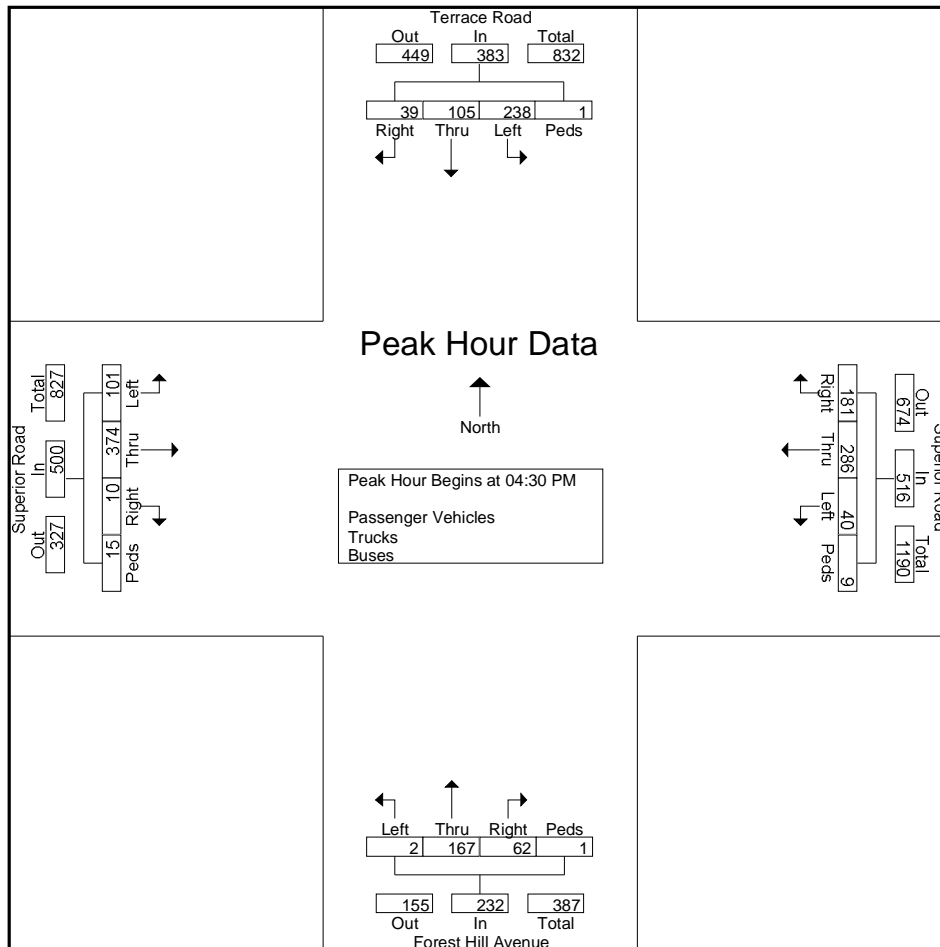


Superior Road / Forest Hill Avenue / Terrace Road Intersection

Project Number: 2008113.00  
 Project Name: City Wide Safety Study  
 Project Location: East Cleveland, OH  
 Client Name: City of East Cleveland

File Name : superior and terrace rd 3-17-09  
 Site Code : 36015555  
 Start Date : 3/17/2009  
 Page No : 5

Start Time	Superior Road Eastbound					Superior Road Westbound					Forest Hill Avenue Northbound					Terrace Road Southbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
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	25	105	4	10	144	12	73	39	0	124	0	32	5	1	38	62	24	7	0	93	399
04:45 PM	27	94	4	0	125	7	70	36	2	115	0	56	15	0	71	53	26	9	0	88	399
05:00 PM	22	81	2	4	109	10	83	41	2	136	2	34	13	0	49	64	25	9	1	99	393
05:15 PM	27	94	0	1	122	11	60	65	5	141	0	45	29	0	74	59	30	14	0	103	440
Total Volume	101	374	10	15	500	40	286	181	9	516	2	167	62	1	232	238	105	39	1	383	1631
% App. Total	20.2	74.8	2	3		7.8	55.4	35.1	1.7		0.9	7.2	26.7	0.4		62.1	27.4	10.2	0.3		
PHF	.935	.890	.625	.375	.868	.833	.861	.696	.450	.915	.250	.746	.534	.250	.784	.930	.875	.696	.250	.930	.927



## **APPENDIX B**

### **TRAFFIC SIGNAL WARRANTS WORKSHEETS**

**GPD Group**  
 Superior Ave / Terrace Road / Forest Hill Ave  
 City of East Cleveland, Ohio

Study Name : **Forrest-Terrace-Superior**  
 Study Date : **03/18/09**  
 Page No. : 1

**Signal Warrants - Summary**

**Major Street Approaches**

**Eastbound: Superior Road**  
 Number of Lanes: 2  
 Approach Speed: 35  
 Total Approach Volume: 3,583

**Westbound: Superior Road**  
 Number of Lanes: 2  
 Approach Speed: 35  
 Total Approach Volume: 5,125

**Minor Street Approaches**

**Northbound: Forest Hill Road**  
 Number of Lanes: 2  
 Total Approach Volume: 1,426

**Southbound: Terrace Road**  
 Number of Lanes: 2  
 Total Approach Volume: 3,683

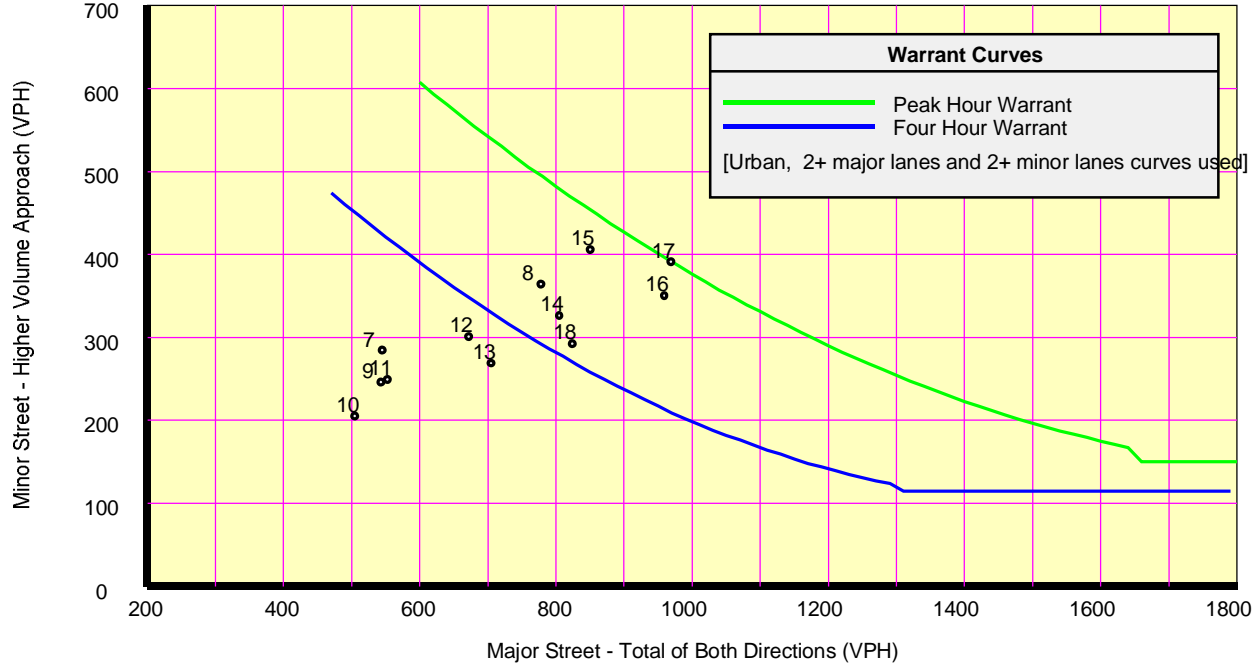
**Warrant Summary** (Urban values apply.)

<b>Warrant 1 - Eight Hour Vehicular Volumes</b> .....	<b>Satisfied</b>
<b>Warrant 1A - Minimum Vehicular Volume</b> ..... <b>Satisfied</b>	
Required volumes reached for 8 hours, 8 are needed	
<b>Warrant 1B - Interruption of Continuous Traffic</b> ..... <b>Not Satisfied</b>	
Required volumes reached for 2 hours, 8 are needed	
<b>Warrant 1 A&amp;B - Combination of Warrants</b> ..... <b>Not Satisfied</b>	
Required volumes reached for 6 hours, 8 are needed	
<b>Warrant 2 - Four Hour Volumes</b> .....	<b>Satisfied</b>
Number of hours (6) volumes exceed minimum >= minimum required (4).	
<b>Warrant 3 - Peak Hour</b> .....	<b>Satisfied</b>
<b>Warrant 3A - Peak Hour Delay</b> ..... <b>Not Satisfied</b>	
Total approach volumes and delays on minor street do not exceed minimums for any hour.	
<b>Warrant 3B - Peak Hour Volumes</b> ..... <b>Satisfied</b>	
Volumes exceed minimums for at least one hour.	
<b>Warrant 4 - Pedestrian Volumes</b> .....	Not Evaluated
<b>Warrant 5 - School Crossing</b> .....	Not Evaluated
<b>Warrant 6 - Coordinated Signal System</b> .....	Not Evaluated
<b>Warrant 7 - Crash Experience</b> .....	Not Evaluated
<b>Warrant 8 - Roadway Network</b> .....	Not Evaluated

**GPD Group**  
 Superior Ave / Terrace Road / Forest Hill Ave  
 City of East Cleveland, Ohio

Study Name : **Forrest-Terrace-Superior**  
 Study Date : **03/18/09**  
 Page No. : **2**

**Signal Warrants - Summary**



**Analysis of 8-Hour Volume Warrants:**

Hour Begin	Major Total	Higher Minor Vol	Dir	War-1A			War-1B			War-1A&B		
				Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?
00:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
01:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
02:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
03:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
04:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
05:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
06:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
07:00	545	284	SB	600-No	200-Yes	Minor	900-No	100-Yes	Minor	720-No	160-Yes	Minor
08:00	778	364	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
09:00	543	246	SB	600-No	200-Yes	Minor	900-No	100-Yes	Minor	720-No	160-Yes	Minor
10:00	505	205	SB	600-No	200-Yes	Minor	900-No	100-Yes	Minor	720-No	160-Yes	Minor
11:00	553	249	SB	600-No	200-Yes	Minor	900-No	100-Yes	Minor	720-No	160-Yes	Minor
12:00	672	301	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-No	160-Yes	Minor
13:00	705	269	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-No	160-Yes	Minor
14:00	805	326	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
15:00	850	406	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
16:00	959	350	SB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
17:00	969	391	SB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
18:00	824	292	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
19:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
20:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
21:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
22:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
23:00	0	0	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---

**APPENDIX C**  
**SITE PHOTOGRAPHS**



Photo 1 East Approach (looking west)



Photo 3 South Approach (looking north)



Photo 2 North Approach (looking south)



Photo 4 West Approach (looking east)

**APPENDIX D**  
**COLLISION DIAGRAM**



**APPENDIX E**  
**CRASH DATA SUMMARY**

APPENDIX E  
CITY OF EAST CLEVELAND SAFETY STUDY  
SUPERIOR ROAD AND FORREST HILL AVENUE  
CRASH DATA SUMMARY FOR YEARS 2005 - 2007

Document Number	Local Report Number	Crash Severity	Total Units Involved	Date	Time	Day of Week	Pavement Conditions	Crash Type	Weather Conditions	Light Conditions	Alcohol Related	Drug Related	Total Injured	Total Killed	Speed Related	Pedestrian Related
20058079018	EC0501575	INJURY	2	3022005	1200	WEDNESDAY	SNOW	SIDESWIPE SAME DIRECTION	CLEAR	DAYLIGHT	NO	NO	2	0	NO	NO
20058121633	EC0502644	INJURY	2	4232005	1145	SATURDAY	WET	ANGLE	ICE	DAYLIGHT	NO	NO	1	0	NO	NO
20058137041	EC0502723	PROPERTY DAMAGE ONLY	2	4272005	1500	WEDNESDAY	DRY	ANGLE	CLOUDY	DAYLIGHT	NO	NO	0	0	NO	NO
20058140571	EC0503136	PROPERTY DAMAGE ONLY	2	5132005	1830	FRIDAY	DRY	ANGLE *	CLEAR	DAYLIGHT	NO	NO	0	0	NO	NO
20058140576	EC0503159	PROPERTY DAMAGE ONLY	2	5142005	1640	SATURDAY	WET	ANGLE	CLOUDY	DAYLIGHT	NO	NO	0	0	NO	NO
20058159733	EC0503840	PROPERTY DAMAGE ONLY	2	6072005	820	TUESDAY	DRY	ANGLE	CLEAR	DAYLIGHT	NO	NO	0	0	NO	NO
20058182953	EC0504672	PROPERTY DAMAGE ONLY	2	7072005	1830	THURSDAY	DRY	SIDESWIPE SAME DIRECTION	CLEAR	DAYLIGHT	NO	NO	0	0	NO	NO
20058211225	EC0505430	PROPERTY DAMAGE ONLY	2	8042005	2215	THURSDAY	DRY	SIDESWIPE OPPOSITE DIRECTION	CLEAR	DARK-LIGHTED ROADWAY	NO	NO	0	0	NO	NO
20058249614	EC0506565	INJURY	2	9152005	1700	THURSDAY	DRY	ANGLE	CLEAR	DAYLIGHT	NO	NO	1	0	NO	NO
20058261033	EC0507175	PROPERTY DAMAGE ONLY	2	10072005	1555	FRIDAY	WET	ANGLE	ICE	DAYLIGHT	NO	NO	0	0	NO	NO
20058261043	EC0505239	PROPERTY DAMAGE ONLY	2	7282005	1600	THURSDAY	DRY	ANGLE	CLEAR	DAYLIGHT	NO	NO	0	0	NO	NO
20058323739	EC0508423	PROPERTY DAMAGE ONLY	2	11232005	730	WEDNESDAY	DRY	ANGLE	CLOUDY	DAYLIGHT	NO	NO	0	0	NO	NO
20068075624	EC0601652	PROPERTY DAMAGE ONLY	2	3052006	130	SUNDAY	DRY	REAR-END	CLOUDY	DARK-LIGHTED ROADWAY	YES	NO	0	0	NO	NO
20068075879	EC0602069	INJURY	2	3222006	2000	WEDNESDAY	DRY	REAR-END	CLEAR	DARK-LIGHTED ROADWAY	NO	NO	1	0	NO	NO
20068083116	EC0602679	INJURY	3	4182006	1830	TUESDAY	WET	ANGLE *	CLEAR	DAYLIGHT	NO	NO	5	0	NO	NO
20068162111	EC06045303	PROPERTY DAMAGE ONLY	2	7082006	1115	SATURDAY	DRY	REAR-END *	CLEAR	DAYLIGHT	NO	NO	0	0	NO	NO
20068186637	EC06-05369	INJURY	4	8122006	2150	SATURDAY	DRY	ANGLE	CLEAR	DARK-LIGHTED ROADWAY	NO	NO	3	0	YES	NO
20068214884	EC0606294	INJURY	2	9222006	1848	FRIDAY	WET	ANGLE	CLEAR	DAYLIGHT	NO	NO	4	0	NO	NO
20068223447	EC0606502	PROPERTY DAMAGE ONLY	2	10022006	1330	MONDAY	WET	REAR-END	ICE	DAYLIGHT	NO	NO	0	0	NO	NO
20068233134	EC06-06632	PROPERTY DAMAGE ONLY	2	10072006	1920	SATURDAY	DRY	ANGLE	CLEAR	DARK-LIGHTED ROADWAY	NO	NO	0	0	NO	NO
20068245867	EC0607003	PROPERTY DAMAGE ONLY	2	10232006	1600	MONDAY	SNOW	ANGLE	WATER (STANDING, MOVING)	DAYLIGHT	NO	NO	0	0	YES	NO
20068245872	EC0606948	INJURY	2	10202006	1430	FRIDAY	WET	ANGLE *	ICE	DAYLIGHT	NO	NO	2	0	NO	NO
20068263022	EC0607072	PROPERTY DAMAGE ONLY	2	10262006	1530	THURSDAY	DRY	REAR-END	CLEAR	DAYLIGHT	NO	NO	0	0	NO	NO
20068266855	EC0607491	INJURY	2	11122006	1250	SUNDAY	DRY	ANGLE	CLOUDY	DAYLIGHT	NO	NO	2	0	NO	NO
20068276574	EC0607566	PROPERTY DAMAGE ONLY	2	11152006	1600	WEDNESDAY	WET	ANGLE	ICE	DUSK	NO	NO	0	0	NO	NO
20068295149	EC0607471	PROPERTY DAMAGE ONLY	2	11112006	1500	SATURDAY	WET	ANGLE	ICE	DAYLIGHT	NO	NO	0	0	NO	NO
20068322887	EC0608563	PROPERTY DAMAGE ONLY	2	12292006	2004	FRIDAY	DRY	ANGLE *	CLEAR	DARK-LIGHTED ROADWAY	YES	NO	0	0	NO	NO
20068322888	EC06-08584	INJURY	1	12302006	1910	SATURDAY	DRY	NOT 2 VEHICLES MOVING	CLEAR	DARK-LIGHTED ROADWAY	NO	NO	1	0	NO	NO
20074000848	EC0700934	PROPERTY DAMAGE ONLY	2	2102007	1945	SATURDAY	DRY	ANGLE *	CLEAR	DARK-LIGHTED ROADWAY	NO	NO	0	0	NO	NO
20078002095	EC07000132	PROPERTY DAMAGE ONLY	2	1072007	2025	SUNDAY	WET	REAR-END	ICE	DARK-LIGHTED ROADWAY	NO	NO	0	0	NO	NO
20078062241	EC0701502	PROPERTY DAMAGE ONLY	2	3072007	1800	WEDNESDAY	SNOW	REAR-END *	OTHER	DUSK	NO	NO	0	0	NO	NO
20078093738	EC0702863	INJURY	2	5062007	1345	SUNDAY	DRY	ANGLE *	CLEAR	DAYLIGHT	NO	NO	1	0	NO	NO
20078155409	EC0705109	PROPERTY DAMAGE ONLY	2	8152007	1109	WEDNESDAY	DRY	ANGLE	CLEAR	DAYLIGHT	NO	NO	0	0	NO	NO
20078168746	EC0705444	PROPERTY DAMAGE ONLY	2	9012007	1515	SATURDAY	DRY	REAR-END	CLEAR	DAYLIGHT	NO	NO	0	0	NO	NO
20078179943	EC0705661	INJURY	2	9112007	1800	TUESDAY	DRY	ANGLE	CLEAR	DAYLIGHT	NO	NO	1	0	NO	NO
20078180044	EC0705649	PROPERTY DAMAGE ONLY	3	9112007	811	TUESDAY	WET	ANGLE	CLOUDY	DAYLIGHT	NO	NO	0	0	NO	NO
20078180045	EC0705651	PROPERTY DAMAGE ONLY	2	9112007	830	TUESDAY	WET	ANGLE	ICE	DAYLIGHT	NO	NO	0	0	NO	NO
20078234832	EC0708118	PROPERTY DAMAGE ONLY	3	12152007	1700	SATURDAY	SNOW	REAR-END	WATER (STANDING, MOVING)	DARK-LIGHTED ROADWAY	NO	NO	0	0	NO	NO
20078258634	EC0707758	PROPERTY DAMAGE ONLY	2	12022007	1015	SUNDAY	SNOW	SIDESWIPE SAME DIRECTION	WATER (STANDING, MOVING)	DARK-LIGHTED ROADWAY	NO	NO	0	0	NO	NO

\* REVISED CRASH TYPE BASED ON REVIEW OF THE OH-1 FORMS

**APPENDIX F**  
**CRASH DATA CHARTS**

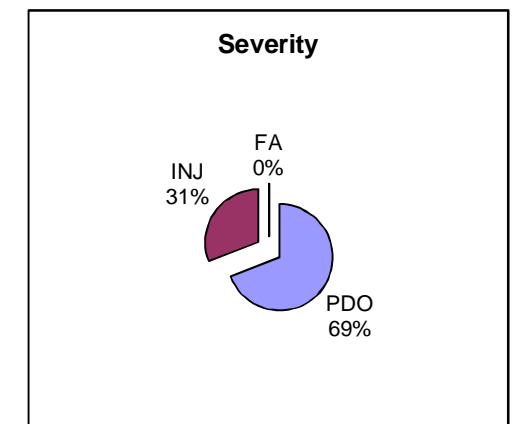
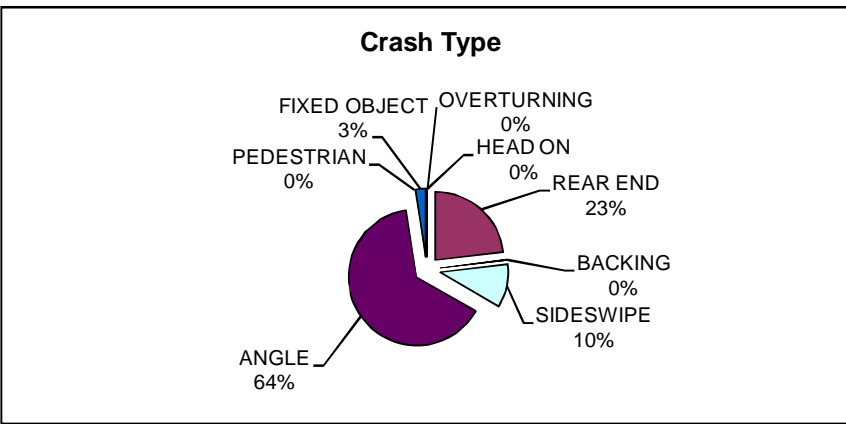
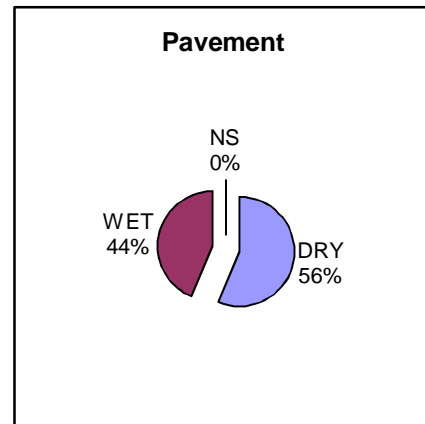
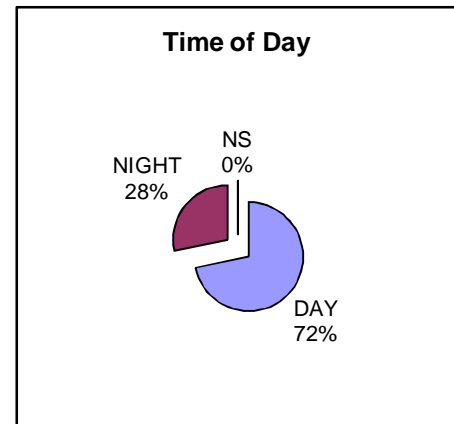
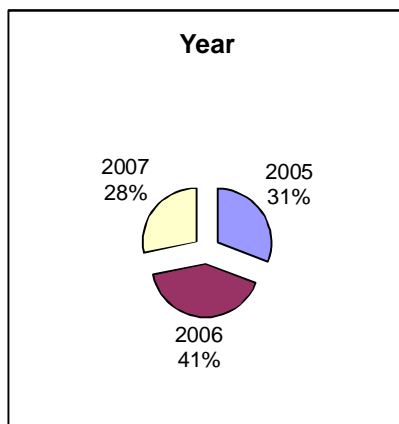
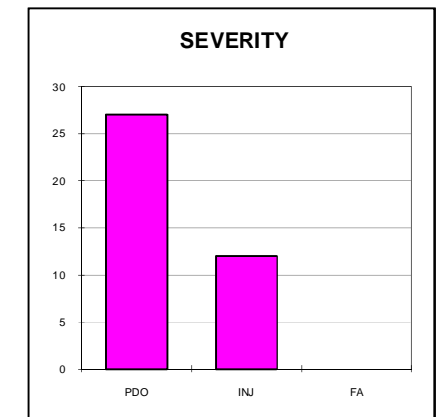
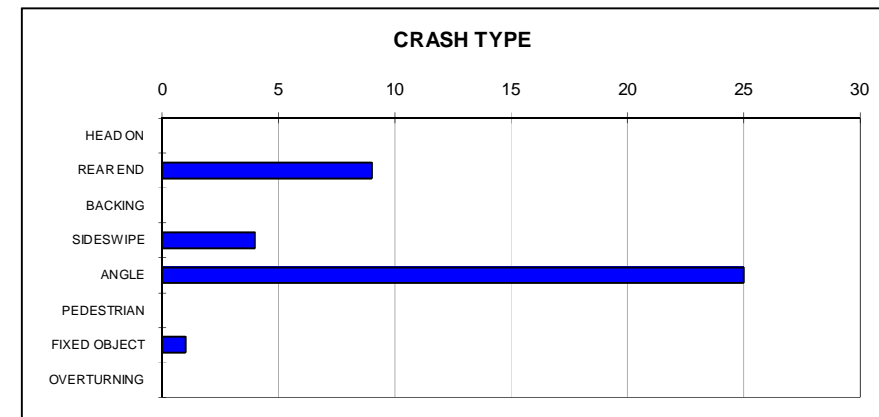
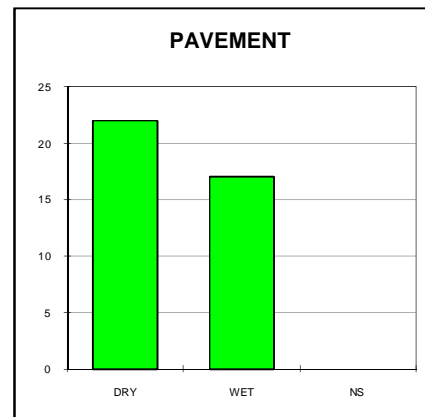
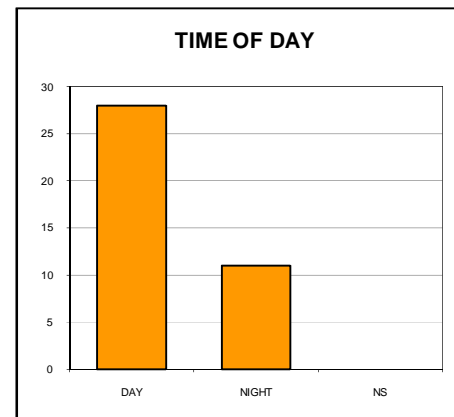
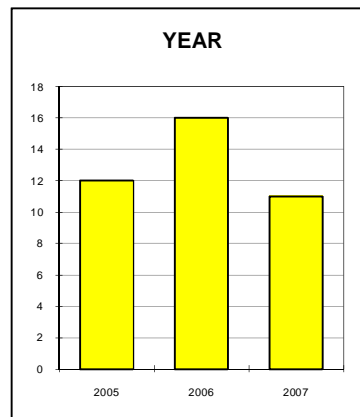
# CITY OF EAST CLEVELAND SAFETY STUDY SUPERIOR ROAD AND FOREST HILL AVENUE TRAFFIC CRASH ANALYSIS

County **Cuyahoga**

Primary Roadway **Superior Road**  
Secondary Roadway **Forest Hill Avenue**

Begin SLM **2005** End SLM **2007**  
Begin Year **2005** End Year **2007**

Year	TIME OF DAY									PAVEMENT CONDITION									CRASH TYPE																		Total										
	DAY			NIGHT			NS			DRY			WET			NS			HEAD ON			REAR END			BACKING			SIDESWIPE			ANGLE			PEDESTRIAN				FIXED OBJECT			OVERTURNING			Subtotal			
	PDO	INJ	FA	PDO	INJ	FA	PDO	INJ	FA	PDO	INJ	FA	PDO	INJ	FA	PDO	INJ	FA	PDO	INJ	FA	PDO	INJ	FA	PDO	INJ	FA	PDO	INJ	FA	PDO	INJ	FA	PDO	INJ	FA		PDO	INJ	FA	PDO	INJ	FA				
2005	8	3	0	1	0	0				7	1	0	2	2	0				0	0	0	0	0	0	0	0	0	2	1	0	7	2	0	0	0	0	0	0	0	0	0	0	9	3	0	12	
2006	6	4	0	3	3	0				5	4	0	4	3	0				0	0	0	4	1	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	9	7	0	16
2007	5	2	0	4	0	0				3	2	0	6	0	0				0	0	0	4	0	0	0	0	0	1	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	9	2	0	11
Subtotal	19	9	0	8	3	0	0	0	0	15	7	0	12	5	0	0	0	0	0	0	8	1	0	0	0	0	3	1	0	16	9	0	0	0	0	0	0	0	0	0	0	0	27	12	0	39	
Average	6.33	3.00	0.00	2.67	1.00	0.00	0.00	0.00	0.00	5.00	2.33	0.00	4.00	1.67	0.00	0.00	0.00	0.00	0.00	0.00	2.67	0.33	0.00	0.00	0.00	0.00	1.00	0.33	0.00	5.33	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	4.00	0.00	13.00		
Total	28			11			0			22			17			0			0			9			0			4			25			0			1			0			39				



**APPENDIX G**  
**CRASH DATA ANALYSIS CALCULATIONS**

**CITY OF EAST CLEVELAND - HIGH CRASH INTERSECTIONS**  
(SORTED BY TOTAL NUMBER OF CRASHES)

		CRASHES 2005-2007				Approach ADT	Annual Crash Rate	Severity Index	
Street	Intersecting Street	Fatal	Injury	PDO	Total				
SUPERIOR	FOREST HILL		12	27	39	15391	2.31	1.62	
NOBLE	TERRACE		13	24	37	10787	3.13	1.70	
EUCLID	TAYLOR		9	25	35	17460	1.83	1.49	*
EUCLID	NOBLE		8	25	33	25809	1.17	1.48	*
EUCLID	SHAW		4	25	29	20484	1.29	1.28	
LEE	TERRACE		6	19	26			1.42	
EUCLID	FOREST HILLS		4	19	23			1.35	*
EUCLID	SUPERIOR		3	20	23			1.26	*
EUCLID	STANWOOD		5	17	22			1.45	*
HAYDEN	SHAW		5	16	21			1.48	
FOREST HILLS	TERRACE	1	7	10	18	18600	0.88	2.39	
HAYDEN	SUPERIOR		2	14	17			1.18	
EUCLID	EDDY		5	12	17			1.59	*
COVENTRY	SUPERIOR		5	12	17			1.59	
TAYLOR	TERRACE		4	11	15			1.53	
EUCLID	LAKEVIEW		5	9	15			1.60	
HAYDEN	LAKEFRONT		9	5	14			2.29	
NOBLE	0152ND		1	12	14			1.07	
COLLERMERE	ELDERWOOD		4	7	11			1.73	
HAYDEN	EDDY		1	10	11			1.18	
EMILY	SUPERIOR		2	7	10			1.30	
EUCLID	MARLOES		1	8	10			1.10	
FOREST HILL	LEE		2	8	10			1.40	
SUPERIOR	LUXOR		2	7	9			1.44	*
EUCLID	LEE		2	7	9			1.44	
SUPERIOR	CARLYON		3	6	9			1.67	
EUCLID	COIT		2	6	8			1.50	*
EUCLID	DELMONT		2	5	7			1.57	
EUCLID	HILLSBORO		2	5	7			1.57	
EUCLID	NELA		3	4	7			1.86	
HAYDEN	MANN	1	2	4	7			3.14	
TERRACE	BELMORE		1	5	6			1.33	
HAYDEN	ELM		1	5	6			1.33	

\* Indicates an intersection coincident with a high crash section

## **APPENDIX H**

# **ESTIMATES OF COUNTERMEASURES EFFECTIVENESS REDUCTION (CFR) FACTORS**



**APPENDIX H**  
**Estimates of Countermeasure Effectiveness Reduction (CRF) Factors**  
**(September 1997, Revised July 2007)**

ID	Description	All	PDO	INJ/FAT	Night	Wet	Pedestrian	Left	Right	Angle	Rear	Head	Side	Fixed	Ran
46	35 Install section lighting				0.5										
47	36 Upgrade existing lighting				0.5										
48	43 Replace culvert													0.6	
49	44 Replace bridge													0.62	
50	45 Widen bridge													0.43	
51	46 Widen culvert													0.25	
52	62 Install guard rail at bridge end [Injury-fatal crashes only]													0.2	
53	49 Install guard rail [Injury-fatal crashes only]													0.2	0.2
54	63 Improve guard rail [Injury-fatal crashes only]													0.2	
55	50 Remove or relocate fixed object to a safe distance from the roadway	0.38		0.38											
56	64 Make utility pole breakaway [Utility pole fatal crashes only]													0.3	
57	65 Relocate utility pole 3 0' from edge of pavement [Utility pole fatal crashes only]													0.32	
58	66 Remove utility pole [Utility pole fatal crashes only]													0.38	
59	67 Remove tree [Tree crashes only]													0.25	
60	68 Make sign support breakaway - all sizes [Sign injury-fatal crashes only]													0.24	
61	69 Install auto. prot. device at R/R grade crossing [Train-vehicle crashes only]	0.28													
62	48 Install impact attenuator device [Injury-fatal crashes only]													0.5	
63	47 Eliminate fixed objects													1	
64	55 Improve horizontal alignment - rural section	0.4													
65	70 Reconstruct curves on rural section - 2 lane [Curve crashes only]	0.88													
66	10 Eliminate parking														
67	11 Speed zone														
68	12 Prohibit turn	0.4													
69	18 Close median opening														
70	19 Relocate driveway entrance							0.1	0.1	0.1	0.2	0.2			
71	51 Relocate intersection	0.25													
72	52 Increase cross corner sight distance									0.5					
73	71 Prohibit right-turn-on-red								0.2						
74	53 Install rumble strips														
75	54 Provide proper super-elevation on curve - rural [curve crashes only]	0.5													

When using multiple countermeasures, the total reduction factor is:  
 $R1 + (1-R1)R2 + (1-R1)(1-R2)R3 + (1-R1)(1-R2)(1-R3)R4 + \dots = RT$   
 Cost of crashes for determining ROR (Updated - 2007)

SYSTEM	PDO	INJ/FAT
Rural State Highways	\$12,799	\$84,340
Counties and Unincorporated Villages	\$12,294	\$78,940

**APPENDIX I**

**RATE OF RETURN WORKSHEETS**







**APPENDIX J**  
**COST ESTIMATES**

EAST CLEVELAND SAFETY STUDY  
SUPERIOR ROAD AND FOREST HILLS AVENUE  
SHORT TERM SPOT COUNTERMEASURES ESTIMATE OF COSTS  
GPD GROUP  
MARCH, 2009

ITEM	EXTENSION	UNIT	DESCRIPTION	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
642	00190	MILE	LANE LINE	0.1	\$1,000.00	\$100.00
642	00290	MILE	CENTER LINE	0.12	\$10,000.00	\$1,200.00
642	00390	FT	CHANNELIZING LINE	210	\$1.00	\$210.00
642	00490	FT	STOP LINE	100	\$12.00	\$1,200.00
642	00590	FT	CROSSWALK LINE	340	\$3.00	\$1,020.00
642	00690	FT	TRANSVERSE/DIAGONAL LINE	350	\$5.00	\$1,750.00
642	01290	EACH	LANE ARROW	4	\$50.00	\$200.00
642	01390	EACH	WORD ON PAVEMENT, 72"	2	\$60.00	\$120.00
642	01490	FT	DOTTED LINE, 4"	150	\$3.00	\$450.00
642	50000	MILE	PAVEMENT MARKING, MISC.: PARKING LANE	0.05	\$800.00	\$40.00
						\$0.00
					TOTAL	\$6,290.00

EAST CLEVELAND SAFETY STUDY  
SUPERIOR ROAD AND FOREST HILLS AVENUE  
MEDIUM TERM SPOT COUNTERMEASURES ESTIMATE OF COSTS  
GPD GROUP  
MARCH, 2009

MEDIUM TERM - RESTRIPE LANES FOR DEDICATED LEFT TURN LANES AND UPGRADE SIGNAL INSTALLATION

ITEM	EXTENSION	UNIT	DESCRIPTION	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
632	00302	EACH	VEHICULAR SIGNAL HEAD, 3 SECTION, 12" LENS, 1-WAY, POLYCARBONATE	6	\$500.00	\$3,000.00
632	00502	EACH	VEHICULAR SIGNAL HEAD, 5 SECTION, 12" LENS, 1-WAY, POLYCARBONATE	3	\$600.00	\$1,800.00
632	26500	EACH	DETECTOR LOOP	4	\$1,500.00	\$6,000.00
632	27008	EACH	LOOP DETECTOR UNIT, DELAY AND EXTENSION TYPE	4	\$75.00	\$300.00
632	40700	FT	SIGNAL CABLE, 7 CONDUCTOR, NO. 14 AWG	600	\$5.00	\$3,000.00
632	65200	FT	LOOP DETECTOR LEAD-IN CABLE	1200	\$4.00	\$4,800.00
633	01550	EACH	CONTROLLER UNIT, TYPE TS2/A2, WITH CABINET, TYPE TS2	1	\$8,000.00	\$8,000.00
642	00190	MILE	LANE LINE	0.12	\$1,000.00	\$120.00
642	00290	MILE	CENTER LINE	0.05	\$10,000.00	\$500.00
642	00390	FT	CHANNELIZING LINE	370	\$1.00	\$370.00
642	00490	FT	STOP LINE	120	\$12.00	\$1,440.00
642	00590	FT	CROSSWALK LINE	340	\$3.00	\$1,020.00
642	00690	FT	TRANSVERSE/DIAGONAL LINE	350	\$5.00	\$1,750.00
642	01290	EACH	LANE ARROW	8	\$50.00	\$400.00
642	01390	EACH	WORD ON PAVEMENT, 72"	4	\$60.00	\$240.00
642	50000	MILE	PAVEMENT MARKING, MISC.: PARKING LANE	0.05	\$800.00	\$40.00
624	10000	LUMP	MOBILIZATION	1	\$1,500.00	\$1,500.00
990	10020	LUMP	ESTIMATED COST OF ENGINEERING, SUPERINTENDENCE AND CONTINGENCIES	1	\$2,500.00	\$2,500.00
			INFLATION AND OTHER CONTINGENCIES	1	\$1,000.00	\$1,000.00
						\$0.00
					TOTAL	\$37,780.00

EAST CLEVELAND SAFETY STUDY  
SUPERIOR ROAD AND FOREST HILLS AVENUE  
MEDIUM TERM SPOT COUNTERMEASURES ESTIMATE OF COSTS  
GPD GROUP  
MARCH, 2009

MEDIUM TERM - RESTRIPE LANES FOR DEDICATED LEFT TURN LANES AND UPGRADE SIGNAL INSTALLATION

ITEM	EXTENSION	UNIT	DESCRIPTION	ESTIMATED QUANTITY	UNIT COST	TOTAL COST
632	00302	EACH	VEHICULAR SIGNAL HEAD, 3 SECTION, 12" LENS, 1-WAY, POLYCARBONATE	6	\$500.00	\$3,000.00
632	00502	EACH	VEHICULAR SIGNAL HEAD, 5 SECTION, 12" LENS, 1-WAY, POLYCARBONATE	3	\$600.00	\$1,800.00
632	26500	EACH	DETECTOR LOOP	4	\$1,500.00	\$6,000.00
632	27008	EACH	LOOP DETECTOR UNIT, DELAY AND EXTENSION TYPE	4	\$75.00	\$300.00
632	40700	FT	SIGNAL CABLE, 7 CONDUCTOR, NO. 14 AWG	600	\$5.00	\$3,000.00
632	65200	FT	LOOP DETECTOR LEAD-IN CABLE	1200	\$4.00	\$4,800.00
633	01550	EACH	CONTROLLER UNIT, TYPE TS2/A2, WITH CABINET, TYPE TS2	1	\$8,000.00	\$8,000.00
642	00190	MILE	LANE LINE	0.12	\$1,000.00	\$120.00
642	00290	MILE	CENTER LINE	0.05	\$10,000.00	\$500.00
642	00390	FT	CHANNELIZING LINE	370	\$1.00	\$370.00
642	00490	FT	STOP LINE	120	\$12.00	\$1,440.00
642	00590	FT	CROSSWALK LINE	340	\$3.00	\$1,020.00
642	00690	FT	TRANSVERSE/DIAGONAL LINE	350	\$5.00	\$1,750.00
642	01290	EACH	LANE ARROW	8	\$50.00	\$400.00
642	01390	EACH	WORD ON PAVEMENT, 72"	4	\$60.00	\$240.00
642	50000	MILE	PAVEMENT MARKING, MISC.: PARKING LANE	0.05	\$800.00	\$40.00
624	10000	LUMP	MOBILIZATION	1	\$1,500.00	\$1,500.00
990	10020	LUMP	ESTIMATED COST OF ENGINEERING, SUPERINTENDENCE AND CONTINGENCIES	1	\$2,500.00	\$2,500.00
			INFLATION AND OTHER CONTINGENCIES	1	\$1,000.00	\$1,000.00
						\$0.00
					TOTAL	\$37,780.00

**APPENDIX K**  
**HCS PRINTOUTS**

HCS+: Signalized Intersections Release 5.3

Analyst: GJB Inter.: SUPERIOR/FOREST HILL  
 Agency: GPD GROUP Area Type: CBD or Similar  
 Date: 2/6/2009 Jurisd:  
 Period: AM PEAK - EXISTING Year : 2009  
 Project ID: EAST CLEVELAND SAFETY STUDY - JOB NO. 2008113  
 E/W St: SUPERIOR ROAD N/S St: FOREST HILL / TERRACE

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	1	0	1	0	1	1	0
LGConfig	LTR			LT R			LTR			L TR		
Volume	78	165	16	36	280	203	0	63	25	160	161	51
Lane Width	12.0			12.0 12.0			12.0			12.0 12.0		
RTOR Vol	5			5			5			5		

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
WB Left	P				SB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds		X	
NB Right					EB Right			
SB Right					WB Right			
Green	54.0				10.0		27.0	
Yellow	3.0				3.0		3.0	
All Red	2.0				0.0		2.0	

Cycle Length: 104.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	1259	2424	0.22	0.52	13.8	B	13.8	B
Westbound								
LT	1500	2888	0.23	0.52	13.9	B	14.2	B
R	753	1451	0.29	0.52	14.7	B		
Northbound								
LTR	430	1655	0.21	0.26	30.8	C	30.8	C
Southbound								
L	436	1624	0.41	0.40	22.5	C		
TR	635	1652	0.36	0.38	23.7	C	23.2	C

Intersection Delay = 17.9 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: MAH Inter.: SUPERIOR/FOREST HILL  
 Agency: GPD GROUP Area Type: CBD or Similar  
 Date: 2/6/2009 Jurisd:  
 Period: AM PEAK - SHORT TERM Year : 2009  
 Project ID: EAST CLEVELAND SAFETY STUDY - JOB NO. 2008113  
 E/W St: SUPERIOR ROAD N/S St: FOREST HILL / TERRACE

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	1	0	1	0	1	1	0
LGConfig	LTR			LT R			LTR			L TR		
Volume	78	165	16	36	280	203	0	63	25	160	161	51
Lane Width	12.0			12.0 12.0			12.0			12.0 12.0		
RTOR Vol	5			5			5			5		

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	29.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 70.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	1019	2460	0.28	0.41	13.9	B	13.9	B
Westbound								
LT	1204	2905	0.29	0.41	14.0	B	14.4	B
R	601	1451	0.37	0.41	15.0	B		
Northbound								
LTR	733	1655	0.13	0.44	11.7	B	11.7	B
Southbound								
L	528	1193	0.34	0.44	13.6	B		
TR	732	1653	0.31	0.44	13.2	B	13.4	B

Intersection Delay = 13.8 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: MAH Inter.: SUPERIOR/FOREST HILL  
 Agency: GPD GROUP Area Type: CBD or Similar  
 Date: 2/6/2009 Jurisd:  
 Period: AM PEAK MEDIUM ALT 1 Year : 2009  
 Project ID: EAST CLEVELAND SAFETY STUDY - JOB NO. 2008113  
 E/W St: SUPERIOR ROAD N/S St: FOREST HILL / TERRACE

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	1	0	1	0	1	1	0
LGConfig	LTR			LT R			LTR			L TR		
Volume	78	165	16	36	280	203	0	63	25	160	161	51
Lane Width	12.0			12.0 12.0			12.0			12.0 12.0		
RTOR Vol	5			5			5			5		

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	A		
Thru	A				Thru	A		
Right	A				Right	A		
Peds	X				Peds			
WB Left		A			SB Left	A		
Thru		A			Thru	A		
Right		A			Right	A		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	26.0	28.0	0.0		31.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	828	3185	0.34	0.26	30.2	C	30.2	C
Westbound								
LT	906	3237	0.39	0.28	29.2	C	30.0	C
R	405	1448	0.54	0.28	31.3	C		
Northbound								
LTR	513	1655	0.18	0.31	25.3	C	25.3	C
Southbound								
L	348	1123	0.51	0.31	28.9	C		
TR	512	1652	0.45	0.31	28.0	C	28.4	C

Intersection Delay = 29.2 (sec/veh) Intersection LOS = C

HCS+: Signalized Intersections Release 5.3

Analyst: MAH Inter.: SUPERIOR/FOREST HILL  
 Agency: GPD GROUP Area Type: CBD or Similar  
 Date: 2/6/2009 Jurisd:  
 Period: AM PEAK LONG ALT 2 Year : 2009  
 Project ID: EAST CLEVELAND SAFETY STUDY - JOB NO. 2008113  
 E/W St: SUPERIOR ROAD N/S St: FOREST HILL / TERRACE

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	1	0	1	0	1	1	0
LGConfig	L	TR		L	T	R		LTR		L	TR	
Volume	78	165	16	36	280	203	0	63	25	160	161	51
Lane Width	12.0	12.0		12.0	12.0	12.0		12.0		12.0	12.0	
RTOR Vol			5			5			5			5

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		A			NB Left	A		
Thru			A		Thru	A		
Right			A		Right	A		
Peds			X		Peds			
WB Left		A			SB Left	A		
Thru			A		Thru	A		
Right			A		Right	A		
Peds			X		Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green		23.0	30.5			31.5		
Yellow		3.0	3.0			3.0		
All Red		2.0	2.0			2.0		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	374	1624	0.23	0.23	31.5	C		
TR	984	3225	0.20	0.31	25.8	C	27.5	C
Westbound								
L	374	1624	0.11	0.23	30.5	C		
T	993	3256	0.31	0.31	26.8	C	27.9	C
R	442	1449	0.50	0.31	28.9	C		
Northbound								
LTR	521	1655	0.18	0.31	24.9	C	24.9	C
Southbound								
L	355	1126	0.50	0.31	28.4	C		
TR	520	1652	0.44	0.31	27.6	C	27.9	C

Intersection Delay = 27.6 (sec/veh) Intersection LOS = C

HCS+: Signalized Intersections Release 5.3

Analyst: GJB Inter.: SUPERIOR/FOREST HILL  
 Agency: GPD GROUP Area Type: CBD or Similar  
 Date: 2/6/2009 Jurisd:  
 Period: PM PEAK EXISTING Year : 2009  
 Project ID: EAST CLEVELAND SAFETY STUDY - JOB NO. 2008113  
 E/W St: SUPERIOR ROAD N/S St: FOREST HILL / TERRACE

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	1	0	1	0	1	1	0
LGConfig	LTR			LT R			LTR			L TR		
Volume	90	333	13	37	266	203	3	153	68	239	109	45
Lane Width	12.0			12.0 12.0			12.0			12.0 12.0		
RTOR Vol	5			5			5			5		

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
WB Left	P				SB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds		X	
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				25.0		30.0	
Yellow	3.0				3.0		3.0	
All Red	2.0				0.0		2.0	

Cycle Length: 113.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	997	2504	0.48	0.40	26.1	C	26.1	C
Westbound								
LT	1097	2754	0.31	0.40	23.7	C	24.2	C
R	577	1450	0.38	0.40	25.1	C		
Northbound								
LTR	435	1639	0.56	0.27	38.4	D	38.4	D
Southbound								
L	558	1624	0.48	0.53	17.9	B		
TR	842	1641	0.20	0.51	15.1	B	16.8	B

Intersection Delay = 24.9 (sec/veh) Intersection LOS = C

HCS+: Signalized Intersections Release 5.3

Analyst: MAH Inter.: SUPERIOR/FOREST HILL  
 Agency: GPD GROUP Area Type: CBD or Similar  
 Date: 2/6/2009 Jurisd:  
 Period: PM PEAK SHORT TERM Year : 2009  
 Project ID: EAST CLEVELAND SAFETY STUDY - JOB NO. 2008113  
 E/W St: SUPERIOR ROAD N/S St: FOREST HILL / TERRACE

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	1	0	1	0	1	1	0
LGConfig	LTR			LT R			LTR			L TR		
Volume	90	333	13	37	266	203	3	153	68	239	109	45
Lane Width	12.0			12.0 12.0			12.0			12.0 12.0		
RTOR Vol	5			5			5			5		

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	29.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 70.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	1073	2591	0.45	0.41	15.4	B	15.4	B
Westbound								
LT	1160	2801	0.29	0.41	14.0	B	14.4	B
R	601	1451	0.37	0.41	15.0	B		
Northbound								
LTR	726	1640	0.33	0.44	13.4	B	13.4	B
Southbound								
L	455	1027	0.58	0.44	17.4	B		
TR	727	1641	0.23	0.44	12.4	B	15.5	B

Intersection Delay = 14.8 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: MAH Inter.: SUPERIOR/FOREST HILL  
 Agency: GPD GROUP Area Type: CBD or Similar  
 Date: 2/6/2009 Jurisd:  
 Period: PM PEAK MEDIUM ALT 1 Year : 2009  
 Project ID: EAST CLEVELAND SAFETY STUDY - JOB NO. 2008113  
 E/W St: SUPERIOR ROAD N/S St: FOREST HILL / TERRACE

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	1	0	1	0	1	1	0
LGConfig	LTR			LT R			LTR			L TR		
Volume	90	333	13	37	266	203	3	153	68	239	109	45
Lane Width	12.0			12.0 12.0			12.0			12.0 12.0		
RTOR Vol	5			5			5			5		

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	A		
Thru	A				Thru	A		
Right	A				Right	A		
Peds	X				Peds			
WB Left		A			SB Left	A		
Thru		A			Thru	A		
Right		A			Right	A		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	24.0	24.5			36.5			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	771	3213	0.62	0.24	34.7	C	34.7	C
Westbound								
LT	793	3236	0.42	0.25	32.0	C	33.3	C
R	355	1448	0.62	0.25	35.3	D		
Northbound								
LTR	599	1640	0.41	0.37	23.9	C	23.9	C
Southbound								
L	330	905	0.81	0.37	35.9	D		
TR	599	1641	0.28	0.37	22.5	C	30.8	C

Intersection Delay = 31.7 (sec/veh) Intersection LOS = C

HCS+: Signalized Intersections Release 5.3

Analyst: MAH Inter.: SUPERIOR/FOREST HILL  
 Agency: GPD GROUP Area Type: CBD or Similar  
 Date: 2/6/2009 Jurisd:  
 Period: PM PEAK LONG ALT 2 Year : 2009  
 Project ID: EAST CLEVELAND SAFETY STUDY - JOB NO. 2008113  
 E/W St: SUPERIOR ROAD N/S St: FOREST HILL / TERRACE

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	1	0	1	0	1	1	0
LGConfig	L	TR		L	T	R		LTR		L	TR	
Volume	90	333	13	37	266	203	3	153	68	239	109	45
Lane Width	12.0	12.0		12.0	12.0	12.0		12.0		12.0	12.0	
RTOR Vol			5			5			5			5

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		A			NB Left	A		
Thru			A		Thru	A		
Right			A		Right	A		
Peds			X		Peds			
WB Left		A			SB Left	A		
Thru			A		Thru	A		
Right			A		Right	A		
Peds			X		Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green		15.0	27.0			33.0		
Yellow		3.0	3.0			3.0		
All Red		2.0	2.0			2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	271	1624	0.37	0.17	33.7	C		
TR	973	3244	0.39	0.30	25.1	C	26.9	C
Westbound								
L	271	1624	0.15	0.17	32.2	C		
T	977	3256	0.30	0.30	24.3	C	25.8	C
R	435	1449	0.51	0.30	26.5	C		
Northbound								
LTR	601	1640	0.40	0.37	21.4	C	21.4	C
Southbound								
L	338	923	0.79	0.37	31.5	C		
TR	602	1641	0.27	0.37	20.2	C	27.2	C

Intersection Delay = 25.8 (sec/veh) Intersection LOS = C

**APPENDIX L**  
**STORAGE LENGTH CALCULATIONS**

EAST CLEVELAND SAFTY STUDY  
 CALCULATION OF STORAGE LENGTHS  
 MEDIUM TERM SPOT COUNTERMEASURES  
 GPD GROUP  
 MARCH, 2009

ALTERNATE 1. RESTRIPE LANES FOR DEDICATED LEFT TURN LANES AND UPGRADE SIGNAL INSTALLATION

CYCLE LENGTH = 60 SEC

APPROACH DIRECTION	PEAK HOUR LEFT VOLUME	AVERAGE VEHICLES PER CYCLE	ONE-LANE STORAGE LENGTH	PEAK HOUR THROUGH/ RIGHT VOLUME	AVERAGE VEHICLES PER CYCLE PER LANE	THROUGH-LANE CHECK LENGTH
SOUTHBOUND	168	3	150	130	3	150
NORTHBOUND (N/A)						
WESTBOUND	45	1	50	388	3	150
EASTBOUND	123	2	100	390	3	150

ALTERNATE 2. ADD OFFSET LANES FOR DEDICATED LEFT TURNS AND UPGRADE SIGNAL INSTALLATION

CYCLE LENGTH = 60 SEC

APPROACH DIRECTION	PEAK HOUR LEFT VOLUME	AVERAGE VEHICLES PER CYCLE	ONE-LANE STORAGE LENGTH	PEAK HOUR THROUGH/ RIGHT VOLUME	AVERAGE VEHICLES PER CYCLE PER LANE	THROUGH-LANE CHECK LENGTH
SOUTHBOUND	168	3	150	130	1	50
NORTHBOUND (N/A)						
WESTBOUND	45	1	50	388	2	100
EASTBOUND	123	2	100	390	2	100