

# **Village of Croton-on-Hudson**

## **CROTON HARMON PARKING FACILITY VEHICULAR, PEDESTRIAN AND BICYCLE STUDY**

**July 2008**

**Prepared by:**



## TABLE OF CONTENTS

<b>INTRODUCTION</b> .....	<b>1</b>
<b>2008 EXISTING CONDITIONS</b> .....	<b>2</b>
Roadway Characteristics.....	2
Data Collection .....	4
Traffic Volumes.....	5
Analysis Methodologies and Measures of Effectiveness.....	8
Analysis Results.....	8
<b>2013 NO BUILD CONDITIONS</b> .....	<b>10</b>
Traffic Volumes.....	10
Analysis Results.....	10
<b>2013 BUILD CONDITIONS</b> .....	<b>14</b>
Recommended Improvements .....	14
Analysis Results.....	18
<b>ADDITIONAL/LONGER-TERM IMPROVEMENTS</b> .....	<b>19</b>
<b>CONCLUSION</b> .....	<b>20</b>

## APPENDICES

- Appendix A. Manual Turning Movement Count Summaries
- Appendix B. Transit Bus Schedules
- Appendix C. Existing Traffic Signal Information
- Appendix D. 2008 Existing Condition Synchro Analysis Reports
- Appendix E. Traffic Signal Warrant Analyses
- Appendix F. 2013 Future No Build Condition Synchro Analysis Reports
- Appendix G. 2013 Future Build Condition Synchro Analysis Reports
- Appendix H. Short-Term Improvements Cost Estimate
- Appendix I. April 15, 2008 Public Meeting Notes
- Appendix J. Potential Federal Funding Programs Information

## LIST OF FIGURES

Figure 1. Project Study Area.....	3
Figure 2. 2008 Existing Condition Weekday AM Peak-Hour Traffic Volumes .....	6
Figure 3. 2008 Existing Condition Weekday PM Peak-Hour Traffic Volumes.....	7
Figure 4. 2013 Future No Build and Build Condition Weekday AM Peak-Hour Traffic Volumes .....	11
Figure 5. 2013 Future No Build and Build Condition Weekday PM Peak-Hour Traffic Volumes .....	12
Figure 6. Short-Term Vehicular, Pedestrian, and Bicycle Improvements Conceptual Plan....	16

## LIST OF TABLES

Table 1. Accident Summary - March 2005 through March 2008.....	5
Table 2. 2008 Existing Condition Intersection Analysis Results .....	9
Table 3. 2013 Future No Build and Build Condition Weekday AM Intersection Analysis Results.....	13
Table 4. 2013 Future No Build and Build Condition Weekday PM Intersection Analysis Results.....	14

## INTRODUCTION

The purpose of this project is to improve vehicular, pedestrian, and bicycle access to and from the Croton-Harmon Train Station in Croton-on-Hudson, Westchester County, New York. The station, which is located on Veterans Plaza south of Croton Point Avenue and immediately west of U.S. 9 (see Figure 1), serves both Metro-North and Amtrak passengers. Due to its proximity to New York City (approximately 33 miles north), the station is a commuter hub, as well a major transfer point between local and express train and Westchester County Bee-Line bus services. It serves approximately 3,400 passengers per day<sup>1</sup> and provides parking for over 1,900 vehicles.

Traffic data obtained for this study indicate that the train station's 3,400 passengers per day generate around 5,600 entering and exiting vehicles per weekday – approximately 25 percent of which arrive/depart during the AM/PM peak commuter hours and 50 percent of which arrive/depart during the AM/PM peak periods. This highly concentrated and directional flow of traffic, along a primarily uncontrolled facility and in such close proximity to the U.S. 9 northbound and southbound ramps, results in extreme congestion and poor pedestrian and bicycle, as well as vehicular, operations during the peak periods.

During the weekday AM period (the significantly worse of the two commuter peaks), local drivers commute to the train station by traveling south on S. Riverside Avenue and then west on Croton Point Avenue to Veterans Plaza. Due to a southbound right-turn overlap at the traffic signal at Croton Point Avenue and S. Riverside Avenue, there is a constant stream of vehicles approaching the train station along Croton Point Avenue. These vehicles operate free-flow to the train station, since there are no traffic signals or stop control for the vehicles between S. Riverside Avenue and Veterans Plaza. Because the local vehicular volumes to the train station are high and there are few gaps in traffic, there are few opportunities for pedestrians or bicyclists to cross Croton Point Avenue. Lengthy ramp queues (especially the southbound) exacerbate the situation, as there is a constant stream of traffic wishing to exit U.S. 9.

The frustration and urgency of drivers on the ramps during the weekday AM peak period result in unsafe maneuvers – pulling out in front of vehicles when gaps are inadequate and disregarding pedestrians or bicyclists for whom the drivers should yield. To address these issues in part, the Village of Croton-on-Hudson currently assigns a traffic control officer to Croton Point Avenue at Veterans Plaza and a crossing guard to the immediately adjacent intersection of Croton Point Avenue at the U.S. 9 southbound ramps. The primary goal of both personnel is to facilitate pedestrian crossings at these locations. Most pedestrian traffic to the train station approaches from the same direction as the local vehicular traffic. Pedestrians typically cross S. Riverside Avenue in the vicinity of Benedict Boulevard and then travel on the north side of Croton Point Avenue to the train station (in part because there is no sidewalk along most of the south side of Croton Point Avenue). Since many pedestrians have difficulty crossing the southbound off-ramp, the crossing guard is there to stop the southbound vehicles, prevent them from blocking the crosswalk, and assist

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<sup>1</sup> Croton-Harmon (Metro-North station). 2008. Wikimedia Foundation, Inc. June 20, 2008. < [http:// en.wikipedia.org/wiki/Croton-Harmon\\_\(Amtrak\\_station\)](http://en.wikipedia.org/wiki/Croton-Harmon_(Amtrak_station)) >.

pedestrians across the ramp. The police officer at Croton Point Avenue and Veterans Plaza then helps the pedestrians safely cross Croton Point Avenue to get to the train station. In addition to facilitating pedestrian crossings, the crossing guard at the U.S. 9 southbound ramps monitors traffic along the ramp. When the queue extends almost to the mainline, the crossing guard stops traffic along Croton Point Avenue to give southbound vehicles the right-of-way and allow the queue to dissipate. It should be noted, however, that the Village personnel are only present for a short period during rush hour each weekday.

Similar pedestrian and bicycle safety issues occur during the weekday PM peak period. Although traffic volumes in the outbound direction are less concentrated than during the weekday AM peak period, the volumes are relatively high, and the vehicular traffic exiting the train station and accessing the U.S. 9 on-ramps conflicts with both bicyclists and pedestrians. A traffic control officer is assigned to Croton Point Avenue and Veterans Plaza during the weekday PM peak to assist with pedestrian crossings, however, a crossing guard is not assigned to control traffic at the southbound ramps.

The *Croton Harmon Parking Facility Vehicular, Bicycle and Pedestrian Study* was conducted to examine vehicular, pedestrian, and bicycle operations in the vicinity of Croton-Harmon Train Station and to develop conceptual designs to improve the current conditions. Traffic analyses were conducted to evaluate existing and future traffic operations and to ensure the feasibility of recommended improvements. Traffic models were developed for: existing conditions based on 2008 data collection and field observations and future conditions (five years beyond existing) to identify relatively short-term traffic and pedestrian needs along the corridor. The traffic models comprised the following key intersections in the core study area (see Figure 1).

1. Benedict Boulevard at S. Riverside Avenue
2. Croton Point Avenue at S. Riverside Avenue
3. Croton Point Avenue at the U.S. 9 northbound ramps
4. Croton Point Avenue at the U.S. 9 southbound ramps
5. Croton Point Avenue at Veterans Plaza

## **2008 EXISTING CONDITIONS**

To assess the impact of proposed improvements on traffic conditions in the future design year, it was necessary to determine the existing traffic conditions from which future conditions could be projected.

### Roadway Characteristics

*S. Riverside Avenue* is a north-south Village roadway that extends within the Village from Grand Avenue to the north to Van Cortlandt Manor to the south. In the project study area, the commercial strip between Benedict Boulevard and Croton Point Avenue, S. Riverside Avenue is two lanes (one through plus right-turn only lane) with no parking in each direction.



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CADD FILE \_\_\_\_\_

VILLAGE OF CROTON-ON-HUDSON

FIGURE 1

PROJECT LOCATION MAP

SHEET 1 OF 1

*Croton Point Avenue* is an east-west Village roadway that extends within the Village from S. Riverside Avenue to the east, crossing beneath U.S. 9 and past Croton-Harmon Train Station, to Croton Point Park to the west. In the project study area, between S. Riverside Avenue and the Veterans Plaza entrance to the train station, Croton Point Avenue is two lanes in each direction. Curbside parking is prohibited during the peak commuter periods (7 to 9 AM and 5 to 8 PM) but allowed during all other time periods.

*U.S. 9* is an interstate roadway that extends from the New York City metropolitan area to the U.S./Canadian border. In the project study area, there is a U.S. 9 interchange at Croton Point Avenue. Due to the significant volumes on U.S. 9 and those that are generated by Croton-Harmon Train Station, there is considerable congestion at Croton Point Avenue and both the U.S. 9 northbound and southbound ramps during the weekday peak commuter periods.

*Veterans Plaza* is the internal Village roadway that extends from Croton Point Avenue to the Croton-Harmon Train Station north and south parking lots. South of Croton Point Avenue, in the direction of the train station, Veterans Plaza is two lanes plus a reversible center lane. During the weekday AM peak period, the internal roadway operates as two inbound lanes and one outbound lane. During the weekday PM peak period, the roadway operates as two outbound lanes and one inbound lane.

*Benedict Boulevard* is a local Village roadway that extends from S. Riverside Avenue east to the Cleveland Drive/Truesdale Drive traffic circle. Benedict Boulevard provides access from residential areas to S. Riverside Avenue and U.S. 9 and Croton-Harmon Train Station via S. Riverside Avenue.

### Data Collection

Manual turning movement counts by vehicle classification were collected at all study area intersections in April 2008 during the weekday AM (6:30 to 8:45) and PM (5:15 to 7:30) commuter peak periods. The counts indicate that the morning and evening peak hours are from 7 to 8 a.m. and from 5 to 6 p.m., respectively. Inventories were conducted along S. Riverside Avenue, Croton Point Avenue, and at all of the study area intersections to document lane widths, speed limits, turning restrictions, parking regulations, bus stop locations, and other parameters that would be needed as inputs into existing and future condition traffic models. In addition, a walkability/bikeability audit was conducted to document pavement, sidewalk, and pedestrian and bicycle access conditions and deficiencies in the study area. Finally, Westchester County Bee-Line bus service information was downloaded from the website to supplement bus stop inventories and field observations.

It should be noted that traffic signal timings were obtained in the field; however, both of the existing signalized intersections, S. Riverside Avenue at Benedict Boulevard and at Croton Point Avenue, are actuated signals. Although the cycle length at Benedict Boulevard appeared to be consistent throughout the peak periods, the cycle length at Croton Point Avenue was indiscernible. Traffic signal timings and plans were requested from the

Village and Westchester County; however, no intersection timing and only one intersection plan were obtained.

Detailed turning movement count summaries, transit bus schedules, and the traffic signal plan for Croton Point Avenue at S. Riverside Avenue are provided in Appendices A, B, and C, respectively.

Accident reports for the latest available three-year period (March 2005 through March 2008) were provided by the Village of Croton-on-Hudson Police Department. Along the approximate 0.29-mile segment of S. Riverside and Croton Point Avenues in the project study area, there were approximately 59 accidents in the three-year period, resulting in an accident rate for the roadway segment of 16.7, which is significantly higher than NYSDOT's average of 5.66 for an urban, four-lane, undivided, free-access facility. Individual intersection accident rates are also high – especially at the U.S. 9 ramps. As shown in Table 1, 22 and 12 accidents during the three-year period occurred at Croton Point Avenue at the northbound and southbound ramps, respectively, resulting in accident rates that are considerably higher than the NYSDOT average of 0.09.

**Table 1. Accident Summary – March 2005 through March 2008**

Accident Location	Accident Type			Accident Rate		
	PDO	Injury	Total	Study Area Average	NYSDOT Average	High?
Benedict Boulevard at S. Riverside Avenue	5	2	7	0.63	0.60	Yes
Croton Point Avenue at S. Riverside Avenue	7	2	9	0.59	0.35	Yes
Croton Point Avenue at U.S. 9 Northbound Ramps	21	1	22	1.31	0.09	Yes
Croton Point Avenue at U.S. 9 Southbound Ramps	9	3	12	0.78	0.09	Yes
Croton Point Avenue at Veterans Plaza	9	0	9	0.67	0.22	Yes
<b>Entire Segment</b>			<b>59</b>			<b>Yes</b>

Based on the police reports, most accidents in the study area are rear-end, right-angle, or overtake. These types of accidents could be significantly reduced by installing traffic signals at the currently unsignalized intersections of Croton Point Avenue with Veterans Plaza and the U.S. 9 ramps.

#### Traffic Volumes

The 2008 weekday AM and PM peak-hour traffic volumes are provided in Figures 2 and 3, respectively. As shown in the figures, volumes in the area are higher in than mornings than in the evenings and are highest along Croton Point Avenue between Veterans Plaza and the U.S. 9 northbound ramps.

VILLAGE OF CROTON-ON-HUDSON, NY  
 CROTON HARMON PARKING FACILITY VEHICULAR,  
 PEDESTRIAN AND BICYCLE STUDY

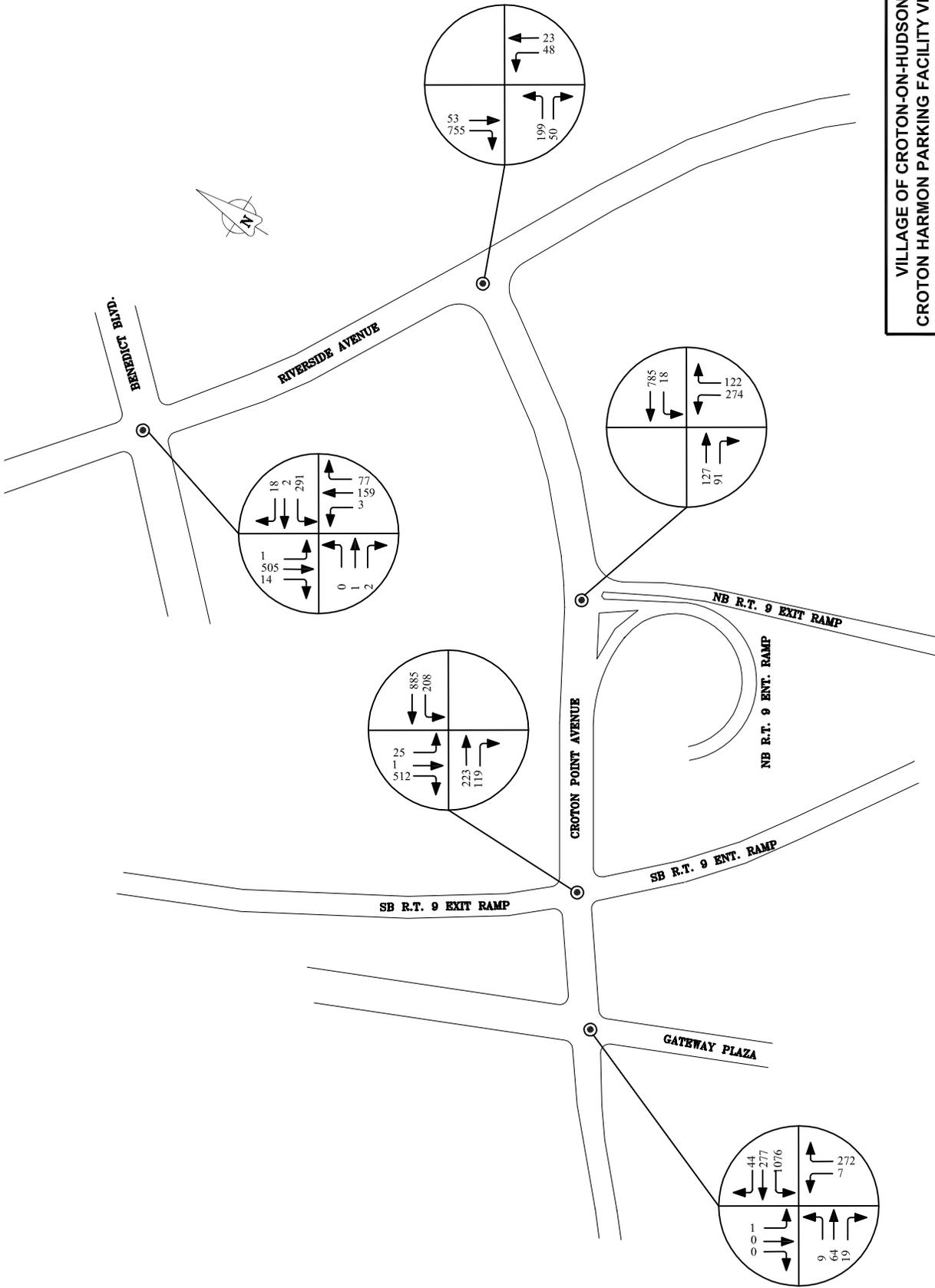
2008 EXISTING CONDITION WEEKDAY  
 AM PEAK-HOUR TRAFFIC VOLUMES

**The RBA**  
 ENGINEERS • ARCHITECTS • PLANNERS

FIGURE NO. 2

SCALE: N.T.S.

DATE: APRIL 2008



VILLAGE OF CROTON-ON-HUDSON, NY  
 CROTON HARMON PARKING FACILITY VEHICULAR,  
 PEDESTRIAN AND BICYCLE STUDY

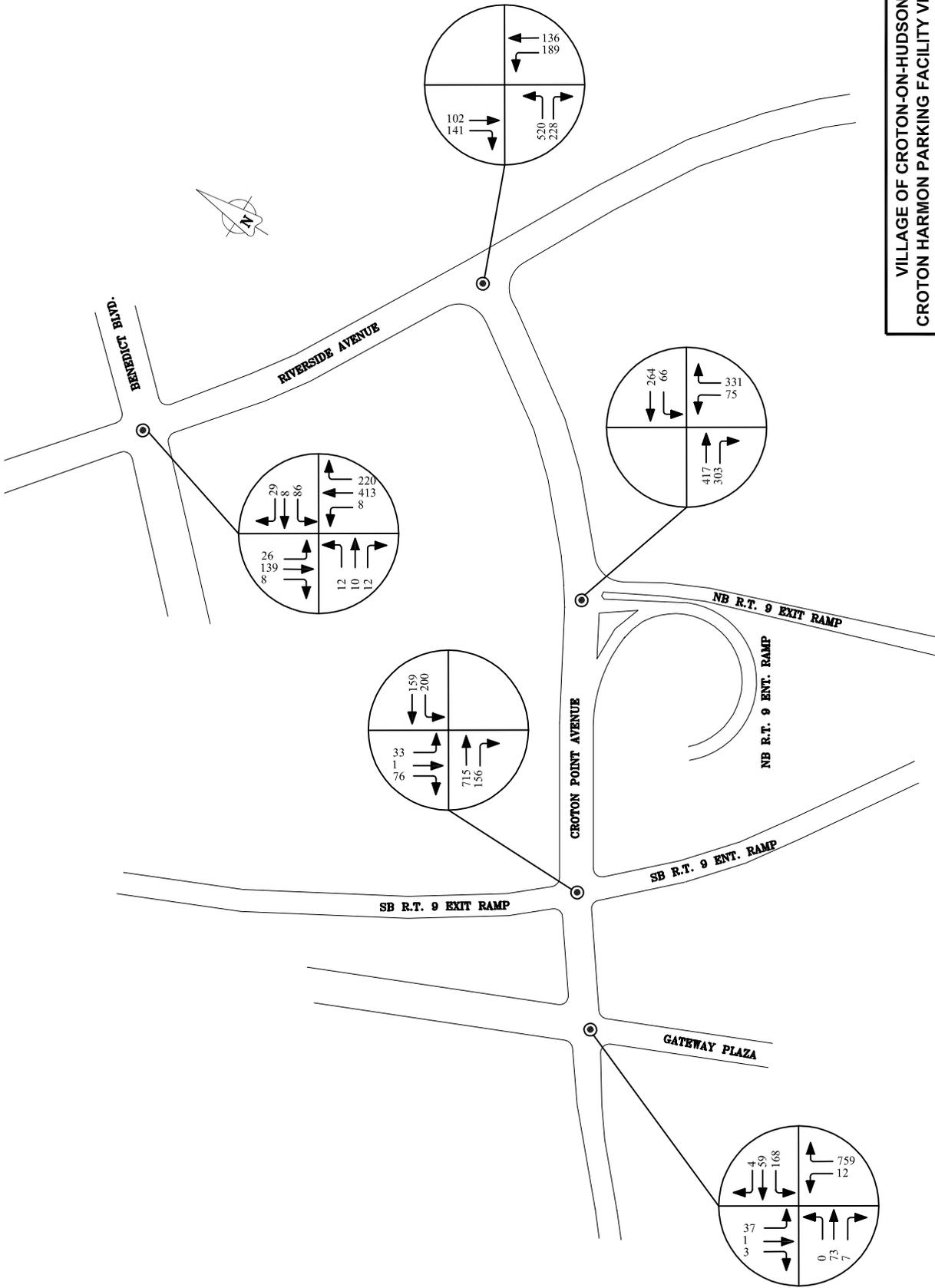
2008 EXISTING CONDITION WEEKDAY  
 PM PEAK-HOUR TRAFFIC VOLUMES



FIGURE NO. 3

SCALE: N.T.S.

DATE: APRIL 2008



During the weekday AM peak, the bi-directional traffic volumes along Croton Point Avenue range from approximately 1,050 vehicles per hour (vph) to the east to 1,750 vph between the U.S. 9 southbound ramps and Veterans Plaza. Traffic volumes throughout the study area are very directional, with an eastbound/westbound directional split of basically 80/20. The highest traffic volumes are between the U.S. 9 southbound ramps and Veterans Plaza (1,397 vph toward the train station, 342 vph away from the train station). Nearly 1,110 vph enter the train station during the peak hour – over 500 and nearly 275 vph of which approach via U.S. 9 from the north and south, respectively. Traffic volumes along S. Riverside Avenue between Benedict Boulevard and Croton Point Avenue are almost identical to those along Croton Point Avenue east of the U.S. 9 northbound ramps. Bi-directional traffic volumes west of Veterans Plaza decrease considerably – from nearly 1,750 to around 375 vph.

During the weekday PM peak, traffic volumes in the area are noticeably lower than and not quite as directional as during the AM period, although the directional split immediately east of Veterans Plaza is still 80/20 but in the opposite direction. Along the stretch of Croton Point Avenue between Veterans Plaza and S. Riverside Avenue, the bi-directional traffic volume is approximately 1,100 vph (roughly 800 vph eastbound away from the train station, 300 vph westbound). Approximately 750 vph exit the train station during the peak hour – of which over 300 and 150 vph utilize U.S. 9 to head to points north and south, respectively. The bi-directional traffic volumes on S. Riverside Avenue drop from the 1,100 vph along Croton Point Avenue to 900 vph, since a significant number of eastbound vehicles turn right to head toward the shopping plaza. Bi-directional traffic volumes along Croton Point Avenue west of the train station are even less than during the AM peak – around 150 vph.

### Analysis Methodologies and Measures of Effectiveness

Intersection and arterial analyses of the core study area were conducted using Synchro 7 traffic signal coordination software. Typical measures of effectiveness for both signalized and unsignalized intersection analyses include volume-to-capacity ratio, delay, and level-of-service. Volume-to-capacity ratio (v/c) is an indicator of the amount of congestion that occurs at a particular location. A v/c equal to or greater than 1 indicates traffic operations at or above capacity (high levels of congestion). Delay, typically provided in seconds per vehicle (sec/veh), is an indicator of how much travel time, in addition to that which would be incurred for base conditions, is experienced on a roadway due to downstream traffic (signal or sign) control and queuing issues. Level-of-service (LOS), defined in terms of delay, is an indicator of how efficient traffic operations are at a particular location. LOS designations range from favorable A to failing F. An additional measure of effectiveness for arterial analyses is travel time, the total time, including delay, that it takes to travel between signalized intersections.

### Analysis Results

The results of 2008 existing condition intersection analyses are summarized in Table 1. As indicated in the table, S. Riverside Avenue and Croton Point Avenue between Benedict Boulevard and the train station operate well during both peak hours but at the

**Table 2. 2008 Existing Condition Intersection Analysis Results**

Intersection and Approach	Weekday AM Peak Hour					Weekday PM Peak Hour						
	Queue (ft)	Mvmt	v/c	Delay (sec/veh)	LOS	Queue (ft)	Mvmt	v/c	Delay (sec/veh)	LOS		
<b>1 - Benedict Boulevard at S. Riverside Avenue</b>						<b>Signalized</b>						
Benedict Boulevard	EB	3	LTR	0.01	11.7	B	25	LTR	0.11	14.9	B	
	WB	248	LTR	0.82	37.8	D	79	LTR	0.44	22.5	C	
S. Riverside Avenue	NB	77	LT	0.27	11.9	B	180	LT	0.49	11.6	B	
			R	0.13	3.0	A		R	0.27	2.0	A	
	SB	304	LTR	0.77	23.1	C	70	LTR	0.27	9.1	A	
					<b>Overall Intersection:</b>	<b>24.1</b>	<b>C</b>					
						<b>Overall Intersection: 10.8 B</b>						
<b>2 - Croton Point Avenue at S. Riverside Avenue</b>						<b>Signalized</b>						
Croton Point Avenue	EB	60	L	0.22	10.6	B	261	L	0.77	21.9	C	
			LR					LR				
S. Riverside Avenue	NB	50	L	0.23	26.6	C	150	L	0.49	20.1	C	
			T	0.08	24.7	C		T	0.23	14.6	B	
	SB	630	T	0.12	24.5	C	73	T	0.19	14.4	B	
			R	0.83	18.6	B		R	0.17	2.9	A	
					<b>Overall Intersection:</b>	<b>17.8</b>	<b>B</b>					
						<b>Overall Intersection: 18.1 B</b>						
<b>3 - Croton Point Avenue at U.S. 9 Northbound Ramps</b>						<b>Unsignalized</b>						
Croton Point Avenue	EB	0	T	0.06	0.0	A	0	T	0.22	0.0	A	
			TR	0.10	0.0	A		TR	0.36	0.0	A	
	WB	1	LT	0.02	0.6	A	6	LT	0.08	4.2	A	
			T	0.37	0.0	A		T	0.12	0.0	A	
Off-Ramp	NB	274	L	0.98	79.2	F	181	L	0.50	42.5	E	
			R	0.18	10.1	B		R	0.79	32.9	D	
<b>4 - Croton Point Avenue at U.S. 9 Southbound Ramps</b>						<b>Unsignalized</b>						
Croton Point Avenue	EB	0	T	0.11	0.0	A	0	T	0.39	0.0	A	
			TR	0.15	0.0	A		TR	0.33	0.0	A	
	WB	21	LT	0.22	5.3	A	55	LT	0.43	14.4	B	
			T	0.40	0.0	A		T	0.08	0.0	A	
Off-Ramp	SB	494	LT	0.64	174.2	F	46	LTR	0.44	71.7	F	
			R	1.14	109.9	F		R	0.10	9.3	A	
<b>5 - Croton Point Avenue at Veterans Plaza</b>						<b>Unsignalized</b>						
Croton Point Avenue	EB	Err	LTR	Err	Err	F	Err	LTR	Err	Err	F	
	WB	257	L	0.82	17.5	C	12	L	0.14	7.9	A	
			TR	0.21	0.0	A		LTR	0.05	0.0	A	
Veterans Plaza	NB	Err	LTR	3.38	Err	F	220	LTR	0.46	12.8	B	
								R	0.80	22.5	C	
	SB	Err	LTR	3.63	Err	F	Err	LTR	Err	Err	F	

**Notes:** Approach = direction of approach. EB = eastbound, WB = westbound, NB = northbound, SB = southbound. Mvmt = allowed lane movement. L = left-turn, T = through, R = right-turn, LT = shared left-turn/through, etc. Err = error. Queue length, v/c, and/or delay were too excessive for Synchro to calculate.

expense of the side street movements – especially those at the unsignalized Croton Point Avenue locations. The U.S. 9 northbound and southbound off-ramps and Veterans Plaza typically fail during the peak hours. During the worse case weekday AM peak hour, drivers on the northbound and southbound off-ramps must wait 1 to 3 minutes to find a gap in traffic which to safely turn onto Croton Point Avenue toward the train station. Drivers wishing to make anything other than a northbound right turn out of Veterans Plaza have even greater problems. Without the traffic control officer who is currently posted there in the mornings, it would be virtually impossible for left-turn or through (or even right-turn vehicles on the eastbound approach) to exit the parking lots because of the constant stream of free-flowing westbound vehicles into the train station. Similar problems exist during the weekday PM peak hour, though due to vehicles headed in the opposite direction. Delays at the northbound and southbound ramps range from around 40 to 70 sec/veh, and southbound Veterans Plaza would fail completely without the on-site traffic control officer. An analysis of the traffic

data collected for this project indicates that all of the unsignalized locations currently meet NYSDOT requirements for signalization based on Warrant 3, Peak Hour criteria.

Existing condition arterial analyses were conducted along the existing signalized segment of project area roadway, S. Riverside Avenue between Benedict Boulevard and Croton Point Avenue. Based on the analyses, it takes between 30 and 35 seconds for drivers to travel between the intersections in the peak AM or PM direction. Travel times are lower – between 20 and 30 seconds in the off-peak direction.

Detailed 2008 existing condition intersection and arterial analyses results are provided in Appendix D. Detailed traffic signal warrant analyses for Croton Point Avenue at Veterans Plaza and at the U.S. 9 northbound and southbound ramps are provided in Appendix E.

## **2013 NO BUILD CONDITIONS**

To develop traffic, pedestrian, and bicycle improvements for this study, traffic analyses were conducted for 2013 weekday AM and PM peak-hour No Build and Build conditions. The No Build conditions are future conditions in the Croton Harmon study area with planned developments, roadway improvements, signalization modifications, etc. that are not related to this study in place. These are the conditions to which Build conditions (those with No Build and recommended study-related improvements in place) will be compared.

### Traffic Volumes

Future condition traffic volumes were developed by increasing existing condition traffic volumes by a linear growth rate of two percent per year as utilized in AKRF's August 2007 *Expanded EAF: Proposed DPW at 1A Croton Point Avenue*. This would result in a ten percent increase in background traffic volumes along the study area roadways between now and 2013. Since there are no planned roadway improvements or other developments in the area, and proposed improvements for this project are not expected to alter traffic volumes or travel patterns in the area, No Build and Build traffic volumes are the same. Weekday AM and PM peak-hour traffic volumes for 2013 future conditions are provided in Figures 4 and 5, respectively.

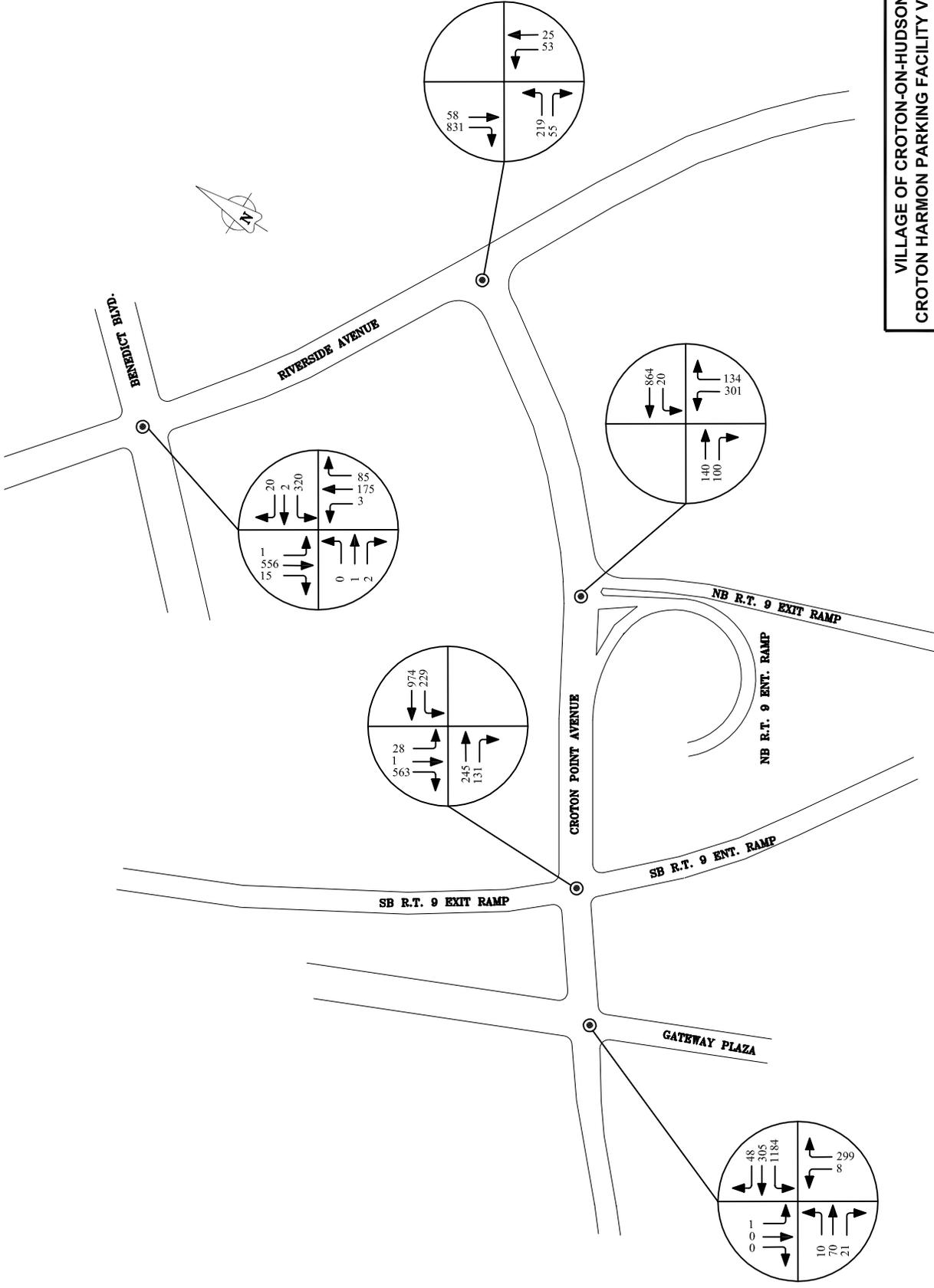
### Analysis Results

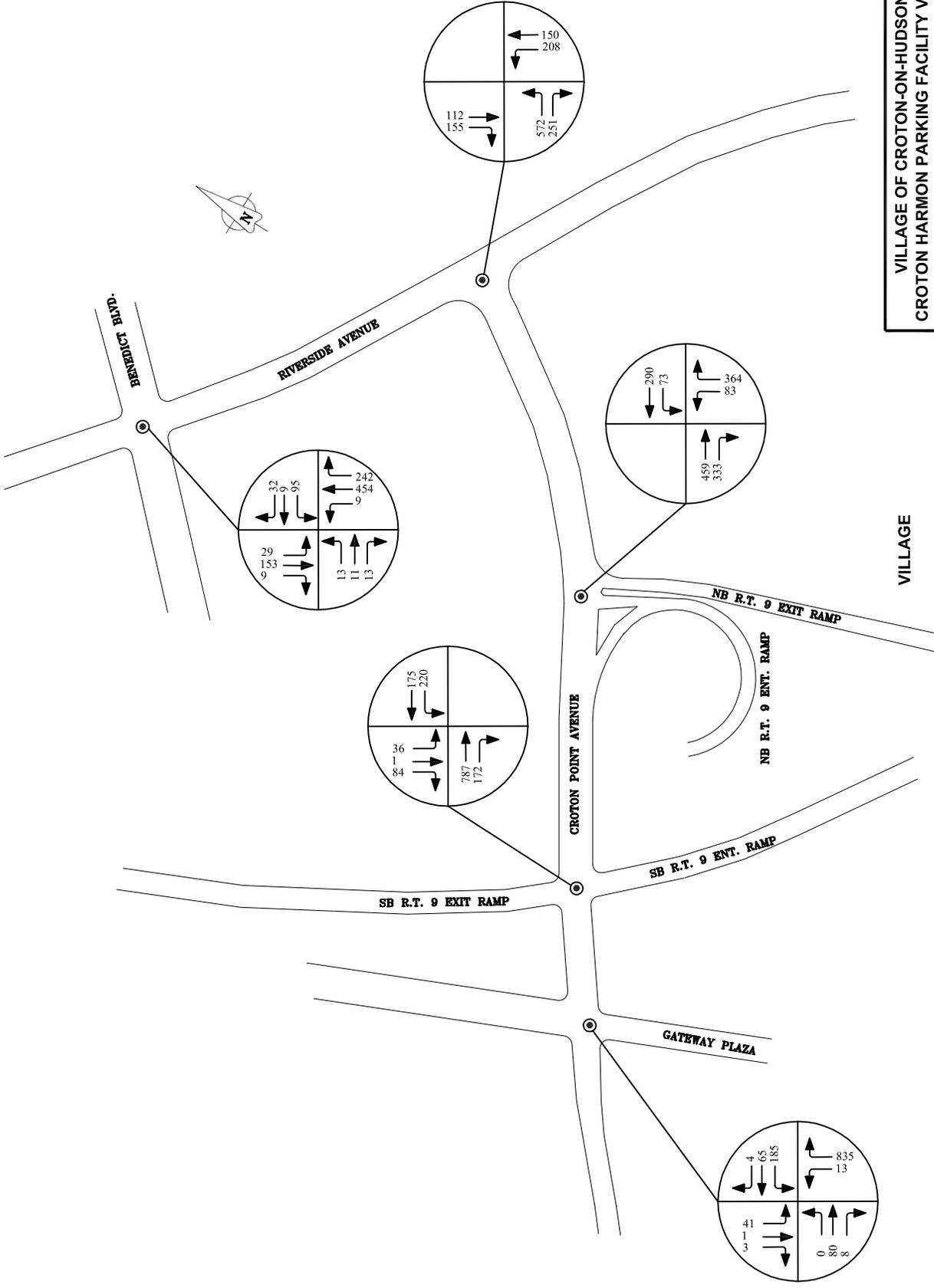
Intersection and arterial analyses were conducted for 2013 No Build conditions using the same methodologies as for existing conditions. The results of weekday AM and PM peak-hour intersection analyses are provided in Tables 2 and 3, respectively. As indicated in the tables, conditions on the unsignalized approaches to the unsignalized Croton Point Avenue intersections would deteriorate noticeably between now and 2013. The northbound and southbound ramps and at least two of the three unsignalized approaches at Veterans Plaza would fail during the peak hours, incurring about double the delays as for existing conditions. At the southbound ramps during the AM peak-hour, drivers would have to wait over

VILLAGE OF CROTON-ON-HUDSON, NY  
 CROTON HARMON PARKING FACILITY VEHICULAR,  
 PEDESTRIAN AND BICYCLE STUDY

2013 FUTURE NO BUILD AND BUILD CONDITION  
 WEEKDAY AM PEAK-HOUR TRAFFIC VOLUMES

FIGURE NO. 4  
 SCALE: N.T.S.  
 DATE: APRIL 2008





**Table 3. 2013 Future No Build and Build Condition Weekday AM Intersection Analysis Results**

Intersection and Approach		Weekday AM Peak Hour									
		2013 No Build Condition					2013 Build Condition				
		Queue (ft)	Mvmt	v/c	Delay (sec/veh)	LOS	Queue (ft)	Mvmt	v/c	Delay (sec/veh)	LOS
<b>1 - Benedict Boulevard at S. Riverside Avenue</b>		<b>Signalized</b>					<b>Signalized</b>				
Benedict Boulevard	EB	3	LTR	0.02	11.3	B	3	LTR	0.04	16.3	B
	WB	267	LTR	0.90	47.8	D	257	LTR	0.87	43.5	D
S. Riverside Avenue	NB	85	LT	0.30	12.2	B	28	LT	0.29	5.2	A
			R	0.14	2.9	A		R	0.14	0.4	A
	SB	404	LTR	0.85	28.3	C	497	LTR	0.82	30.3	C
		<b>Overall Intersection</b>					<b>Overall Intersection</b>				
		<b>29.5</b>					<b>27.9</b>				
		<b>C</b>					<b>C</b>				
<b>2 - Croton Point Avenue at S. Riverside Avenue</b>		<b>Signalized</b>					<b>Signalized</b>				
Croton Point Avenue	EB	65	L	0.21	10.1	B	94	L	0.63	31.8	C
			LR					LR			
S. Riverside Avenue	NB	54	L	0.29	28.9	C	21	L	0.17	5.8	A
			T	0.10	25.7	C		T	0.03	4.4	A
	SB	730	T	0.15	25.9	C	144	TR	0.53	6.9	A
			R	0.89	22.8	C		R	0.51	6.4	A
		<b>Overall Intersection</b>					<b>Overall Intersection</b>				
		<b>20.7</b>					<b>11.9</b>				
		<b>C</b>					<b>B</b>				
<b>3 - Croton Point Avenue at U.S. 9 Northbound Ramps</b>		<b>Unsignalized</b>					<b>Signalized</b>				
Croton Point Avenue	EB	0	T	0.07	0.0	A	5	T	0.17	1.7	A
			TR	0.11	0.0	A		TR			
	WB	1	LT	0.05	0.6	A	56	LT	0.56	7.2	A
			T	0.40	0.0	A		T			
Off-Ramp	NB	414	L	1.21	154.6	F	213	L	0.79	39.3	D
			R	0.20	10.3	B		R	0.32	6.3	A
		<b>Overall Intersection</b>					<b>Overall Intersection</b>				
		<b>12.6</b>					<b>B</b>				
<b>4 - Croton Point Avenue at U.S. 9 Southbound Ramps</b>		<b>Unsignalized</b>					<b>Signalized</b>				
Croton Point Avenue	EB	0	T	0.12	0.0	A	56	T	0.25	7.1	A
			TR	0.16	0.0	A		TR			
	WB	25	LT	0.25	5.8	A	482	LT	0.90	21.6	C
			T	0.44	0.0	A		T			
Off-Ramp	SB	724	LT	0.98	330.7	F	252	LTR	0.82	44.8	D
			R	1.35	194.7	F		R	0.79	42.3	D
		<b>Overall Intersection</b>					<b>Overall Intersection</b>				
		<b>24.6</b>					<b>C</b>				
<b>5 - Croton Point Avenue at Veterans Plaza</b>		<b>Unsignalized</b>					<b>Signalized</b>				
Croton Point Avenue	EB	Err	LTR	Err	Err	F	81	LTR	0.46	30.4	C
	WB	388	L	0.91	25.4	D	347	L	0.77	33.5	C
			TR	0.23	0.0	A		LTR	0.75	22.1	C
Veterans Plaza	NB	Err	LTR	8.56	Err	F	47	LTR	0.79	17.3	B
	SB	Err	LTR	11.30	Err	F	3	LTR	0.04	33.0	C
		<b>Overall Intersection</b>					<b>Overall Intersection</b>				
		<b>26.1</b>					<b>C</b>				

5.5 minutes to turn onto Croton Point Avenue. In addition, traffic operations on the westbound Benedict Avenue approach to S. Riverside Avenue would begin to deteriorate – operating at LOS D with over 45 sec/veh of delay during the weekday AM peak hour.

No Build condition arterial analyses along the existing signalized segment of project area roadway show a nominal 0- to 4-second increase in travel time along S. Riverside Avenue between Benedict Boulevard and Croton Point Avenue.

Detailed 2013 No Build condition intersection and arterial analyses results are provided in Appendix F.

**Table 4. 2013 Future No Build and Build Condition Weekday PM Intersection Analysis Results**

Intersection and Approach		Weekday AM Peak Hour									
		2013 No Build Condition					2013 Build Condition				
		Queue (ft)	Mvmt	v/c	Delay (sec/veh)	LOS	Queue (ft)	Mvmt	v/c	Delay (sec/veh)	LOS
<b>1 - Benedict Boulevard at S. Riverside Avenue</b>		<b>Signalized</b>					<b>Signalized</b>				
Benedict Boulevard	EB	26	LTR	0.13	14.9	B	20	LTR	0.19	12.3	B
	WB	88	LTR	0.48	23.8	C	61	LTR	0.61	22.2	C
S. Riverside Avenue	NB	204	LT	0.53	12.3	B	210	LT	0.49	7.1	A
			R	0.29	2.0	A		R	0.27	1.5	A
	SB	78	LTR	0.30	9.4	A	61	LTR	0.25	7.4	A
		<b>Overall Intersection</b>					<b>Overall Intersection</b>				
		<b>11.4 B</b>					<b>8.4 A</b>				
<b>2 - Croton Point Avenue at S. Riverside Avenue</b>		<b>Signalized</b>					<b>Signalized</b>				
Croton Point Avenue	EB	294	L	0.80	22.5	C	89	L	0.63	8.8	A
			LR					LR			
S. Riverside Avenue	NB	194	L	0.57	24.0	C	126	L	0.73	29.3	C
			T	0.26	15.7	B		T	0.34	14.0	B
	SB	81	T	0.22	15.3	B	46	T	0.28	10.3	B
			R	0.18	3.0	A		R	0.34	3.7	A
		<b>Overall Intersection</b>					<b>Overall Intersection</b>				
		<b>19.2 B</b>					<b>11.7 B</b>				
<b>3 - Croton Point Avenue at U.S. 9 Northbound Ramps</b>		<b>Unsignalized</b>					<b>Signalized</b>				
Croton Point Avenue	EB	0	T	0.25	0.0	A	38	T	0.62	4.4	A
			TR	0.39	0.0	A		TR			
	WB	8	LT	0.09	4.4	A	11	LT	0.44	3.7	A
			T	0.14	0.0	A		T			
Off-Ramp	NB	277	L	0.66	64.6	F	129	L	0.21	12.5	B
			R	0.93	55.1	F		R	0.82	24.7	C
		<b>Overall Intersection</b>					<b>Overall Intersection</b>				
		<b>9.1 A</b>									
<b>4 - Croton Point Avenue at U.S. 9 Southbound Ramps</b>		<b>Unsignalized</b>					<b>Signalized</b>				
Croton Point Avenue	EB	0	T	0.43	0.0	A	37	T	0.55	4.4	A
			TR	0.36	0.0	A		TR			
	WB	77	LT	0.53	18.1	C	38	LT	1.23dl	4.7	A
			T	0.08	0.0	A		T			
Off-Ramp	SB	75	LT	0.68	136.8	F	60	LT	0.13	20.8	C
			R	0.11	9.4	A		R	0.13	30.9	C
		<b>Overall Intersection</b>					<b>Overall Intersection</b>				
		<b>6.2 A</b>									
<b>5 - Croton Point Avenue at Veterans Plaza</b>		<b>Unsignalized</b>					<b>Signalized</b>				
Croton Point Avenue	EB	Err	LTR	Err	Err	F	53	LTR	0.60	32.9	C
	WB	14	L	0.16	8.0	A	58	L	0.45	12.2	B
			TR	0.05	0.0	A		TR	0.11	6.5	A
Veterans Plaza	NB	314	LTR	0.52	14.0	B	12	LTR	0.68	6.6	A
			R	0.90	31.8	D		R	0.68	6.1	A
	SB	Err	LTR	Err	Err	F	30	LTR	0.53	31.0	C
		<b>Overall Intersection</b>					<b>Overall Intersection</b>				
		<b>10.3 B</b>									

**2013 BUILD CONDITIONS**

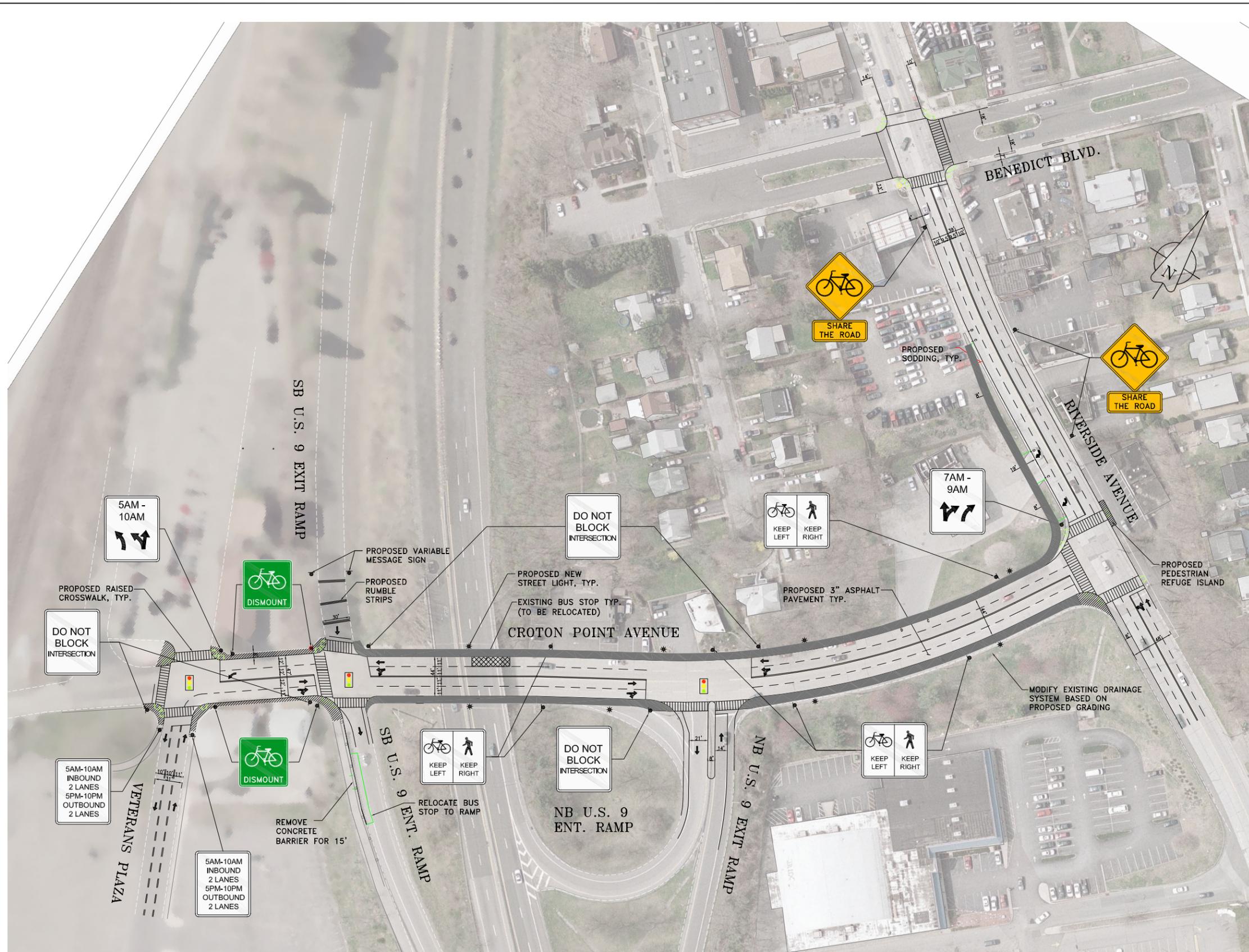
Intersection and arterial traffic analyses were conducted for 2013 weekday AM and PM peak-hour Build conditions with proposed short-term improvements in place. The results of these analyses were compared to those for 2013 No Build conditions to ensure the benefit of recommended vehicle-related improvements. All short-term improvements (vehicular, pedestrian, and bicycle) are discussed below.

Recommended Improvements

Based on traffic analyses, the walkability and bikeability audit, the April 15 public meeting, and a walkthrough of the draft conceptual design that was conducted on June 12, 2008 with Village employees, trustees, and committee members, the following short-term

improvements are recommended for the project study area. These improvements are illustrated in Figure 6.

1. *Construction of a raised and pigmented shared bicycle/pedestrian path on both sides of Croton Point Avenue.* The eastbound path would begin on the west side of S. Riverside Avenue between Benedict Boulevard and Croton Point Avenue and would continue on the north side of Croton Point Avenue to the U.S. 9 southbound off-ramp. The westbound path would begin at the U.S. 9 southbound on-ramp and continue on the south side of Croton Point Avenue to S. Riverside Avenue. Due to limited right-of-way along Croton Point Avenue between the U.S. 9 southbound ramps and Veterans Plaza, the shared bicycle/pedestrian path cannot be extended to the train station. The shared paths will provide improved facilities for bicyclists and pedestrians. The eastbound path will replace narrow, cracked, and uneven sidewalk along S. Riverside Avenue and Croton Point Avenue. The westbound path will provide a facility where there is no sidewalk and only a shoulder between the U.S. 9 northbound off-ramp and S. Riverside Avenue. Although some bicyclists will still choose to travel with the stream of traffic, an alternative for the bicyclists will now be available. It should be noted that pedestrian lighting will be installed along both bicycle/pedestrian paths and that the construction of a path on the south side of Croton Point Avenue would require modifications to drainage along Croton Point Avenue between S. Riverside Avenue and the U.S. 9 northbound ramps.
2. *Sidewalk replacement.* Cracked and uneven sidewalk along Croton Point Avenue between the U.S. 9 ramps and Veterans Plaza, at all four corners of Veterans Plaza, and at the southwest corner of Croton Point Avenue at S. Riverside Avenue would be replaced.
3. *Traffic signal installation.* Traffic signals are recommended at the Croton Point Avenue intersections with the U.S. 9 northbound ramps, U.S. 9 southbound ramps, and Veterans Plaza. An actuated and coordinated traffic signal system with these and the existing S. Riverside signals would be developed. Detectors would be installed on the minor-street approaches, and signals would be timed to better accommodate traffic volumes in the study area. Traffic signals would also provide sufficient pedestrian crossing times. The traffic signals would improve overall traffic operations, improve accident conditions at the currently unsignalized locations, and eliminate the need for traffic control personnel.
4. *Pedestrian push button and countdown signal installation.* Pedestrian push buttons and countdown signals would be installed throughout the study area – at all new traffic signals and at some missing locations at existing signalized locations. The pedestrian push buttons would allow traffic signals to be pedestrian-activated. Pedestrian countdown signals would provide better guidance to pedestrians and create more of a pedestrian presence for motorists in the study area.
5. *Construction of a pedestrian refuge island.* A pedestrian refuge island would be constructed on the northeast corner of Croton Point Avenue and S. Riverside Avenue to provide a safer and more substantial location within the Croton on Hudson Veterinary



**LEGEND:**

EXISTING CURB	— DC —
PROPOSED CURB	—
PROPOSED SHARED BICYCLE AND PEDESTRIAN PATH	█
PROPOSED SIDEWALK	▨
PROPOSED PEDESTRIAN RAMP	▬
PROPOSED PEDESTRIAN CROSSWALK (STREET PRINT OR HIGH VISIBILITY)	▬
PROPOSED SIGNAL	🚦

VILLAGE OF CROTON-ON-HUDSON

**FIGURE 6**

SHORT-TERM VEHICULAR, PEDESTRIAN AND BICYCLE IMPROVEMENT CONCEPTUAL PLAN

DRAWN BY \_\_\_\_\_ CADD FILE \_\_\_\_\_

SHEET 1 OF 1

Clinic parking lot for pedestrians to stand. This is advisable, since there is a bus stop on the corner and it is proposed that a high-visibility crosswalk be installed along the north approach to accommodate existing relatively high volumes of pedestrian traffic.

6. *Asphalt overlay.* An asphalt overlay is recommended along S. Riverside Avenue and Croton Point Avenue between Benedict Boulevard and Veterans Plaza (inclusive of the intersections). The overlay would provide an even surface for motorists, bicyclists, and crossing pedestrians. At present, the roadway is cracked with uneven pavement repairs.
7. *Pavement marking installation.* Pavement markings, including lane, lane-use, and high-visibility crosswalk markings are recommended throughout the study area to provide clear delineation of permitted vehicular and pedestrian movements. Reversible lane markings along Veterans Plaza would be updated to conform to NYSDOT standards.
8. *Sign installation.* New signs are recommended throughout the study area to clearly guide vehicular, pedestrian, and bicycle operations. Since the roadway is too narrow to provide bike lanes, SHARE THE ROAD signs are recommended along S. Riverside Avenue to alert motorists to the presence of bicyclists. BICYCLIST KEEP LEFT/ PEDESTRIANS KEEP RIGHT signs should be installed along the proposed shared bicycle/pedestrian paths to provide guidance to users. At the west end of the project study area where the roadway is too narrow to provide shared bicycle/pedestrian facilities, BICYCLIST DISMOUNT signs should be installed. At the Croton Point Avenue intersections, DO NOT BLOCK INTERSECTION signs should be installed to ensure the most effective operation of new traffic signals. Along Veterans Plaza and at Croton Point Avenue at S. Riverside Avenue and Veterans Plaza, signs should be installed to show allowed lane movements during particular time periods. In addition, variable message signs showing YIELD TO PEDESTRIANS IN CROSSWALK are recommended along the U.S. 9 southbound off-ramp to increase motorist awareness of pedestrians.
9. *Reconfiguration of U.S. 9 northbound ramps.* It is proposed to realign the intersection of the Croton Point Avenue and the U.S. 9 northbound ramps. The eastbound channelized right-turn would be eliminated so that right-turns would be made from the intersection proper. This will narrow the northbound off-ramp approach, reduce bicycle/pedestrian conflict points, reduce bicycle/pedestrian crossing distance, slow right-turning vehicles, and improve bicycle/pedestrian safety. This recommendation will require coordination with and approval by NYSDOT.
10. *Reconfiguration of U.S. 9 southbound off-ramp.* A second approximately 250-foot lane is recommended on the southbound off-ramp. This lane would allow shared left-turn/through/right-turn movements throughout the day or at least during the weekday AM peak period. This would improve overall traffic conditions in the area by making traffic operations at the congested Croton Point Avenue at U.S. 9 southbound ramps intersection more efficient. This recommendation will require coordination with and approval by NYSDOT.

11. *Relocation of existing bus stop.* It is recommended to relocate the bus stop on the north side of Croton Point Avenue beneath the U.S. 9 overpass to the U.S. 9 southbound on-ramp. This will reduce congestion caused by buses along Croton Point Avenue. It will bring the bus stop closer to the train station and allow bus/train transfers to be made without crossing Croton Point Avenue.

It is estimated that the cost of implementing these short-term improvements will be approximately \$1.5 million. Funding for these improvements has been requested through NYSDOT's Transportation Enhancements Program (TEP) – the application for which was submitted on June 27, 2008. A detailed cost estimate and notes from the April 15 public meeting from which some of the short-term, as well as long-term improvements, were derived are provided in Appendices H and I, respectively.

### Analysis Results

Intersection and arterial analyses were conducted for 2013 Build conditions to assess the impacts of above short-term vehicle-related improvements. The results of weekday AM and PM peak-hour intersection analyses are provided in Tables 2 and 3, respectively. As indicated in the tables, traffic operations in the Croton Harmon study area would be better for Build conditions with the installation and coordination of traffic signals along the corridor than for No Build conditions. All lane movements would operate at generally acceptable LOS D with less than 45 sec/veh of delay or better during the weekday AM peak hour and at good LOS C with less than 35 sec/veh of delay or better during the weekday PM peak hour. With recommended signal timings and phasing, as documented in the Synchro analysis, the actuated approaches could operate at LOS D or better while the local traffic along S. Riverside Avenue and Croton Point Avenue, although no longer free-flowing, could operate at LOS C or better. It should be noted, however, that establishing the actual offsets between intersections should be done in the field. As indicated in Table 2, there are times during the weekday AM peak period when entering traffic volumes and resulting queue lengths may exceed storage capacity, as they do for existing conditions. To ensure the best traffic operations, offsets should be based on field observations, and DON'T BLOCK THE INTERSECTION regulations should be enforced.

Build condition arterial analyses along the proposed signalized segment of project area roadway indicate that it would take about 1 minute and 45 seconds to travel between Benedict Boulevard and Veterans Plaza in either direction during the weekday AM peak hour – approximately 45 seconds of which would be signal delay along Croton Point Avenue. It would take less than 1 minute and 30 seconds to travel between Benedict Boulevard and Veterans Plaza in either direction during the weekday PM peak hour – approximately 25 seconds of which would be signal delay along Croton Point Avenue. Delays to Croton Point Avenue are higher during the weekday AM peak period because more time must be allotted to the U.S. 9 northbound and southbound off-ramp traffic in the mornings than in the evenings.

Detailed 2013 Build condition intersection and arterial analyses results are provided in Appendix G.

## **ADDITIONAL/LONGER-TERM IMPROVEMENTS**

In the process of speaking with the public and developing short-term improvements for which a TEP application has been submitted, the following additional long-term improvements have been identified.

1. The installation of SHARE THE ROAD signs north of the project study area between Benedict Boulevard and Oneida Avenue and of bicycle lanes between Oneida Avenue and U.S. 129/Maple Street to provide a continuous bicycle accommodation along S. Riverside Avenue to U.S. 129/Maple Street
2. Since S. Riverside Avenue is currently not wide enough to accommodate on- or off-street bicycle facilities, the acquisition of right-of-way along S. Riverside Avenue, in coordination with future development along the roadway between Benedict Boulevard and Croton Point Avenue, to facilitate on-street bicycle lanes and/or continuation of the raised shared bicycle/pedestrian path
3. The continuation of the River Walk bicycle/pedestrian trail from the U.S. 9 southbound on-ramp at Croton Point Avenue north of the project study area to Municipal Place
4. Consideration should be given to the construction of a bicycle/pedestrian overpass from the west end of Benedict Boulevard over U.S. 9 to a new bicycle/pedestrian path or roadway immediately north of the train station and to
5. The acquisition of property to accomplish the complete reconfiguration of the U.S. 9 southbound ramps (with a potential direct connection to the train station), which may especially be necessary should plans to construct a parking garage at the train station be implemented.

Based on discussions with the Village, it may be possible to implement the bicycle signing and striping north of the project area with available Village funds. If not, it is recommended that the Village contact NYSDOT and the New York Metropolitan Transportation Council (NYMTC) to identify the most likely funding sources for these and long-term improvements. NYSDOT Region 8 may elect to fully or partially fund improvements with State money, especially since the short-term modifications to the U.S. 9 northbound and southbound ramps at Croton Point Avenue and the potential long-term reconfiguration of the U.S. 9 southbound ramp would require NYSDOT involvement and approval. Or, NYSDOT may steer the Village toward acquiring federal funding. Based on research and a review of the Federal Highway Administration's *A Guide To Federal-Aid Programs And Projects*<sup>2</sup>, it is possible that federal funding may be obtained from the NYSDOT/NYMTC Congestion Mitigation and Air Quality Improvement (CMAQ) program, straight Surface Transportation Program (STP), or affiliated STP TEP and Bicycle and Pedestrian Walkways program. Some improvements may also be federally funded by the New York State Department of Housing

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<sup>2</sup> Federal Highway Administration Office of Program Administration. [A Guide to Federal-Aid Programs and Projects](http://www.fhwa.dot.gov/federalaid/projects.pdf). U.S. Department of Transportation, Federal Highway Administration. June 24, 2008. < <http://www.fhwa.dot.gov/federalaid/projects.pdf> >.

and Community Renewal (NYSDHCR) Community Development Block Grant (CDBG) program.

Detailed information regarding some of the potential federal funding sources is provided in Appendix J.

## **CONCLUSION**

The goal of this project was to develop a conceptual plan to improve vehicular, pedestrian, and bicycle operations in the vicinity of Croton-Harmon Train Station. Based on field observations, traffic analyses, and community feedback, it was found that numerous short-term improvements could be made to improve conditions. As discussed previously and shown in Figure 6, the major short-term improvements include the following. The \$1.5 million in funding required to implement these and the additional improvements in Figure 6 will be applied for from NYSDOT's Transportation Enhancement Program.

- The construction of a raised shared bicycle/pedestrian path on either side of Croton Point Avenue
- The replacement of sidewalks
- The installation of actuated and coordinated traffic signals
- The reconfiguration of the U.S. 9 northbound and southbound off-ramps
- The repaving and re-striping of the study area roadways

Improvements outside of the project study area and/or that are more long-term could also be implemented. These improvements could include the following.

- Signing, striping, right-of-way acquisition to improve bicycle/pedestrian operations within and north of the project study area
- Construction of a River Walk bicycle/pedestrian trail extension from the U.S. 9 on-ramp to Municipal Place
- Property acquisition to effect a realignment/reconfiguration of the U.S. 9 southbound ramps

The costs and preferred funding sources for these projects are to be determined.