Appendix F

Traffic Analysis Report

Traffic Analysis Report

HNTB Corporation

May 2013

Pennsylvania and Minnesota Avenues, SE
Intersection Improvement Project
Environmental Assessment

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1.0 TRAFFIC IMPACT ANALYSIS

1.1 Purpose

An important aspect of the alternatives evaluation is the impacts to vehicle, pedestrian and bicyclist traffic and transit services. A traffic analysis was conducted to assess the impact of each alternative, including vehicular delays, queues, travel times, pedestrian and bicyclist safety, transit services, etc. This chapter describes the analysis methodology and presents the results.

The purpose of the Proposed Action is to provide improvements to the Pennsylvania and Minnesota Avenues, SE intersection in keeping with the District of Columbia's Great Streets Initiative as set forth in the 2007 *Great Streets Framework Plan* and the 2007 *Revitalization of Pennsylvania Avenue, SE for the Great Streets Initiative Concepts Design Final Report (Great Streets Design Final Report)*.

1.2 Existing Conditions

Road Network

The study intersection is located on a major commuter route, Pennsylvania Avenue SE, in an urban environment at its crossing with the local travel route of Minnesota Avenue SE. The adjacent land use is a mix of townhome residences, one or two level retail shops and park space. To assess the traffic impacts to the surrounding area, the adjacent intersections to the subject intersection were also included in the traffic analysis.

The streets included in the study are described below:

- Pennsylvania Avenue SE is a median-separated Principle Arterial according to the DDOT Roadway Functional Classification with average annual daily traffic (AADT) of 42,500 vehicles per day. It is one of the few major gateways used by motorists to reach downtown Washington D.C. from southeast region of D.C. east of Anacostia River and Maryland.
- Minnesota Avenue SE is as a Minor Arterial with AADT of 10,200 vehicles per day.
- 25th Street is a Minor Arterial with AADT of 5,800 vehicles per day. It is a one-way street going southbound within the study area.

The intersections in the study are provided in **Table 1** and shown in **Figure 1.** The subject intersection includes ID 1A and 1B in the table. Note that Intersection ID Numbers 2-5 in the table are intersections adjacent to the subject intersection that would not be modified by any of the alternatives; however, nearby impacts to these adjacent intersections due to each of the alternatives are being considered in the evaluation of alternatives for this study.

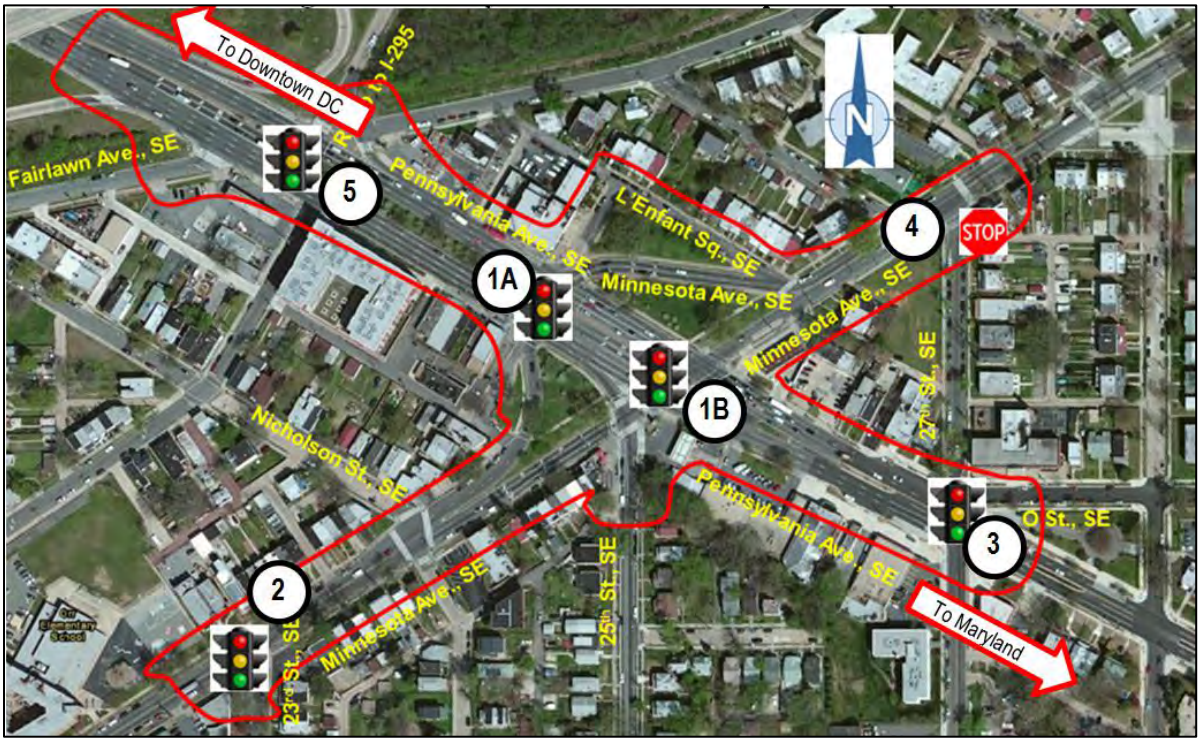
Table 1: List of Intersections in the Study Area

ID	Intersection	Traffic Control
1A	Pennsylvania Ave. and Minnesota Ave., SE West	Signalized
1B	Pennsylvania Ave. and Minnesota Ave., SE East	Signalized
2	Minnesota Ave. and 23rd St., SE	Signalized
3	Pennsylvania Ave., 27th St. and O St., SE	Signalized
4	Minnesota Ave. and 27th St., SE	Un-signalized
5	Pennsylvania Ave., I-295 N.B. On Ramp and Fairlawn Ave., SE	Signalized

Source: HNTB Corporation, 2013.

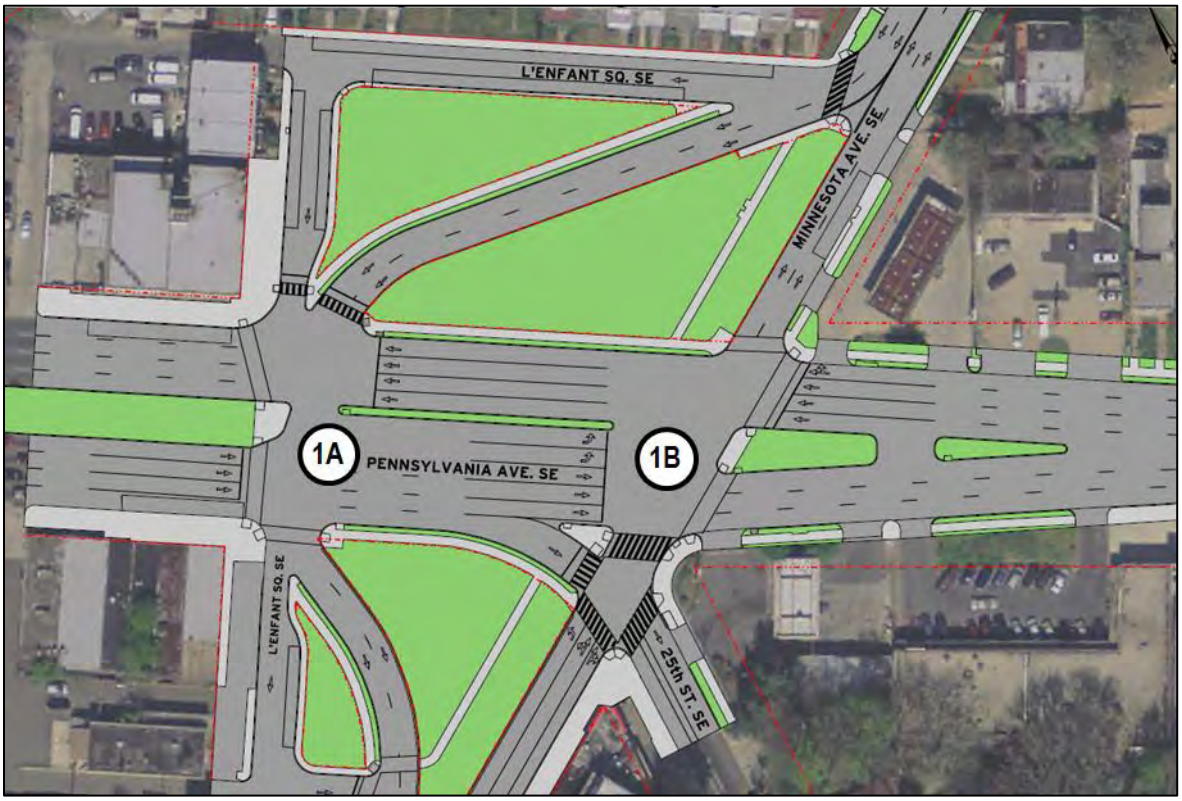
In the existing configuration, shown in **Figure 2**, Pennsylvania Avenue SE is two-way with a concrete median; it has three or four travel lanes in each direction with two added lanes at the left turn onto northbound Minnesota Avenue SE. Minnesota Avenue SE is a two-way undivided road south of Nicholson Street and north of L'Enfant Square SE. Within the study area, a National Park Service (NPS)-owned park space separates Minnesota Avenue into two one-way roads and this forms two signalized intersections on Pennsylvania Avenue (1A and 1B). L'Enfant Square is a one-lane one-way street with on-street parking on both sides, providing access to the local residences and shops; it joins the west Pennsylvania Avenue & Minnesota Avenue intersection (1A) however it is not controlled by any traffic signals – only right turns are allowed and they are controlled by a Stop sign.

Figure 1: Study Area for Traffic Impact Analysis



Source: ESRI (Aerial), and HNTB Corporation, 2013.

Figure 2: Existing Configuration



Source: HNTB Corporation, 2013.

Transit Network

Currently there are twelve bus routes (32, 34, 36, 39, A11, B2, J13, K11, M6, V7, V8 and V9) using Pennsylvania Avenue, five routes (B2, U2, V7, V8 and V9) on Minnesota Avenue and two (32 and 34) on 25th Street, as shown in **Figure 3**. While not shown on Figure 3-13, bus route 39 is an express bus route that runs along Pennsylvania Avenue. The nearest Metro station is the Potomac Avenue Station which is located one mile to the west of the Study Area.

Figure 3: Bus Routes within the Study Area and Vicinity

Source: Washington Metropolitan Area Transit Authority website www.wmata.com, 2013.

1.3 Alternatives

1.3.1 No Build Alternative

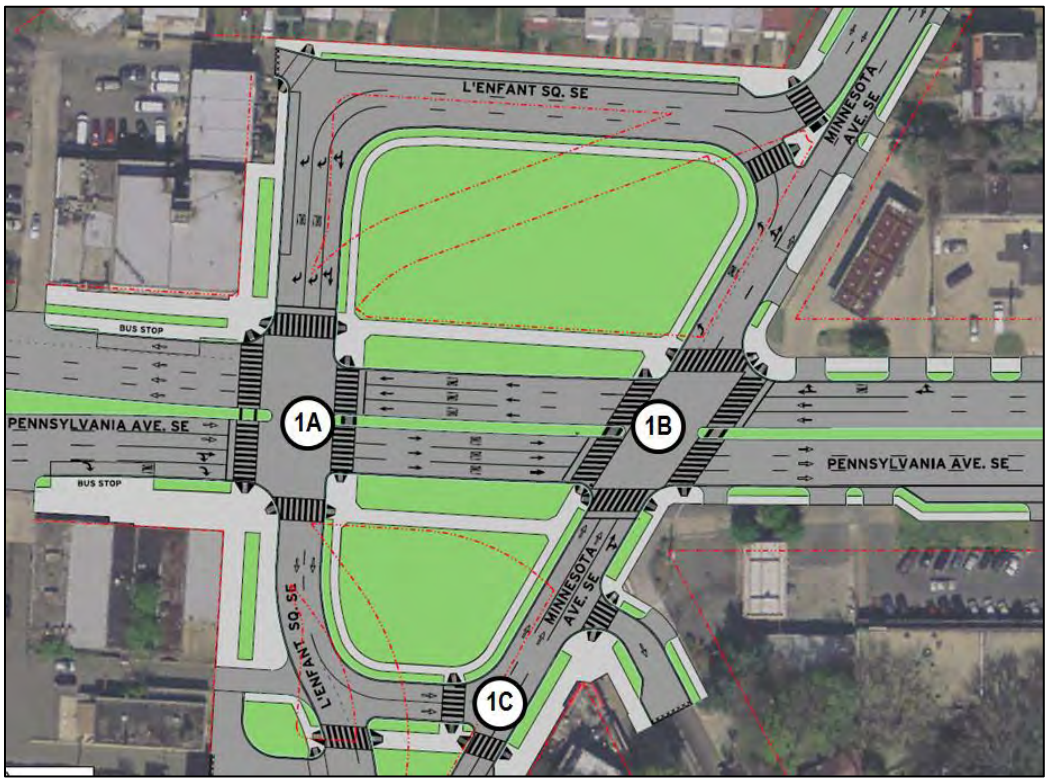
In the No Build Alternative, the roadway configuration and traffic operational characteristics would remain unchanged from the existing condition, as shown in Figure 2.

1.3.2 Revised Square Alternative

The Revised Square Alternative, shown in **Figure 4**, would require all vehicles, with the exception of through movements on Pennsylvania Avenue, to go around the expanded center islands. The following key traffic improvements are proposed in this alternative:

- Prohibit left turning movements on Pennsylvania Avenue in the center of the square and require all turning vehicles circulate around the square;
- Prohibit left turns from both directions of Minnesota Avenue onto Pennsylvania Avenue, directing them around the square, and reduce vehicular conflicts with pedestrians on the crosswalks;
- Expand L'Enfant Square to three lanes on the north side of the square and combine with southbound Minnesota Avenue, providing parking spaces for residents and retail patrons;
- Expand L'Enfant Square to two lanes on the south side of the square and realign the roadway to add the connection to northbound Minnesota Avenue and 25th Street;
- Add wider sidewalks and additional crosswalks to provide safe and convenient access for pedestrians; and
- Add traffic signal control at the new south intersection 1C to improve traffic flow.

Figure 4: Revised Square Alternative



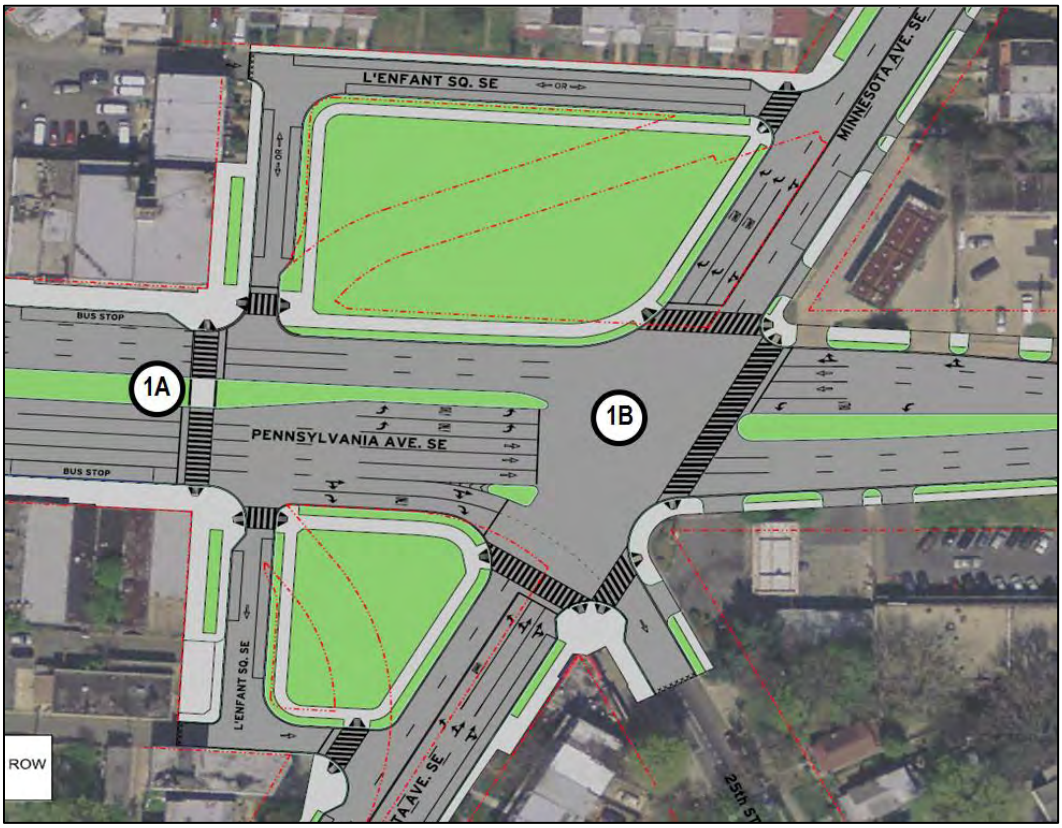
Source: HNTB Corporation, 2013.

1.3.3 Conventional Intersection Alternative

The Conventional Intersection Alternative, shown in **Figure 5**, is a typical at-grade intersection allowing all turning movements for all approaches, except that 25th Street would still be a one-way street going southbound. The existing west side intersection (1A) in the square would be reconfigured by building a continuous median along Pennsylvania Avenue, eliminating vehicular crossings; a crosswalk with a pedestrian-activated traffic signal would also be provided at this location (1A) to allow safe crossing for pedestrians. Other key traffic improvements include:

- Turn Minnesota Avenue SE into a five-lane roadway through the intersection,
- Provide a new left turn bay on westbound Pennsylvania Avenue for access to southbound Minnesota Avenue and 25th Street, and
- Add bulb-outs at multiple intersection corners to shorten pedestrian crossing distance, protect parked vehicles and reduce traffic impact caused by bus pullovers.

Figure 5: Conventional Intersection Alternative



Source: HNTB Corporation, 2013.

1.3.4 Analysis Methodology

Analysis Scenarios and Tools

This study analyzes traffic operations during AM and PM peak hours when vehicular and pedestrian traffic reach the highest levels and most accidents occur. It is important to capture these study periods, as it represents the most intense period of use for the study area.

Per FHWA and DDOT requirements, the following years were included in the analysis for all alternatives:

- 2012 (Existing Year)
- 2015 (Opening Year)
- 2040 (Design Year)

Table 2 summarizes the scenarios included in the analysis.

Table 2: List of Scenarios Included in Traffic Analysis

Scenario	Analysis Year					
	2012		2015		2040	
	AM	PM	AM	PM	AM	PM
Existing Condition	X	X	-	-	-	-
Alt 1 - No Build	-	-	X	X	X	X
Alt 2 - Revised Square	-	-	X	X	X	X
Alt 3 - Conventional Intersection	-	-	X	X	X	X

Notes:

X : included in the analysis.

- : not included in the analysis.

To evaluate and compare the vehicular traffic operations of all alternatives, the following measures of effectiveness (MOE's) were selected for this study:

- Intersection Delay
- Intersection Level of Service (LOS)
- Approach Delay
- Approach LOS
- Queues on key approaches
- Travel times

Per FHWA guidance[1], traffic simulation was used to model, analyze and compare the traffic operations the two alternatives. Synchro software (version 8.0) was used to model and analyze the traffic signal operations including delays, LOS and queues. VISSIM software (version 5.3) was used to provide the travel time results.

For pedestrian traffic, a qualitative analysis was performed that identified the deficiency of the current configuration based on the existing field observations and discuss the improvements proposed by the alternatives.

Data Collection and Traffic Volume Development

The existing traffic signal timing plans at all signalized intersections were received from DDOT Traffic Operation Administration (TOA) and coded in the simulation models. For the proposed alternatives, signal timing was optimized based on forecasted traffic demand to improve traffic operation at individual signals as well as along the corridor.

Available traffic counts within the last three years were collected from DDOT and the existing year (2012) volumes were developed using an annual growth rate of 0.5 percent. Based on the data and field observations, the peak hours of traffic are identified as 7:30 -8:30 in the morning and 4:30 – 5:30 in the evening. At intersections with missing data, data were collected for one-hour period during the AM and PM peak hours. To account for the traffic pattern change caused by the newly constructed I-295 NB

[1] USDOT Federal Highway Administration: Traffic Analysis Toolbox Volume II: Decision Support Methodology for Selecting Traffic Analysis Tools, FHWA-HRT-04-039

ramps at the adjacent 11th Street Bridge, traffic counts were collected again in 2013. Using this data, a balanced set of peak hour traffic volumes were developed for the analysis of Existing Conditions. Volumes for the year 2015 were also developed using the 0.5 percent annual growth rate.

For the year 2040, the corridor-level traffic forecasts provided by Metropolitan Washington Council of Government (MWCOG) were used to generate the growth rate between the existing year and 2040. This rate was applied to the existing year volumes to develop 2040 traffic.

Multiple field visits have been conducted to monitor the existing peak hour traffic operations and to verify field conditions. Average and maximum queue lengths, peak condition durations, posted speed limits, bottleneck locations and typical driving behaviors were recorded and were used for simulation base model development and calibration.

The peak hour turning movement volumes used in this study are presented in **Figures 6 through 12**.

Figure 6: Peak Hour Volumes –Existing Conditions

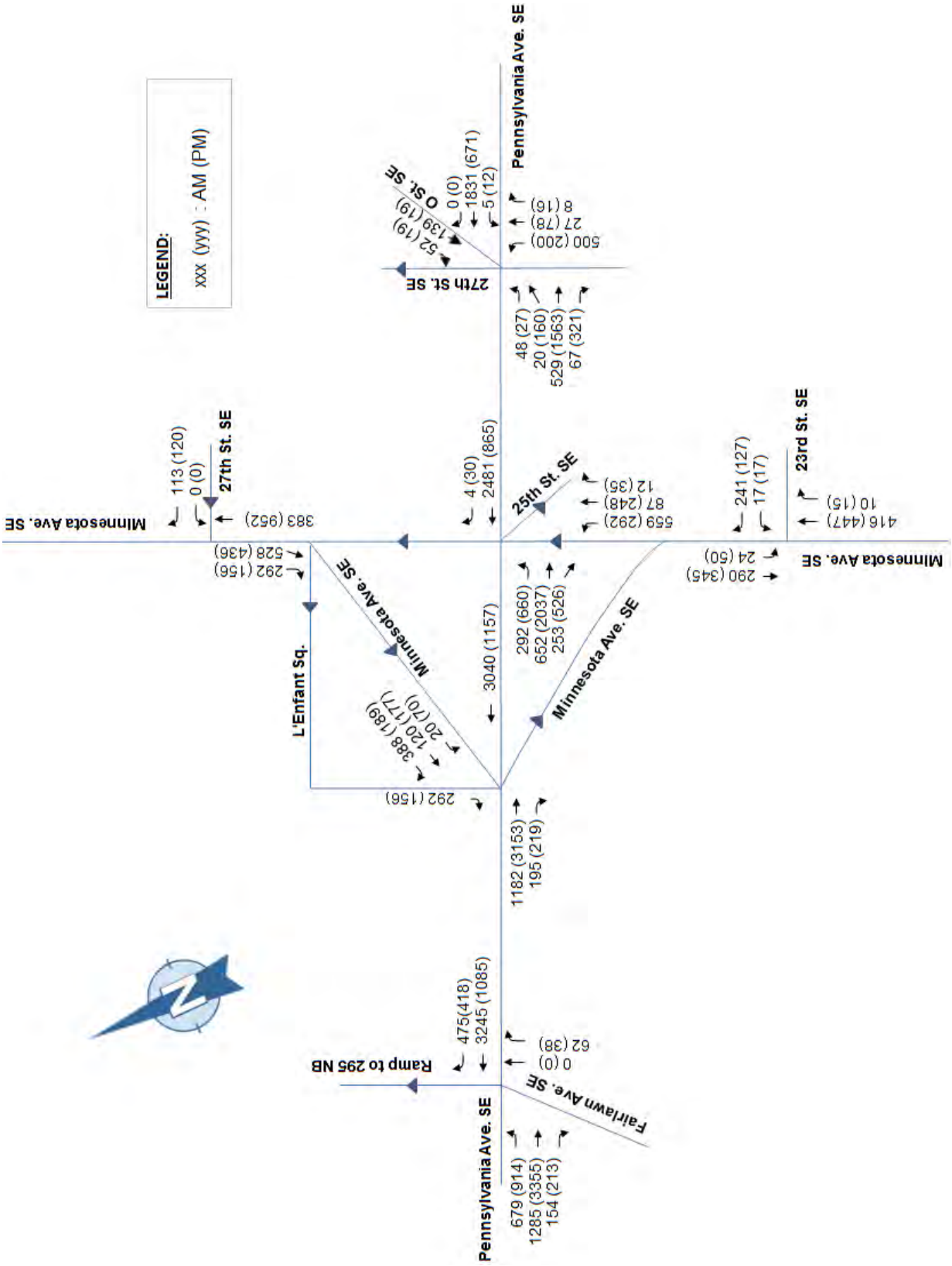


Figure 7: Peak Hour Volumes – 2015 No Build Alternative

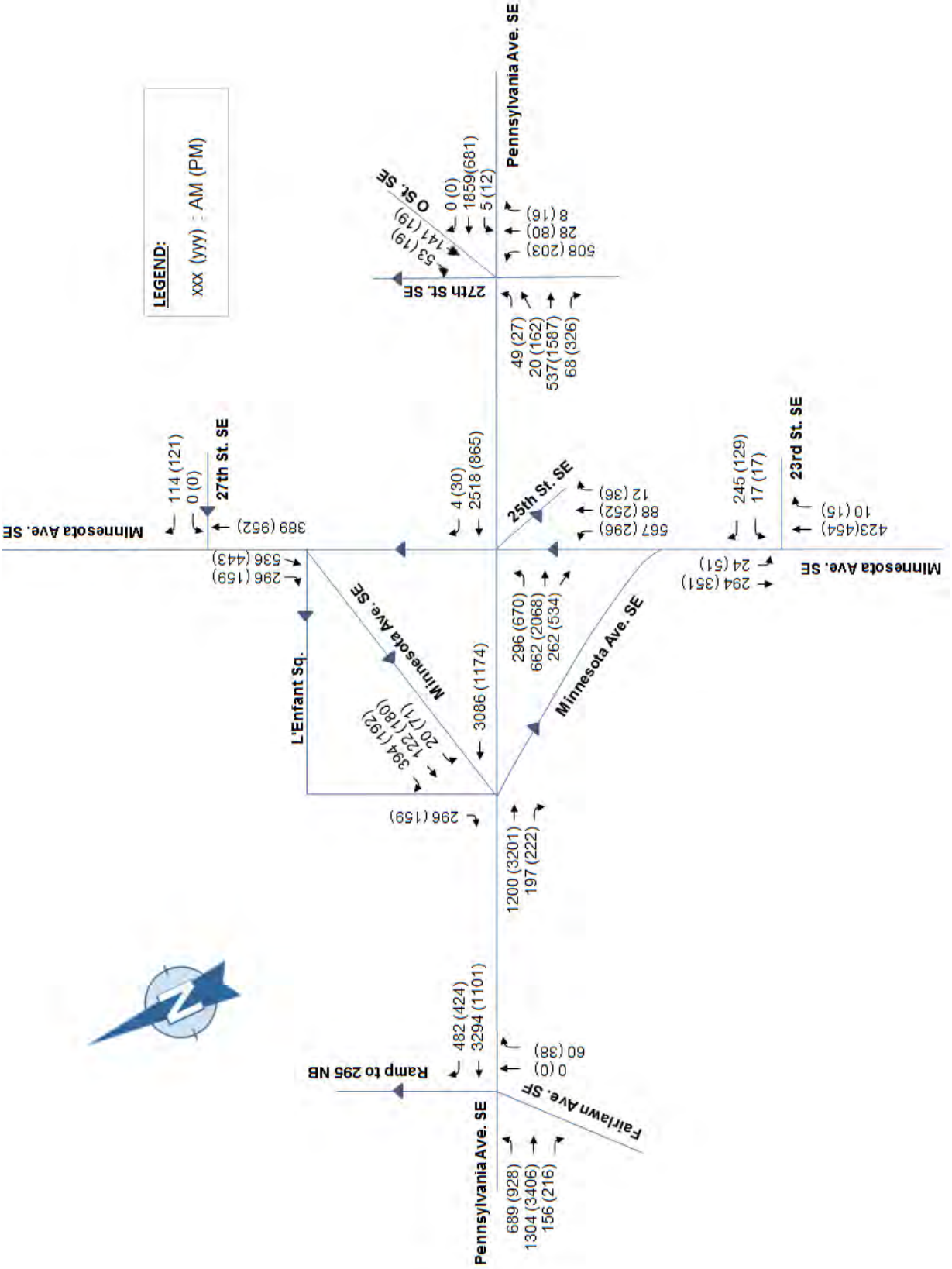


Figure 8: Peak Hour Volumes – 2015 Revised Square Alternative

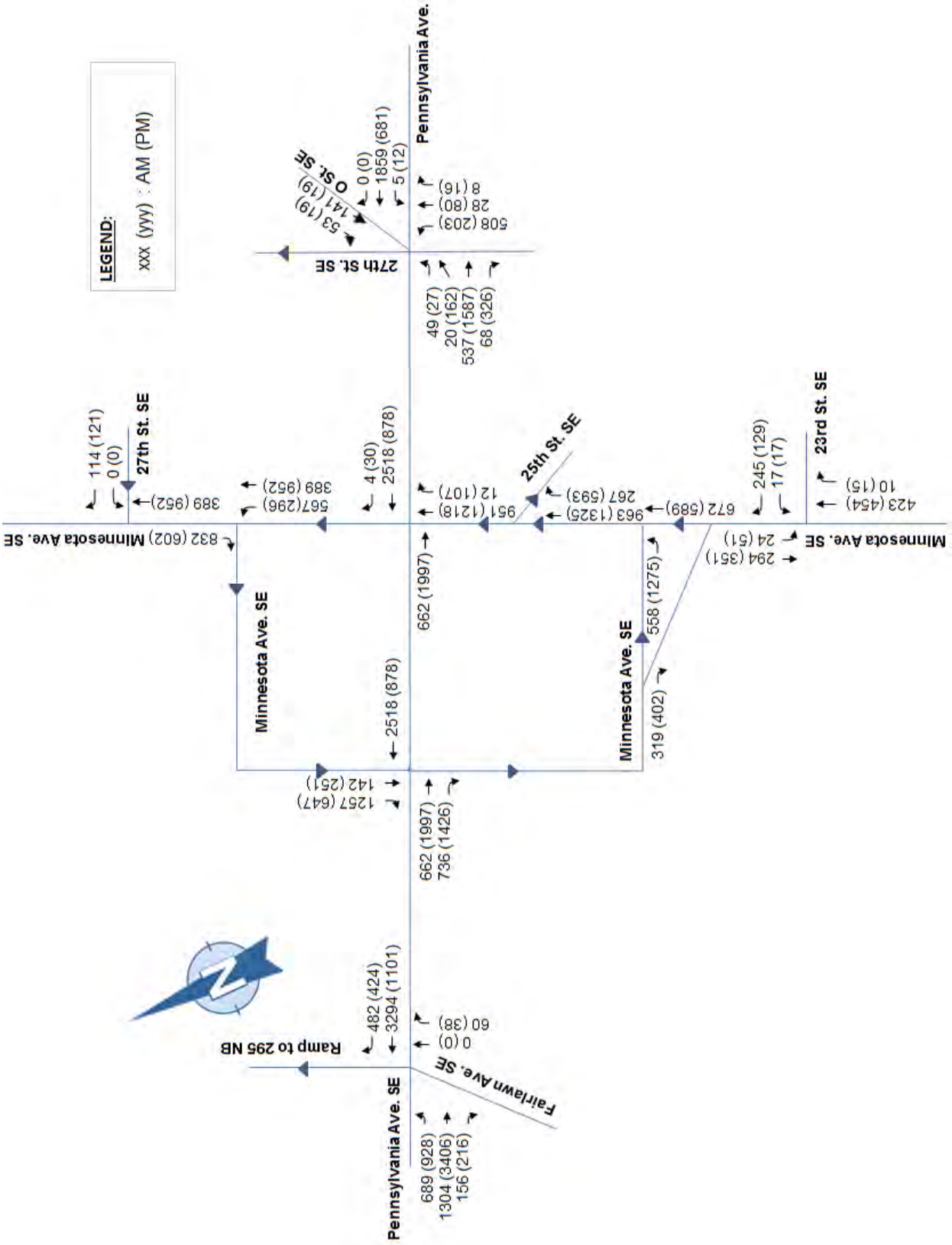


Figure 9: Peak Hour Volumes – 2015 Conventional Intersection Alternative

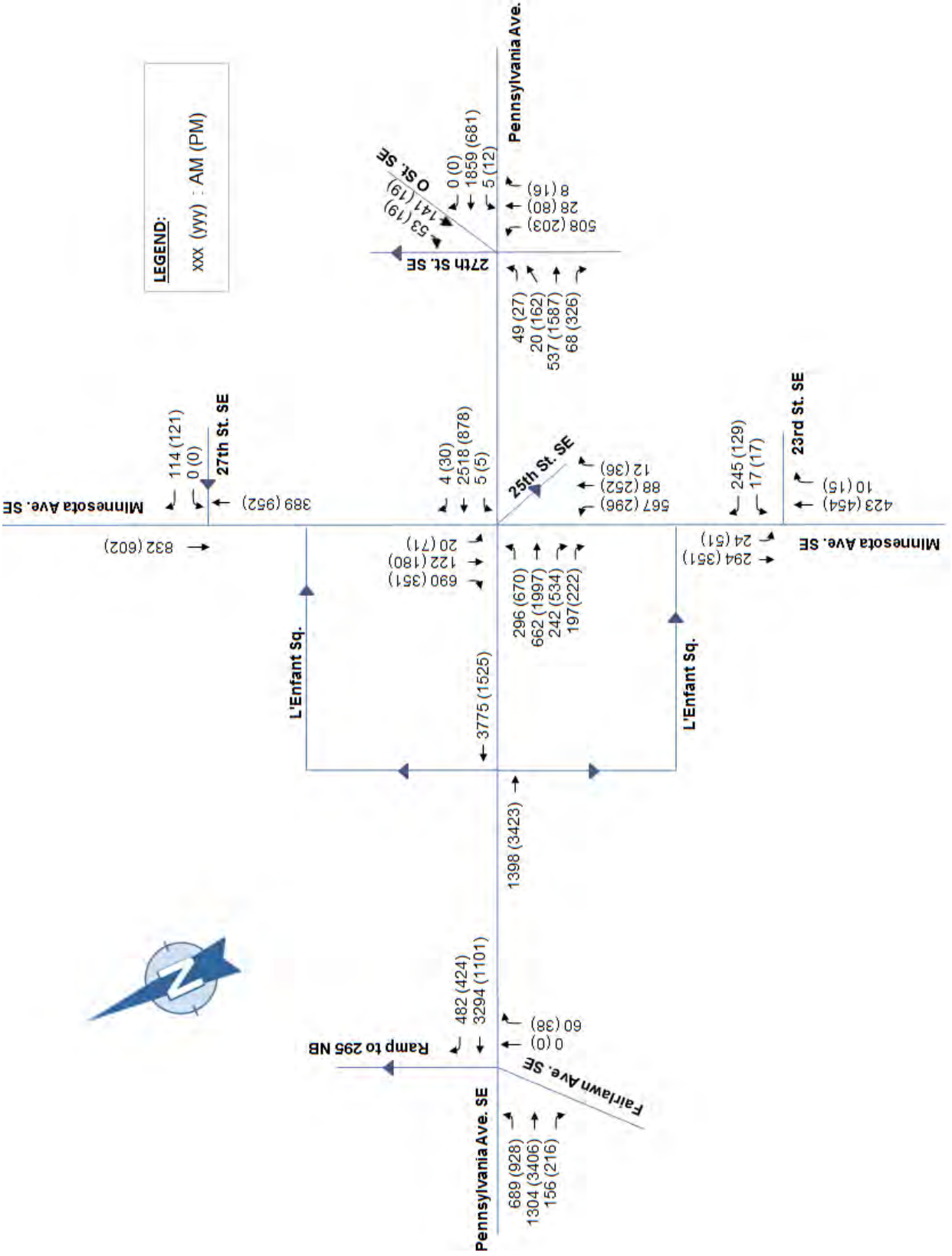


Figure 10: Peak Hour Volumes – 2040 No Build Alternative

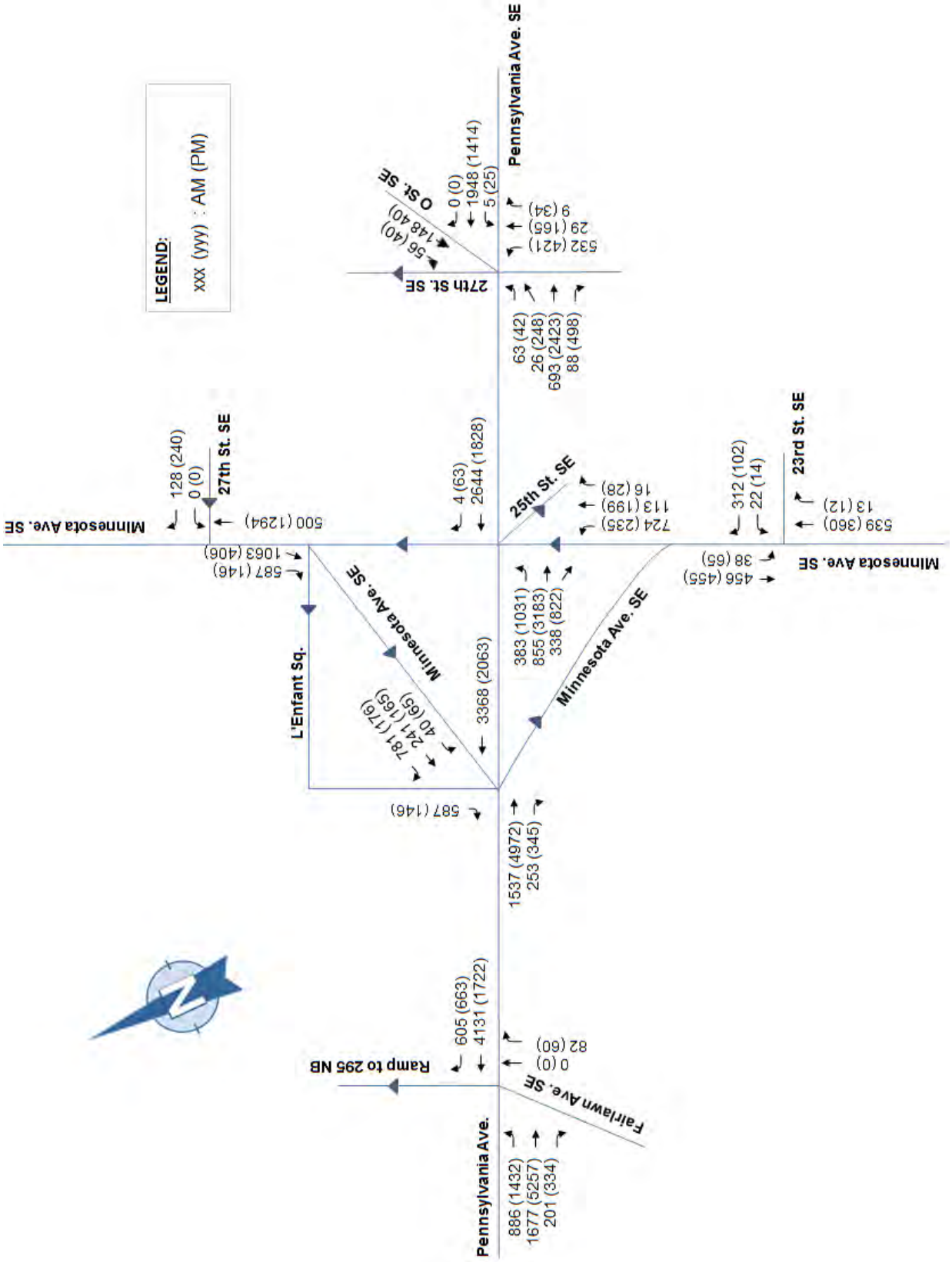


Figure 11: Peak Hour Volumes – 2040 Revised Square Alternative

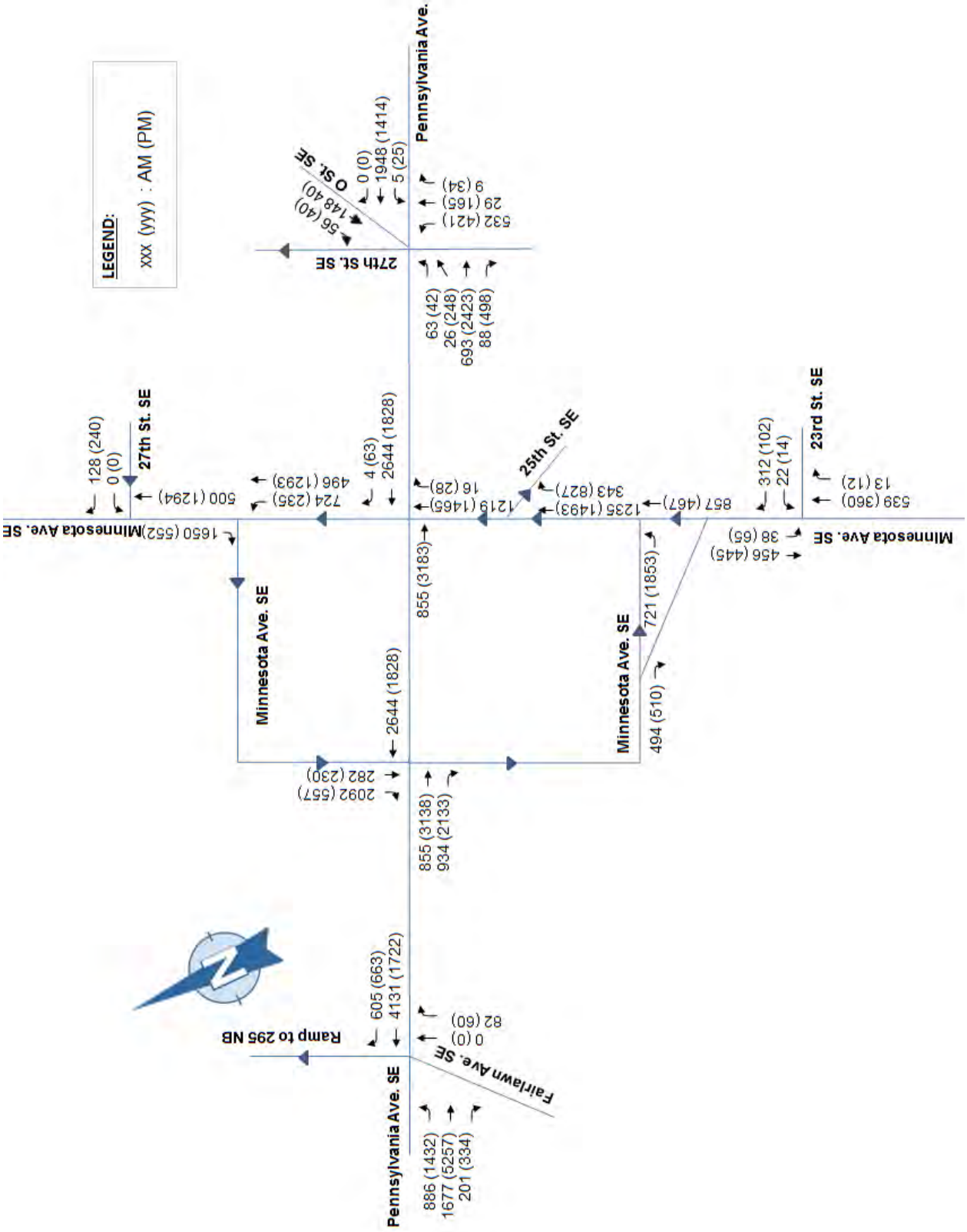
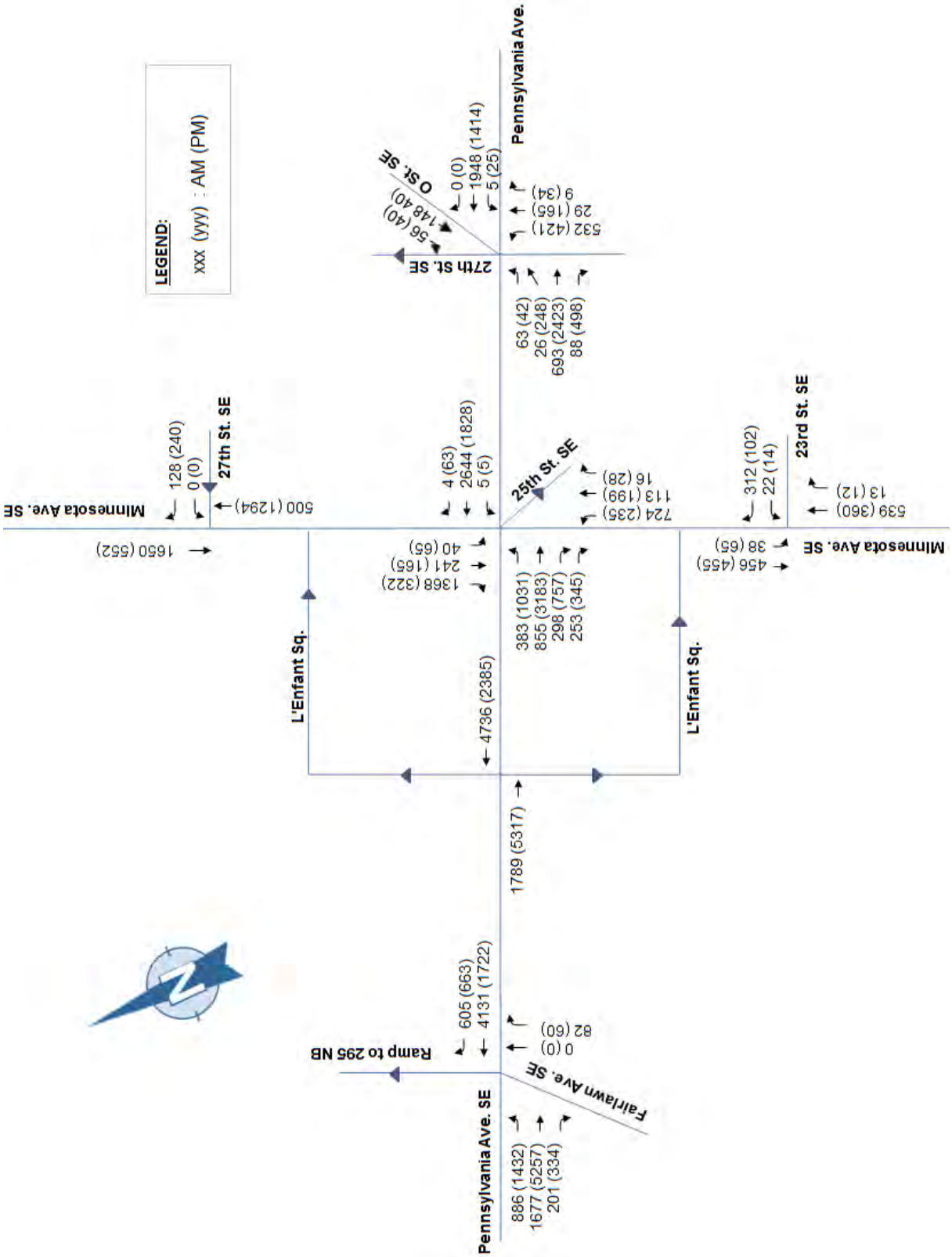


Figure 12: Peak Hour Volumes – 2040 Conventional Intersection



1.3.5 Traffic Simulation Model Calibration

The Federal Highway Administration's (FHWA's) *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software* were used as a guideline for the development of the VISSIM models. **Table 3** shows the key parameters in the modeling process. **Figure 13** depicts the workflow in the VISSIM modeling and traffic analysis.

Table 3: Key Parameters in the VISSIM Modeling

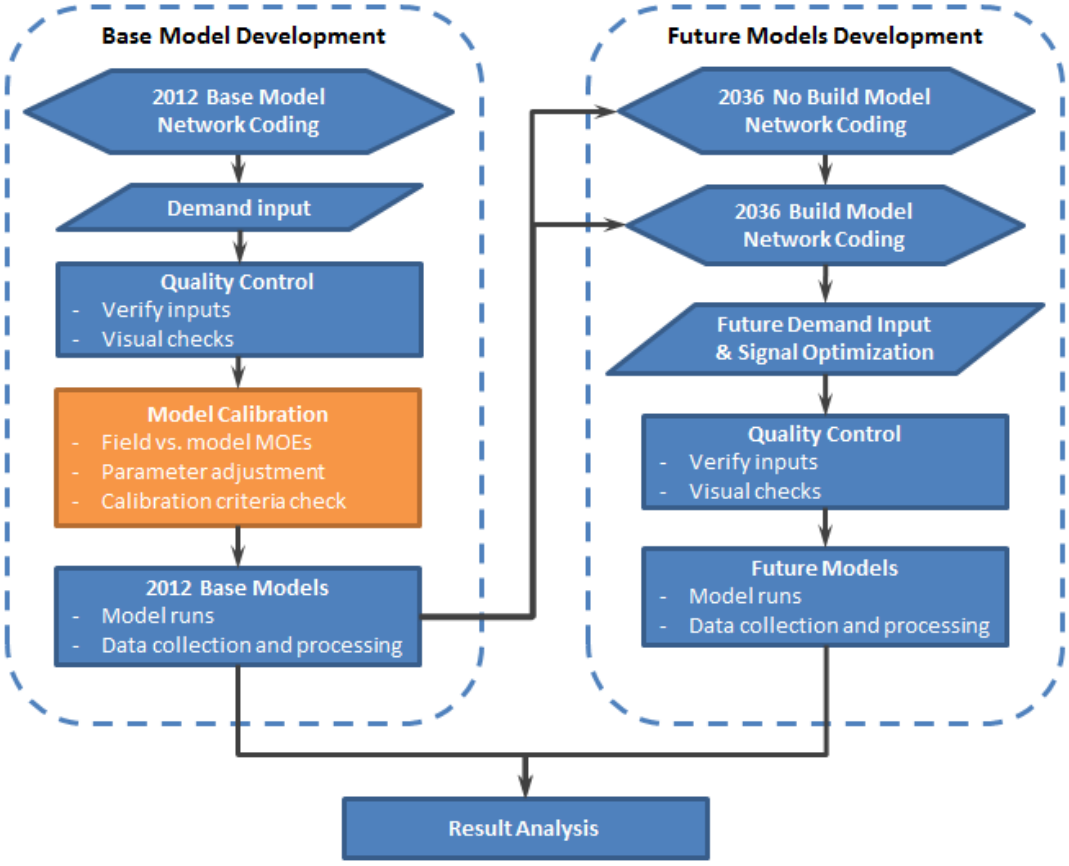
Parameter	Value
VISSIM Version	5.4
Simulation Resolution	10 time steps/sec
Seeding Time	0-900 seconds
Recording Time	900 - 4500 seconds
Number of Runs	6 runs (determined based on statistical tests)
Random Seeds	Starting 1 with increment of 1

Source: FHWA, *Traffic Analysis Toolbox Volume III*, June 2004.

Based on the recommendations from the FHWA's Toolbox[2], 15 minutes (900 simulation seconds) were used as the seeding period for the VISSIM models. After the seeding period, the simulation time was 1 hour for each run.

[2] Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, Appendix C: Estimation of Simulation Initialization Period. Federal Highway Administration, June 2004.

Figure 13: VISSIM Model Development Process



Given the stochastic nature of the micro-simulation, VISSIM models need to be run with several different random seeds. For a 95 percent confidence level, four runs were required for the AM peak period model and six runs for the PM peak period model. To be conservative, the numbers of runs were decided to be six for all scenarios.

Calibration criteria[3] recommended in FHWA's Toolbox were used in determining when calibration was achieved. Calibration results and FHWA's criteria are presented in **Table 4**. In this study, three key measures of effectiveness (MOEs) were used to verify the adequacy of the calibration:

- Hourly throughput volumes served
- Travel times in both directions on Pennsylvania Avenue and
- Queue lengths on each movement of the intersections

Throughput volume was the primary calibration MOE, and queue lengths and travel times were used as the system performance MOEs. Additionally, visual audits were used as a fourth means to validate the models.

[3] Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, p. 63. Federal Highway Administration, June 2004.

The model parameters were adjusted to reflect actual network performance and driver behaviors in an iterative process. The models were run with adjusted parameters, and the outputs were examined against field measurements. In the models for this study, values of driving behavior parameters for most links used the default values. Then based on field observations and iterative calibration experiment, parameter values at several locations were modified to reflect the real driving behaviors.

Table 4: VISSIM Modeling Calibration Criteria and Results

Criterion	Calibration Target	Results	
Throughput		AM	PM
Individual Link Flows			
Within 15% (Flow from 700 to 2700 veh/h)	> 85% of cases	100%	100%
Within 100 veh/h (Flow < 700 veh/h)	> 85% of cases	100%	100%
Within 400 veh/h (Flow > 2700 veh/h)	> 85% of cases	100%	100%
GEH Statistic < 5 for Individual Link Flows	> 85% of cases	100%	100%
Sum of All Link Flows			
GEH Statistic for Sum of All Link Flows	GEH < 4	< 1	< 2
Travel Times			
Within 15%	> 85% of cases	90%	95%
Queuing	Match field observations	Matched	
Visual Audits of Speed and Bottlenecks	Match field observations	Matched	

For both peak hours, the GEH statistic of all the movements at each intersection in the study area were less than five and the GEH of sum of total volumes were less than four. Therefore, the link/intersection volume MOE reached the calibration acceptance targets defined in FHWA's toolbox.

Similarly, the queue lengths from VISSIM matched field observations matched. VISSIM models of Existing conditions are calibrated to satisfactorily reproduce the existing field queuing conditions at key approaches. Visual inspections were also performed to check the simulation animations to ensure the overall VISSIM models appropriately simulate the field conditions through the network.

To maintain a consistent base for traffic operational analyses of all the scenarios, driver behavior parameters in the calibrated existing models were largely retained in the future No-Build and Build models. However, under certain particular conditions, such as significantly high demand growth, or major changes to the network, some parameters were adjusted to reflect drivers' responses to these changes. Initial model assessments were performed using a review of simulation outputs and a visual inspection of animation to ensure the future models generated outputs.

1.4 Analysis Results

1.4.1 Roadway Network and Traffic

Vehicular Delays and LOS

A key metric used for traffic operation is Level of Service (LOS). LOS is an estimate of the performance efficiency and quality of an intersection or roadway as established by the *Highway Capacity Manual (HCM)*[4] methodology. The HCM methodology measures the degree of delay at intersections using a letter scale from A to F, A being the free flow condition and F being total gridlock. LOS D or better is desirable for urban corridors.

Table 5 shows the LOS scales and their descriptions for signalized intersections.

Table 5: Level of Service Definitions

LOS	Vehicular Delay	Description
A	< 10 sec/veh	Desirable - free flow
B	10 – 20 sec/veh	Desirable - nearly free flow
C	20 - 35 sec/veh	Desirable - stable traffic flow
D	35 – 55 sec/veh	Acceptable - unstable traffic flow
E	55 – 80 sec/veh	Congestion - operation at capacity
F	> 80 sec/veh	Gridlock - over capacity

Source: Transportation Research Board, *Highway Capacity Manual*, 2000.

The traffic delay and LOS results for the AM and PM peak hours are presented in **Tables 6 through 11** and discussed in the following sections.

AM Peak Hour

In the existing year, shown in **Table 6**, all intersections operate at acceptable level of service during the AM peak hour, except that the Pennsylvania Avenue & 27th Street intersection is LOS E, slightly beyond the threshold of LOS D (55.0 sec/veh). The peak travel direction, northwest Pennsylvania Avenue towards downtown DC is LOS B except at 27th Street.

[4] * Highway Capacity Manual 2000, Transportation Research Board, 2000

Table 6: Traffic Delay (in Second/Vehicle) and LOS Results – Existing AM

ID	INTERSECTION	APPROACH	EXISTING			
			APPROACH		INTERSECTION	
			DELAY	LOS	DELAY	LOS
1A	L'Enfant Sq & Pennsylvania Ave	SWB	287.5	F	39.5	D
		SWR (L'Enfant Sq.)	0.4	A		
		SEB	12.6	B		
		NWB	12.4	B		
1B	Pennsylvania Ave & Minnesota Ave	SEB	18.4	B	18.4	B
		NWB	19.5	B		
		NEB	14.1	B		
		SWB	-			
1C*	L'Enfant Sq South & Minnesota Ave NB	NET	-		-	
		SEL				
2	Minnesota Ave & 23rd St	EB	4.5	A	10.8	B
		WB	4.0	A		
		NB	29.3	C		
3	Pennsylvania Ave & 27th St	WB	101.1	F	59.4	E
		NB	108.1	F		
		SEB	14.4	B		
		NWB	57.1	E		
4	Minnesota Ave & 27th St	NB	10.4	B	0.9	A
		NEB	0.0	A		
		SWB	0.0	A		
5	Pennsylvania Ave & NB 295 Ramp	SEB	24.9	C	23.4	C
		NWB	23.0	C		

*Note: Intersection 1C only exists in the Revised Square Alternative.
Source: HNTB Corporation, 2013.

In 2015, shown in **Table 7**, in the No Build Alternative, all other intersections would remain the same LOS as the existing condition, except the intersection of Pennsylvania Avenue and 27th Street, east of the project would deteriorate to LOS F due to increased traffic.

For the Revised Square Alternative, all three intersections (1A, 1B and 1C) in the square would operate at LOS B or C.

The Conventional Intersection Alternative would drop to F, as all movements would be accommodated at the reconfigured Pennsylvania Avenue and Minnesota Avenue intersection (1B). The new pedestrian-activated signal (1A) would be at LOS A.

The four adjacent intersections (2 through 5) would operate nearly the same in all three alternatives.

Table 7: Traffic Delay (in Second/Vehicle) and LOS Results – 2015 AM

ID	INTERSECTION	APPROACH	2015 NO BUILD				2015 REVISED SQUARE				2015 CONV. INTERSECTION			
			APPROACH		INTERSECTION		APPROACH		INTERSECTION		APPROACH		INTERSECTION	
			DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS
1A	L'Enfant Sq & Pennsylvania Ave	SWB	295.2	F	40.7	D	74.7	E	25.7	C	-		0.1	A
		SWR (L'Enfant Sq.)	0.4	A			-	-			-	-		
		SEB	12.7	B			14.2	B			0.1	A		
		NWB	13.1	B			4.8	A			0.2	A		
1B	Pennsylvania Ave & Minnesota Ave	SEB	18.6	B	19.1	B	4.2	A	23.4	C	46.8	D	117.5	F
		NWB	20.2	C			23.9	C			97.1	F		
		NEB	15.5	B			35.2	D			124.4	F		
		SWB	-				-				292.4	F		
1C*	L'Enfant Sq South & Minnesota Ave NB	NET	-		-		19.9	B	18.8	B	-		-	
		SEL					17.4	B						
2	Minnesota Ave & 23rd St	EB	4.6	A	10.8	B	4.6	A	10.8	B	4.6	A	10.8	B
		WB	4.0	A			4.0	A			4.0	A		
		NB	29.3	C			29.3	C			29.3	C		
3	Pennsylvania Ave & 27th St	WB	367.0	F	86.3	F	367.0	F	86.6	F	367.0	F	86.1	F
		NB	158.1	F			158.1	F			158.1	F		
		SEB	14.3	B			15.8	B			13.3	B		
		NWB	62.2	E			62.2	E			62.2	E		
4	Minnesota Ave & 27th St	NB	10.4	B	0.9	A	10.4	B	0.9	A	10.4	B	0.9	A
		NEB	0.0	A			0.0	A			0.0	A		
		SWB	0.0	A			0.0	A			0.0	A		
5	Pennsylvania Ave & NB 295 Ramp	SEB	26.0	C	26.6	C	26.0	C	29.6	C	26.0	C	31.1	C
		NWB	27.4	C			32.2	C			34.5	C		

*Note: Intersection 1C only exists in the Revised Square Alternative.
Source: HNTB Corporation, 2013.

In 2040, shown in **Table 8**, the increased traffic demand would cause LOS to deteriorate at most intersections compared to 2015.

At the Pennsylvania Avenue and L'Enfant Square intersection (1A), the No Build Alternative would experience the worse delay of nearly 158 sec/veh at LOS F. The Revised Square Alternative would also operate at LOS F, with a 116 sec/veh delay, better than the No Build.

The east side intersection (1B) in both No Build and Revised Square alternatives would operate adequately at LOS D or C. The Conventional Intersection Alternative would operate at LOS F with a 274 sec/veh delay.

Table 8: Traffic Delay (in Second/Vehicle) and LOS Results – 2040 AM

ID	INTERSECTION	APPROACH	2040 NO BUILD				2040 REVISED SQUARE				2040 CONV. INTERSECTION			
			APPROACH		INTERSECTION		APPROACH		INTERSECTION		APPROACH		INTERSECTION	
			DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS
1A	L'Enfant Sq & Pennsylvania Ave	SWB	932.9	F	158.1	F	296.5	F	115.9	F	-		58.4	E
		SWR (L'Enfant Sq.)	1.3	A			-	-			-	-		
		SEB	14.2	B			19.5	B			0.1	A		
		NWB	17.6	B			18.9	B			80.4	F		
1B	Pennsylvania Ave & Minnesota Ave	SEB	29.7	C	32.7	C	4.4	A	48.6	D	47.7	D	274.1	F
		NWB	21.8	C			70.5	E			153.1	F		
		NEB	70.7	E			23.3	C			309.1	F		
		SWB	-				-				696.1	F		
1C*	L'Enfant Sq South & Minnesota Ave NB	NET	-		-		21.7	C	23.4	C	-		-	
		SEL					25.4	C						
2	Minnesota Ave & 23rd St	EB	6.2	A	12.0	B	6.2	A	12.0	B	6.2	A	12.0	B
		WB	5.9	A			5.9	A			5.9	A		
		NB	30.4	C			30.4	C			30.4	C		
3	Pennsylvania Ave & 27th St	WB	404.5	F	103.5	F	404.5	F	103.7	F	404.5	F	102.6	F
		NB	178.9	F			178.9	F			178.9	F		
		SEB	14.7	B			15.0	B			10.7	B		
		NWB	89.7	F			89.7	F			89.7	F		
4	Minnesota Ave & 27th St	NB	11.2	B	0.6	A	11.2	B	0.6	A	11.2	B	0.6	A
		NEB	0.0	A			0.0	A			0.0	A		
		SWB	0.0	A			0.0	A			0.0	A		
5	Pennsylvania Ave & NB 295 Ramp	SEB	59.1	E	101.9	F	59.1	E	109.2	F	59.1	E	106.9	F
		NWB	128.6	F			140.3	F			136.5	F		

*Note: Intersection 1C only exists in the Revised Square Alternative.
Source: HNTB Corporation, 2013.

PM Peak Hour

In the existing year, shown in **Table 9**, all intersections in the study area operate at acceptable LOS D or better during the PM peak hour. The southwest bound approach at intersection 1A experience heavy delay and LOS F. The peak travel direction during the PM rush hour is southeast on Pennsylvania Avenue, operates at LOS C or better.

In 2015, shown in **Table 10**, all intersections in all three alternatives would operate at an acceptable LOS D or better. The LOS of the heaviest southeast bound traffic would also be comparable, LOS D or better, in the No Build, Revised Square and Conventional Intersection alternatives.

In 2040, shown in **Table 11**, the increased traffic volumes would cause the two signals (1A and 1B) at Pennsylvania Avenue at Minnesota Avenue/L'Enfant Square to deteriorate to LOS F in the No Build Alternative. The Revised Square Alternative would reduce the delays at the east signal (1B) from 105 to 62 sec/veh and improve the LOS from F to E. The Conventional Intersection Alternative would eliminate the heavy delays at the west signal (1A) by moving all vehicular traffic to the east side signal (1B) which would remain the same LOS F with comparable delays; however, all four approaches at the east side signal (1B) would experience LOS F, while there is only one approach at LOS F in the No Build scenario.

Table 9: Traffic Delay (in Second/Vehicle) and LOS Results – Existing PM

ID	INTERSECTION	APPROACH	EXISTING			
			APPROACH		INTERSECTION	
			DELAY	LOS	DELAY	LOS
1A	L'Enfant Sq & Pennsylvania Ave	SWB	186.2	F	35.2	D
		SWR (L'Enfant Sq.)	0.2	A		
		SEB	27.9	C		
		NWB	4.2	A		
1B	Pennsylvania Ave & Minnesota Ave	SEB	3.6	A	24.8	C
		NWB	73.0	E		
		NEB	49.3	D		
		SWB	-			
1C*	L'Enfant Sq South & Minnesota Ave NB	NET	-		-	
		SEL				
2	Minnesota Ave & 23rd St	EB	4.7	A	8.1	A
		WB	4.4	A		
		NB	29.0	C		
3	Pennsylvania Ave & 27th St	WB	57.1	E	17.3	B
		NB	51.8	D		
		SEB	10.8	B		
		NWB	19.9	B		
4	Minnesota Ave & 27th St	NB	14.7	B	1.1	A
		NEB	0.0	A		
		SWB	0.0	A		
5	Pennsylvania Ave & NB 295 Ramp	SEB	5.8	A	7.3	A
		NWB	11.9	B		

*Note: Intersection 1C only exists in the Revised Square Alternative.
Source: HNTB Corporation, 2013.

Table 10: Traffic Delay (in Second/Vehicle) and LOS Results – 2015 PM

ID	INTERSECTION	APPROACH	2015 NO BUILD				2015 REVISED SQUARE				2015 CONV. INTERSECTION			
			APPROACH		INTERSECTION		APPROACH		INTERSECTION		APPROACH		INTERSECTION	
			DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS
1A	L'Enfant Sq & Pennsylvania Ave	SWB	193.9	F	37.0	D	51.0	D	33.2	C	-		0.3	A
		SWR (L'Enfant Sq.)	0.2	A			-				-	-		
		SEB	29.6	C			36.6	D			0.4	A		
		NWB	4.2	A			1.9	A			0.1	A		
1B	Pennsylvania Ave & Minnesota Ave	SEB	3.6	A	25.0	C	3.6	A	24.2	C	33.1	C	45.2	D
		NWB	73.6	E			8.8	A			38.5	D		
		NEB	49.6	D			65.9	E			78.6	E		
		SWB	-				-				91.8	F		
1C*	L'Enfant Sq South & Minnesota Ave NB	NET	-		-		39.3	D	27.7	C	-		-	
		SEL					22.3	C						
2	Minnesota Ave & 23rd St	EB	4.7	A	8.1	A	4.7	A	8.1	A	4.7	A	8.1	A
		WB	4.5	A			4.5	A			4.5	A		
		NB	29.0	C			29.0	C			29.0	C		
3	Pennsylvania Ave & 27th St	WB	57.1	E	17.8	B	57.1	E	19.0	B	57.1	E	13.1	B
		NB	52.0	D			52.0	D			52.0	D		
		SEB	11.5	B			13.3	B			4.4	A		
		NWB	20.1	C			20.1	C			20.1	C		
4	Minnesota Ave & 27th St	NB	14.9	B	1.1	A	14.9	B	1.1	A	14.9	B	1.1	A
		NEB	0.0	A			0.0	A			0.0	A		
		SWB	0.0	A			0.0	A			0.0	A		
5	Pennsylvania Ave & NB 295 Ramp	SEB	5.9	A	7.4	A	5.9	A	10.7	B	5.9	A	13.2	B
		NWB	12.1	B			25.3	C			35.4	D		

*Note: Intersection 1C only exists in the Revised Square Alternative.

Source: HNTB Corporation, 2013.

Table 11: Traffic Delay (in Second/Vehicle) and LOS Results – 2040 PM

ID	INTERSECTION	APPROACH	2040 NO BUILD				2040 REVISED SQUARE				2040 CONV. INTERSECTION			
			APPROACH		INTERSECTION		APPROACH		INTERSECTION		APPROACH		INTERSECTION	
			DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS
1A	L'Enfant Sq & Pennsylvania Ave	SWB	160.2	F	176.3	F	53.9	D	170.4	F	-		1.4	A
		SWR (L'Enfant Sq.)	0.2	A			-	-			-	-		
		SEB	247.7	F			245.3	F			2.0	A		
		NWB	7.7	A			3.1	A			0.0	A		
1B	Pennsylvania Ave & Minnesota Ave	SEB	11.5	B	105.3	F	41.5	D	61.7	E	104.3	F	119.4	F
		NWB	328.7	F			8.6	A			151.9	F		
		NEB	46.4	D			172.2	F			179.0	F		
		SWB	-				-				103.2	F		
1C*	L'Enfant Sq South & Minnesota Ave NB	NET	-		-		36.9	D	29.1	C	-		-	
		SEL					27.1	C						
2	Minnesota Ave & 23rd St	EB	4.2	A	7.6	A	4.2	A	7.6	A	4.2	A	7.6	A
		WB	5.2	A			5.2	A			5.2	A		
		NB	28.8	C			28.8	C			28.8	C		
3	Pennsylvania Ave & 27th St	WB	55.8	E	144.6	F	61.1	E	147.4	F	61.1	E	147.4	F
		NB	83.7	F			106.2	F			106.2	F		
		SEB	205.5	F			205.8	F			205.8	F		
		NWB	39.7	D			39.6	D			39.6	D		
4	Minnesota Ave & 27th St	NB	34.3	D	3.9	A	34.3	D	3.9	A	33.8	D	3.9	A
		NEB	0.0	A			0.0	A			0.0	A		
		SWB	0.0	A			0.0	A			0.0	A		
5	Pennsylvania Ave & NB 295 Ramp	SEB	14.4	B	16.6	B	14.4	B	23.1	C	14.4	B	30.1	C
		NWB	23.3	C			49.4	D			77.1	E		

*Note: Intersection 1C only exists in the Revised Square Alternative.
Source: HNTB Corporation, 2013.

Vehicular Queues

Tables 12 and 13 show the queuing analysis results on key movements at the intersections for all three alternatives.

AM Peak Hour

During the AM peak hour, the northwest bound Pennsylvania Avenue carries heavy commuter traffic towards Downtown Washington, D.C. It would have longer queues at the Pennsylvania Avenue & northbound Minnesota Avenue intersection (1B) in both build alternatives in 2015 and 2040, comparing to the No Build Alternative. This is because:

- In the Revised Square Alternative, the rerouted traffic around the square would significantly increase the volumes on the northeast bound approach; additional green time would have to be taken away from the northwest bound traffic on Pennsylvania Avenue to meet the demand of Minnesota Avenue traffic. The queue on westbound Pennsylvania Avenue could be almost 760 feet long in 2015, reaching the 27th Street intersection.

- In the Conventional Intersection Alternative, all traffic crossing Minnesota Avenue would be rerouted to one intersection (1B); this would cause higher demand on all approaches and

more delays and queues in all directions. The westbound Pennsylvania Avenue queue could be over 1,000 feet long in 2015and reach the 28th Street intersection.

Table 12: Queuing Analysis Results (in Feet) – AM

ID	INTERSECTION	DIRECTION	EXISTING	2015			2040		
				NO BUILD	REVISED SQ.	CONV. INT.	NO BUILD	REVISED SQ.	CONV. INT.
1A	L'Enfant Sq & Pennsylvania Ave	SWT	~333	~344	~328	-	~857	~1165	-
		SET	165	169	151	-	243	257	-
		NWT	619	667	73	106	842	~113	~1538
1B	Pennsylvania Ave & Minnesota Ave	SEL	136	138	-	~176	~194	-	~216
		SET	5	6	25	99	9	29	150
		NWL	-	-	-	5	-	-	4
		NWT	338	360	758	~1037	363	~1009	~1114
		NEL	~102	~109	-	~316	~481	-	~559
		NET	0	1	280	191	55	323	~308
		SWL	-	-	-	128	-	-	~372
		SWT	-	-	-	127	-	-	~372
1C*	L'Enfant Sq South & Minnesota Ave NB	NET	-	-	191	-	-	263	-
		SEL	-	-	39	-	-	150	-

*Note: Intersection 1C only exists in the Revised Square Alternative.
~: Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles.
Source: HNTB Corporation, 2013.

PM Peak Hour

In the PM peak hour, similar queue results were found. Both build alternatives would cause longer queues in the peak travel direction compared to the No Build Alternative– southeast bound on Pennsylvania Avenue leaving Downtown Washington, D.C. However, the increase would not be as large as in the AM peak hour, as the Revised Square would have an average queue length of 64 feet in 2015, while the Conventional Intersection Alternative would see a 562 feet long queue, not reaching the I-295 northbound ramp intersection.

Table 13: Queuing Analysis Results (in Feet) – PM

ID	INTERSECTION	DIRECTION	EXISTING	2015			2040		
				NO BUILD	REVISED SQ.	CONV. INT.	NO BUILD	REVISED SQ.	CONV. INT.
1A	L'Enfant Sq & Pennsylvania Ave	SWT	~314	~323	260	-	~279	241	-
		SET	775	804	845	-	~1970	~2016	-
		NWT	79	80	13	0	154	38	73
1B	Pennsylvania Ave & Minnesota Ave	SEL	179	180	-	288	359	-	~579
		SET	12	13	64	562	~1149	~1179	~1298
		NWL	-	-	-	4	-	-	4
		NWT	250	256	101	293	~733	186	~805
		NEL	172	175	-	193	135	-	~192
		NET	170	173	~417	197	134	~624	~184
		SWL	-	-	-	~208	-	-	~265
		SWT	-	-	-	~208	-	-	~265
1C*	L'Enfant Sq South & Minnesota Ave NB	NET	-	-	236	-	-	180	-
		SEL	-	-	420	-	-	574	-

*Note: Intersection 1C only exists in the Revised Square Alternative.

~: Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles.

Source: HNTB Corporation, 2013.

Vehicular Travel Times

Travel time, the amount of time it takes for a motorist to travel from point A to point B, is a direct reflection of motorist experience. Therefore it is a critical and effective measure when comparing the traffic impact of alternatives. The AM and PM peak hour results of travel time analysis are shown in **Tables 14 and 15** respectively.

In the AM peak hour, a comparison among the alternatives indicates that, in the Revised Square Alternative, it would take longer for more than half of all approaches compared to the No Build, because all left turning vehicles would be required to go around the square to go to their destinations. In the Conventional Intersection Alternative, most approaches would experience shorter travel times due to the simplified configuration. However, in 2040, over half of the travel times are longer with the Conventional Intersection Alternative than with the No Build Alternative.

Table 14: Travel Time Analysis Results (in Minutes) – AM

FROM	TO	EXISTING	2015			2040		
			NO BUILD	REVISED SQ.	CONV. INT.	NO BUILD	REVISED SQ.	CONV. INT.
Penn Ave/295NB Ramp	Minn Ave/27th St	2.6	2.6	3.0	4.3	4.5	7.5	7.1
Penn Ave/295NB Ramp	Penn Ave/27th St	1.8	1.8	1.8	1.8	3.3	4.3	3.8
Penn Ave/295NB Ramp	Minn Ave/23rd St	2.3	2.3	3.1	2.2	3.9	8.1	4.0
Penn Ave/295NB Ramp	Minn Ave/25th St	1.8	1.8	3.0	1.6	3.3	7.5	3.6
Penn Ave/27th St	Penn Ave/295NB Ramp	1.3	1.3	1.2	1.4	1.3	1.4	1.5
Penn Ave/27th St	Minn Ave/23rd St	1.0	1.0	1.1	1.5	1.1	1.1	1.4
Minn Ave/23rd St	Penn Ave/295NB Ramp	6.1	6.3	7.1	3.2	7.0	9.1	6.4
Minn Ave/23rd St	Minn Ave/27th St	3.8	4.1	4.6	2.1	4.5	5.2	4.4
Minn Ave/23rd St	Penn Ave/27th St	4.3	4.6	5.0	2.4	5.2	5.2	5.2
Minn Ave/23rd St	Minn Ave/25th St	3.7	3.8	4.0	1.8	4.0	4.0	4.3
Minn Ave/27th St	Minn Ave/25th St	4.4	4.1	3.2	4.1	5.5	5.5	3.9
Minn Ave/27th St	Minn Ave/23rd St	4.5	4.3	3.5	4.7	5.6	5.7	4.5
Minn Ave/27th St	Penn Ave/295NB Ramp	4.9	5.0	3.9	4.0	5.7	5.4	3.6

Source: HNTB Corporation, 2013.

Similar to the AM comparison, in the PM peak hour, the travel times would increase in the Revised Square Alternative for most approaches, especially for northbound Minnesota Avenue traffic which could see travel times as high as 10 minutes due to the high volumes and congestion in the square. The Conventional Intersection Alternative would reduce travel times for most approaches. However in 2040, both build alternatives would cause longer travel times than the No Build.

Table 15: Travel Time Analysis Results (in Minutes) – PM

FROM	TO	EXISTING	2015			2040		
			NO BUILD	REVISED SQ.	CONV. INT.	NO BUILD	REVISED SQ.	CONV. INT.
Penn Ave/295NB Ramp	Minn Ave/27th St	3.4	3.9	7.9	2.9	5.2	6.7	5.2
Penn Ave/295NB Ramp	Penn Ave/27th St	3.4	3.9	5.4	2.2	5.4	4.9	5.5
Penn Ave/295NB Ramp	Minn Ave/23rd St	4.2	4.8	8.1	2.6	5.9	6.7	5.0
Penn Ave/295NB Ramp	Minn Ave/25th St	4.1	4.6	8.0	2.2	5.3	6.5	4.7
Penn Ave/27th St	Penn Ave/295NB Ramp	2.2	2.2	1.3	1.9	3.2	1.8	2.6
Penn Ave/27th St	Minn Ave/23rd St	1.8	1.8	1.2	1.4	2.6	1.2	1.8
Minn Ave/23rd St	Penn Ave/295NB Ramp	2.3	2.3	11.1	2.4	2.3	11.1	3.2
Minn Ave/23rd St	Minn Ave/27th St	2.4	2.6	10.9	1.9	2.1	10.3	2.3
Minn Ave/23rd St	Penn Ave/27th St	3.2	3.2	11.6	2.5	2.7	10.5	3.1
Minn Ave/23rd St	Minn Ave/25th St	2.4	2.3	10.4	1.7	1.6	10.1	1.9
Minn Ave/27th St	Minn Ave/25th St	3.0	3.3	1.8	2.5	2.8	2.2	4.1
Minn Ave/27th St	Minn Ave/23rd St	3.0	3.2	2.3	3.0	2.6	2.6	4.5
Minn Ave/27th St	Penn Ave/295NB Ramp	1.8	1.8	2.2	1.3	2.0	2.2	1.9

Source: HNTB Corporation, 2013.

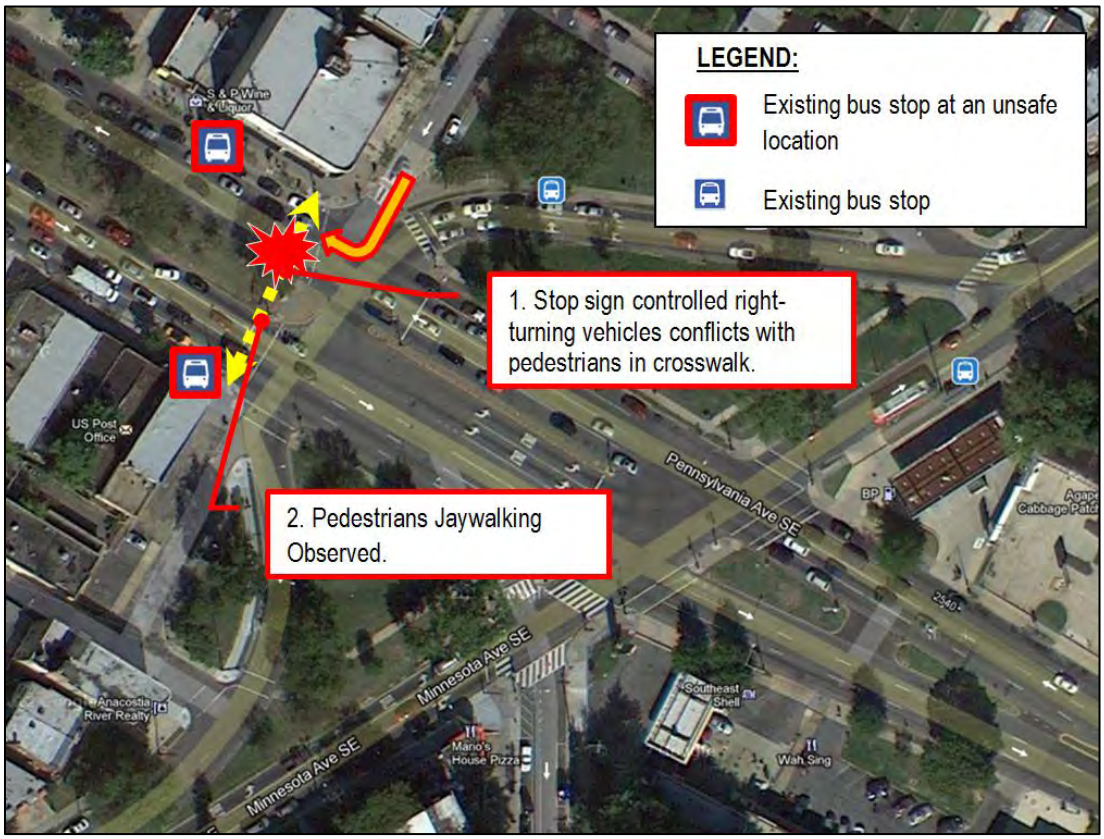
1.4.2 Pedestrian and Bicyclist Safety

In the existing conditions, shown in **Figure 14**, there are two heavily used bus stops on Pennsylvania Avenue just west of L'Enfant Square. As observed during field observations in January of 2013, during both AM and PM peak hours, there are over 150 pedestrians crossing Pennsylvania Avenue via the west side crosswalk to access the two stops. Field observations revealed two dangerous behaviors associated with the pedestrians crossing:

1. Although an Exclusive Pedestrian Phase is provided in the signal timing to stop all vehicles and only allow pedestrians to cross Pennsylvania Avenue, the vehicles from the unsignalized local driveway still attempted to make abrupt right turns between gaps of pedestrians; any vehicles failed to finish the turn would have to suddenly stop, forcing vehicles behind to stop suddenly as well. Field observations found that in a one-hour period during the morning peak, three minor scratches were seen and dismissed without reporting to the police.

2. It was observed that some pedestrians jaywalked to cross Pennsylvania Avenue without waiting for a Walk indication, in order to get to the bus stop across the street. A review of the police crash records indicated that five pedestrians were injured at this intersection in the past three years (2010 to 2012).

Figure 14: Existing Safety Concerns for Pedestrians



Source: Google Maps and HNTB Corporation, 2013.

For bicyclists, field observations were conducted and safety records were reviewed. It was found that:

1. The majority of cyclists currently use the sidewalks and crosswalks on the south side of Pennsylvania Avenue, for two main reasons:

    a. The vehicular traffic is heavy during peak hours and bicyclists feel safer to ride on sidewalks rather than in the roadway[5];

    b. Although sidewalks and crosswalks are present on both sides of Pennsylvania Avenue near Minnesota Avenue, bicyclists prefer to ride on the south side because of lacking continuous sidewalks and curb cuts on the north side at the area west of the northbound 295on-ramp.

2. No major bicyclist safety concerns were identified in the field observation and from the accident history.

In the proposed alternatives, pedestrian and bicyclist safety was given high priority and the conflicts among vehicles, and pedestrians and bicyclists would be reduced as much as possible.

The Revised Square Alternative, shown in **Figure 15**, would include the following pedestrian and bicyclist improvements:

1. A new shorter crosswalk would be provided in the center of the square for pedestrians to cross Pennsylvania Avenue;

2. Left turn movements from southbound L'Enfant Square and northbound Minnesota Avenue into the center of the square would be prohibited to eliminate conflicts between vehicles and crossing pedestrian;

3. The southbound right-turning vehicular traffic from L'Enfant Square would be controlled by traffic signals to minimize the existing vehicle-pedestrian conflict;

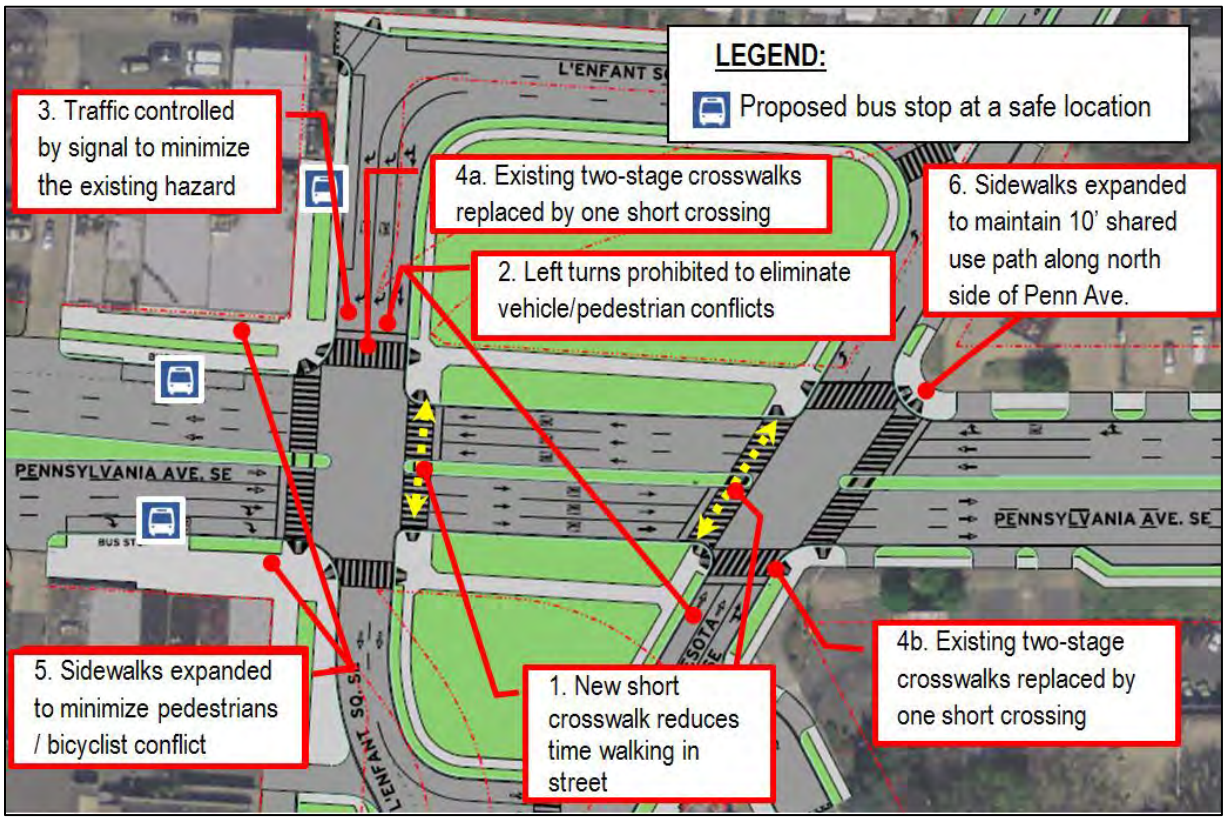
4. New short crosswalks would replace the existing two-step crosswalks on northbound Minnesota Avenue and southbound L'Enfant Square to reduce the time walking in the street therefore enhance safety;

5. The expanded sidewalks at the southwest and northwest corners of Pennsylvania Ave and L'Enfant Square would minimize the conflict between pedestrians waiting at the bus stop and bicyclists traveling on the sidewalk.

6. Sidewalks would be expanded along the north side of Pennsylvania Avenue, SE to the northeast of the intersection to maintain 10' shared use path for bicycle and pedestrian convenience to and through the intersection.

[5] Per the District of Columbia Municipal Regulations (DCMR), Title 18 (1201.9) "Vehicles and Traffic", bicyclists are allowed to use either roadways or sidewalks in the vicinity of the project area.

Figure 15: Proposed Pedestrian/Bicyclist Improvements – Revised Square



Source: HNTB Corporation, 2013.

The Conventional Intersection Alternative, shown in **Figure 16**, would improve pedestrian and bicyclist safety in the following ways:

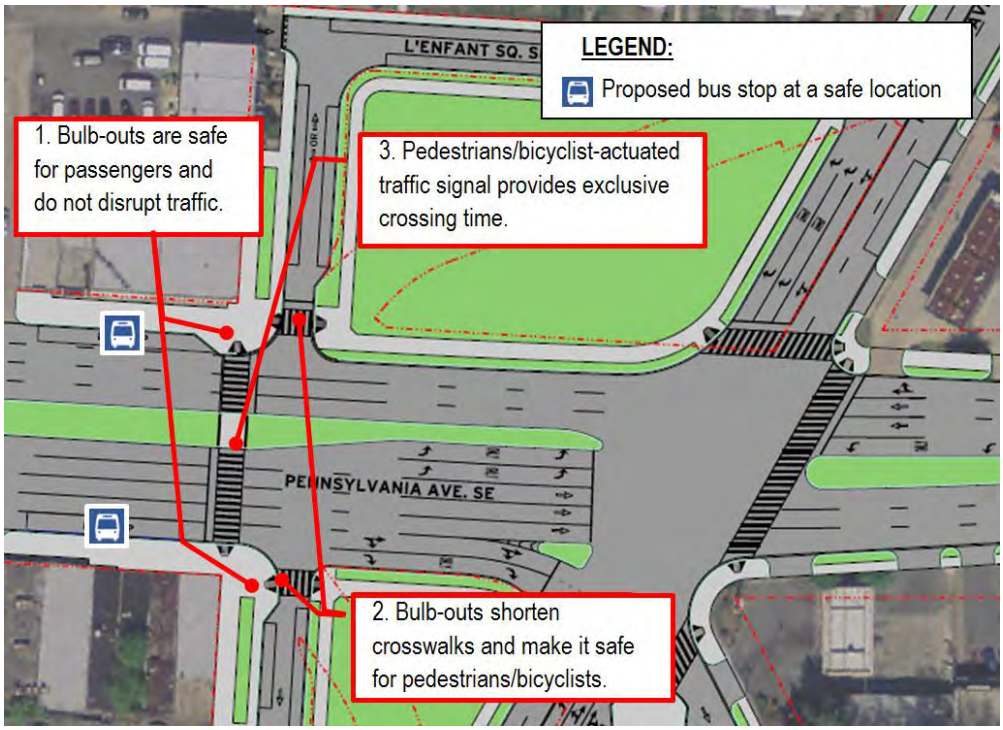
1. Proposed bulb-outs would provide exclusive bus bays that eliminate interruption to traffic on travel lanes and allow safe boarding and alighting for passengers.

2. Proposed bulb-outs would shorten the crosswalk therefore reduce the time that pedestrian walk in street.

3. A proposed pedestrian/bicyclist activated traffic signal at the crosswalk would provide exclusive walk time for pedestrians and bicyclists to safely cross Pennsylvania Avenue without vehicular traffic conflict.

The crosswalk across Pennsylvania Avenue, SE connecting Minnesota Avenue, SE to the north and south of the intersection (east intersection) is a long crossing length for pedestrians. Due to the design of the Conventional Intersection Alternative and the turning radius needed to make a left turn on Pennsylvania Avenue from southbound Minnesota Avenue, there is no median or refuge area breaking up the crosswalk. Therefore the crosswalk crosses all lanes of Pennsylvania Avenue, SE without a median or refuge area. However, given the overall improvement for pedestrians and bicyclists over the No Build Alternative,

Figure 16: Proposed Pedestrian/Bicyclist Improvements – Conventional Intersection



1.4.3 Transit Services

Figure 17 shows the five existing bus stops within the project. Stops 1 and 2 are located on Pennsylvania Avenue west of L'Enfant Square; Stops 3 and 4 are on the southbound Minnesota Avenue between the two NPS-owned park spaces north of Pennsylvania Avenue; Stop 5 is on the northbound Minnesota Avenue north of Pennsylvania Avenue.

In the No Build Alternative, all five stops would remain at their current locations. Proposed bus stop locations for both build alternatives are shown in **Figures 18 and 19**.

As shown in Figure 18, Bus Stop 1 and Bus Stop 5 would remain at their existing locations. Bus Stop 2, located just west of the intersection on eastbound Pennsylvania Avenue, SE, would have to be pulled back farther west of the Pennsylvania Avenue and L'Enfant Square intersection to ensure enough space for buses to change lanes and continue traveling eastbound on Pennsylvania Avenue, SE.

Bus Stop 3 and Bus Stop 4 would also have to be moved to new locations due to their existing location along the cut-through road north of the square (and Pennsylvania Avenue, SE), which would be removed and filled in with park land under the Revised Square Alternative. All three bus routes that Bus Stop 3 serves, V7, V8 and V9, use the cut-through road from Minnesota Avenue, SE to turn right at Pennsylvania Avenue, SE; therefore Bus Stop 3 could be relocated on L'Enfant Square, SE near Pennsylvania Avenue, SE headed westbound.

The only route Stop 4 serves (U2) continues southbound on Minnesota Avenue, SE through the intersection. Due to the reconfiguration with Alternative 1, Stop 4 could be relocated further back, just prior to entering the intersection at the corner of Minnesota Avenue, SE and L'Enfant Square, SE so that

U2 buses would not have to cross two lanes in a short distance to continue straight through the intersection.

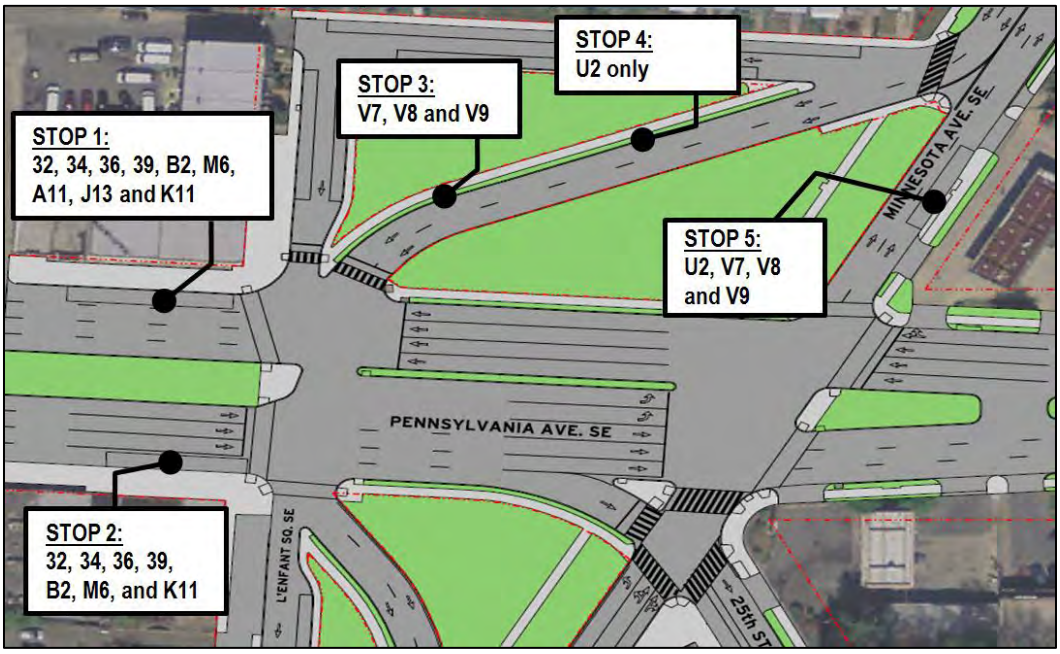
Under the Revised Square Alternative, three of the five Bus Stops would need to be relocated to locations near their current locations to accommodate the new intersection configuration. WMATA would have to adjust their bus routes to accommodate these minor bus stop relocations and bus routes would have to be adjusted to account for the revised intersection design and operations.

As shown in Figure 19, Bus Stops 1, 2 and 5 would remain at their existing locations under the Conventional Intersection Alternative. A bulb-out would be added to Bus Stop 1 to accommodate buses using this bus stop.

Bus Stop 3 and Bus Stop 4 would have to be moved to new locations due to their existing location along the cut-through road north of the square (and Pennsylvania Avenue, SE), which would be removed and filled in with park land under the Conventional Intersection Alternative. All three bus routes that Bus Stop 3 serves, V7, V8 and V9, use the cut-through road from Minnesota Avenue, SE to turn right at Pennsylvania Avenue, SE; therefore Bus Stop 3 could be relocated to Minnesota Avenue, SE, just prior to the right-turn onto Pennsylvania Avenue, SE.

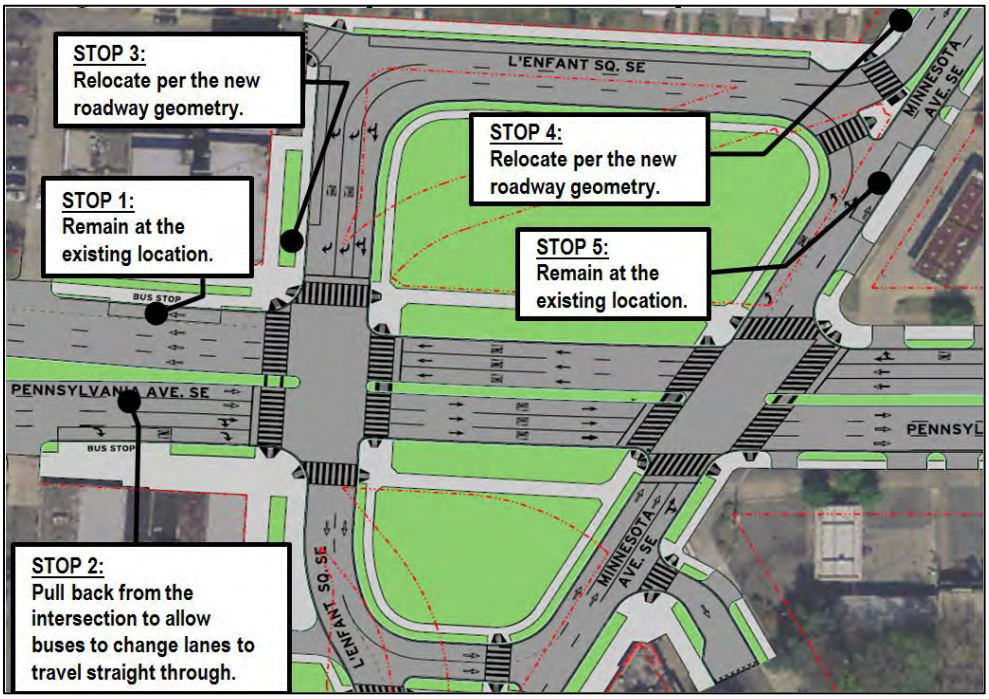
The only route Stop 4 serves (U2) continues southbound on Minnesota Avenue, SE through the intersection. Due to the reconfiguration under the Conventional Intersection Alternative, Stop 4 could be relocated to Minnesota Avenue, SE, just prior to entering the north side of the intersection at the corner of Minnesota Avenue, SE and L'Enfant Square, SE and would then have to move to the far left lane to continue southbound on Minnesota Avenue.

Figure 17: Bus Stops in the Existing Condition / No Build Alternative



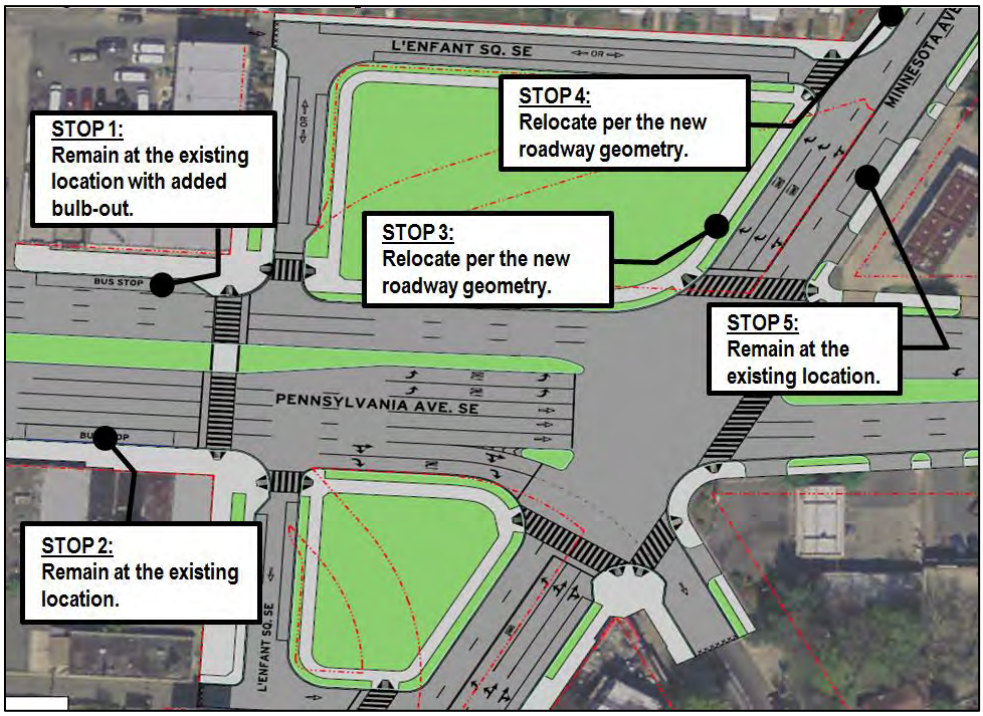
Source: HNTB Corporation, 2013.

Figure 18: Possible Bus Stop Locations in the Revised Square Alternative



Source: HNTB Corporation, 2013.

Figure 19: Possible Bus Stop Locations in the Conventional Intersection Alternative



Source: HNTB Corporation, 2013.

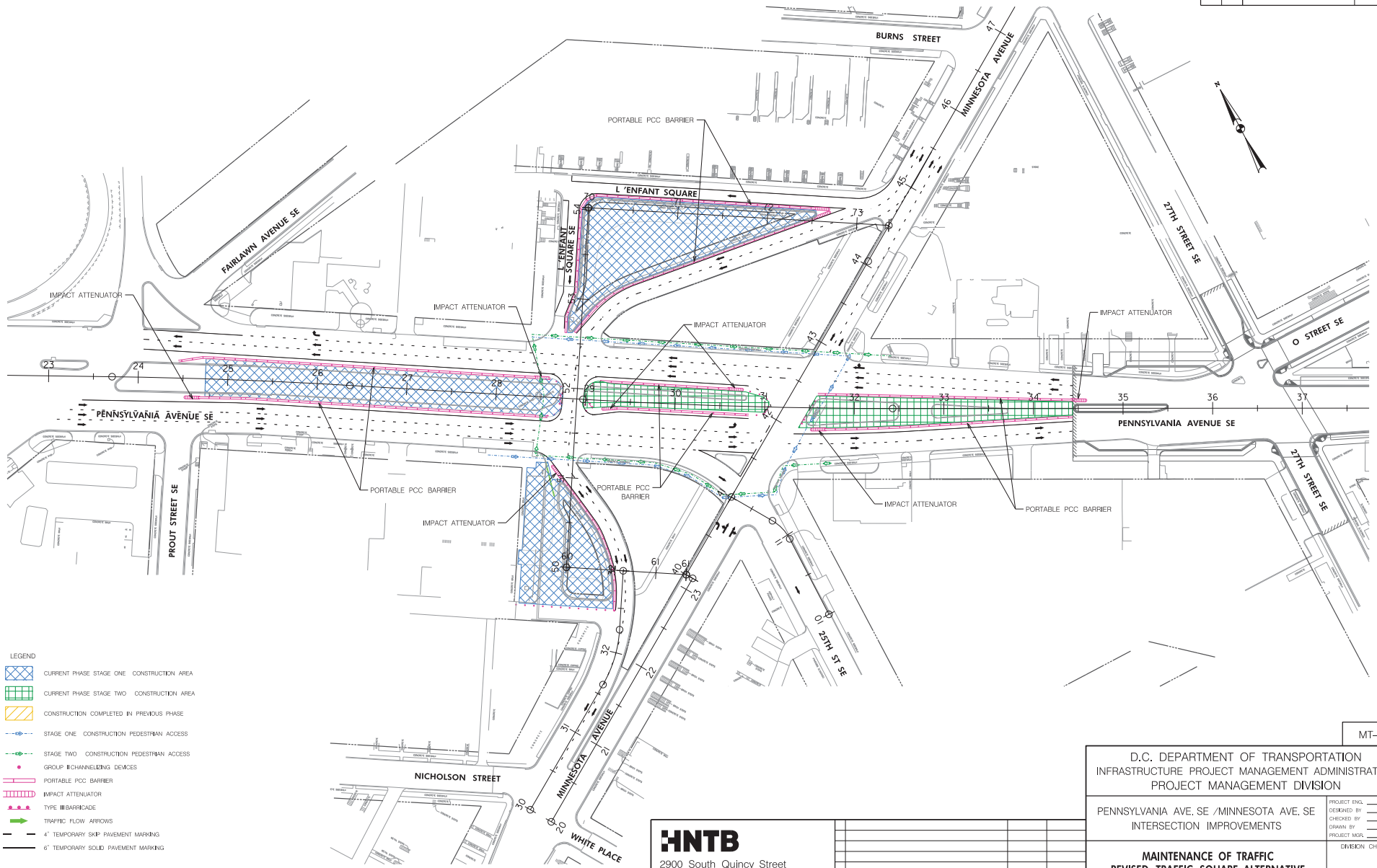
1.4.4 Maintenance of Traffic

It is estimated that both of the Build Alternatives would take approximately 18-24 months to construct (two construction seasons). Potential Maintenance of Traffic (MOT) plans were developed in order to determine the approximate length of construction. The MOT plans are included as Attachment 1 to this appendix. MOT plans were developed for the Revised Square Alternative only; however the MOT for the Conventional Square Alternative would be comparable as they both have the same number of phases.

1.4.5 Summary of Key Findings

- In the opening year 2015, both the No Build and Revised Square Alternatives would operate adequately (LOS D or better) at the intersections of Pennsylvania at Minnesota Avenue and L'Enfant Square, SE. The Conventional Intersection Alternative would experience heavy congestion (LOS F) in the AM peak.
- In 2040, due to the increased traffic demand, all three alternatives would be operating at undesirable LOS F with heavy congestion.
- Both Revised Square and Conventional Intersection Alternatives would cause longer queues, compared to the No Build Alternative, on Pennsylvania Avenue at Minnesota Avenue, SE in the peak travel direction during AM and PM peak hours.
- Compared to the No Build Alternative, the Revised Square Alternative would increase travel times on most vehicular trips due to the traffic being rerouted around the square. The Conventional Intersection Alternative would reduce travel times on the majority of trips in 2015, but would have increased times over the No Build Alterative in over half of the trips by 2040.
- Both Revised Square and Conventional Intersection Alternatives would enhance pedestrian and bicyclist safety via geometry upgrades and traffic management measures, including new bulb-outs, sidewalk expansion, crosswalk reconfiguration, traffic movement restrictions and traffic signalization.
- Both Revised Square and Conventional Intersection Alternatives would relocate a few bus stops to fit in the proposed roadway geometry.

ATTACHMENT 1:
Maintenance of Traffic: Revised Square (Example)



REG.	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
3	D.C.			

MT–01

D.C. DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE PROJECT MANAGEMENT ADMINISTRATION
PROJECT MANAGEMENT DIVISION

PENNSYLVANIA AVE. SE /MINNESOTA AVE. SE
INTERSECTION IMPROVEMENTS

MAINTENANCE OF TRAFFIC
REVISED TRAFFIC SQUARE ALTERNATIVE
PHASE ONE

PROJECT ENG. XX
DESIGNED BY XX
CHECKED BY XX
DRAWN BY XX
PROJECT MGR. XX

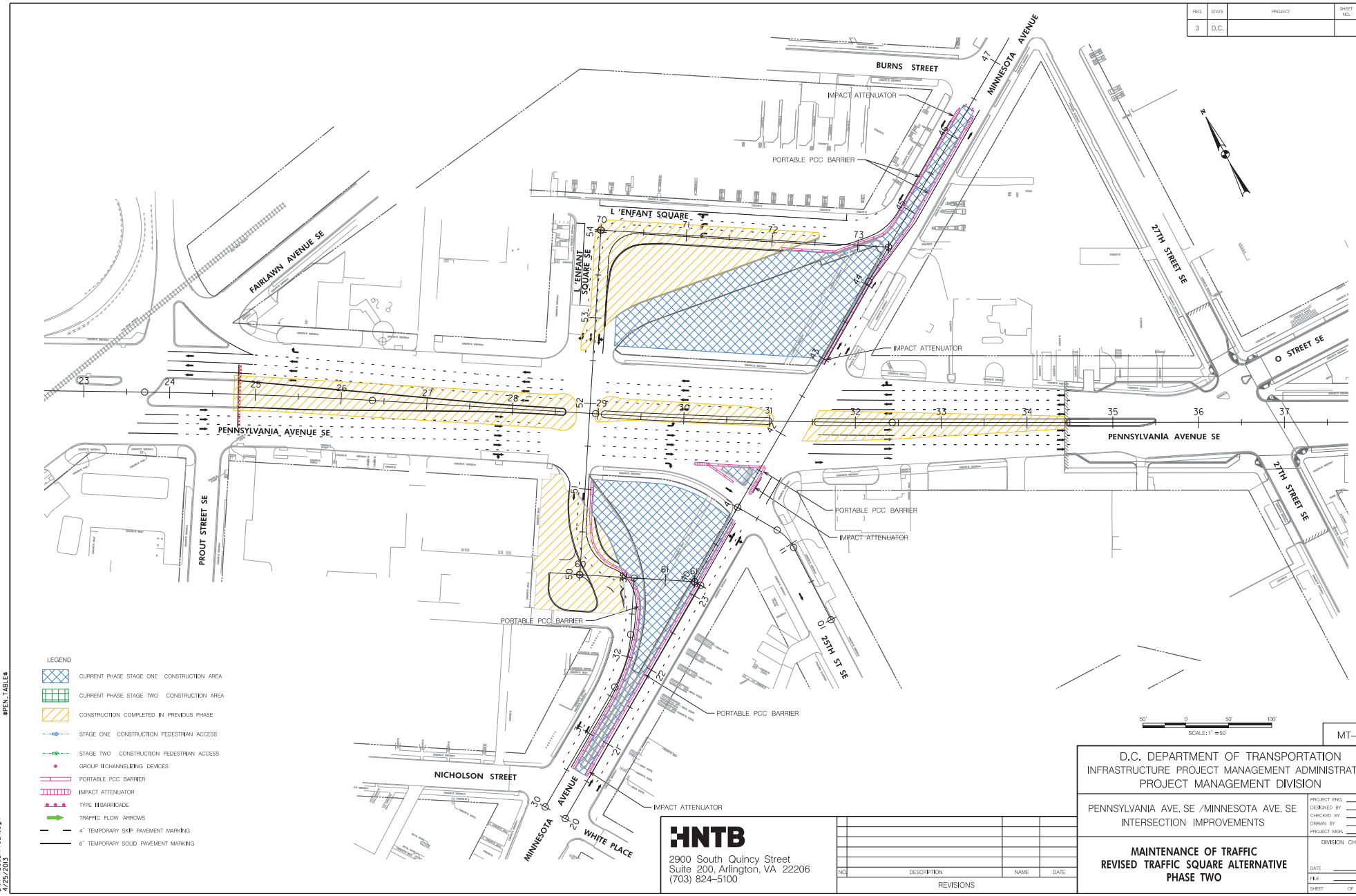
DIVISION CHIEF
DATE
FILE
SHEET OF

HNTB
2900 South Quincy Street
Suite 200, Arlington, VA 22206
(703) 824–5100

NO.	DESCRIPTION	NAME	DATE
	REVISIONS		

PEN_TABLE

pMT-PI00_AI102A.dgn
4/25/2013



REG.	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
3	D.C.			

MT–02

D.C. DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE PROJECT MANAGEMENT ADMINISTRATION
PROJECT MANAGEMENT DIVISION

PENNSYLVANIA AVE. SE /MINNESOTA AVE. SE
INTERSECTION IMPROVEMENTS

MAINTENANCE OF TRAFFIC
REVISED TRAFFIC SQUARE ALTERNATIVE
PHASE TWO

PROJECT ENG. XX
DESIGNED BY XX
CHECKED BY XX
DRAWN BY XX
PROJECT MGR. XX

DIVISION CHIEF
DATE
FILE
SHEET OF

HNTB
2900 South Quincy Street
Suite 200, Arlington, VA 22206
(703) 824–5100

NO.	DESCRIPTION	NAME	DATE
	REVISIONS		

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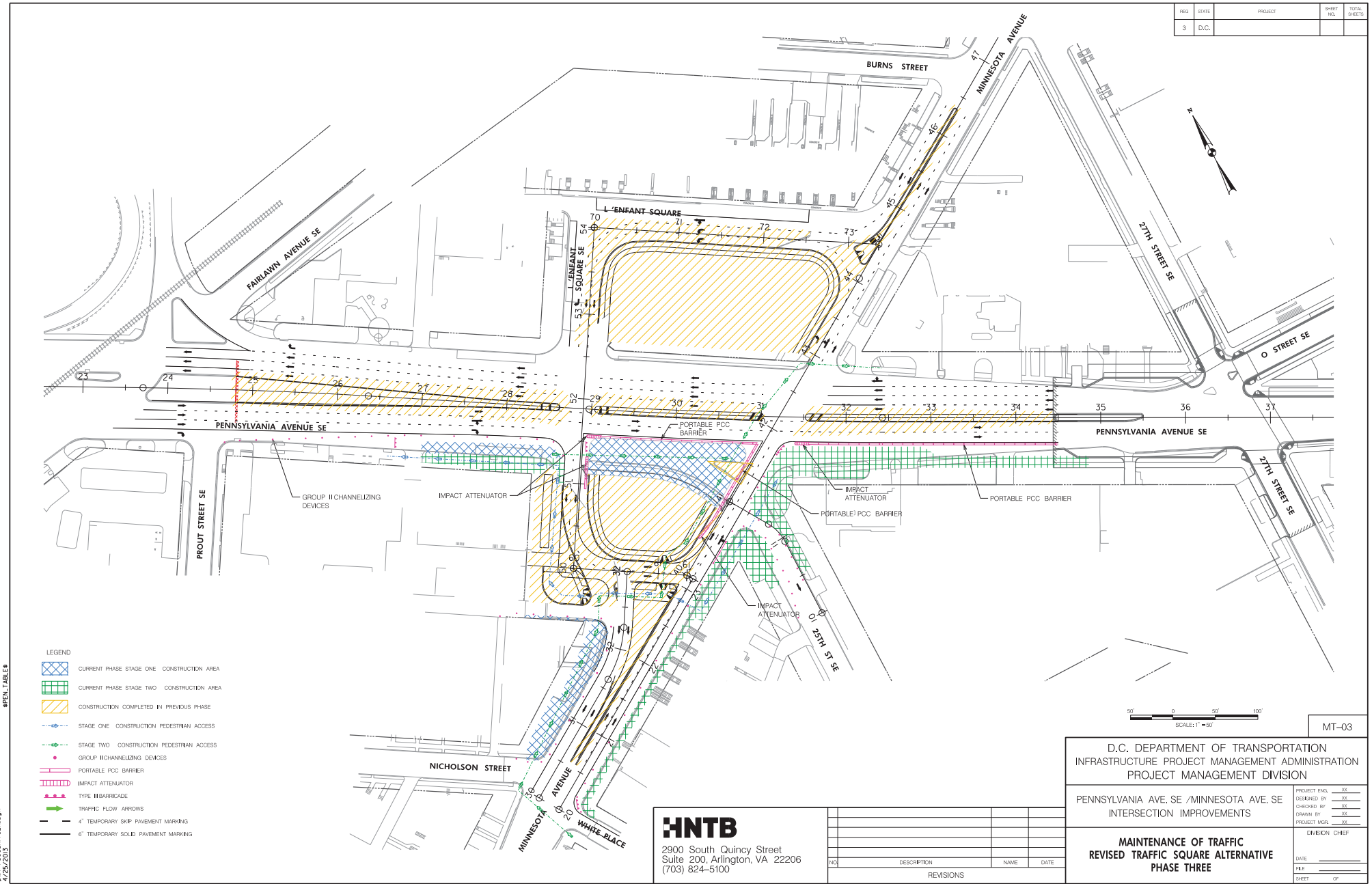


REG.	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
3	D.C.			

MT–03

D.C. DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE PROJECT MANAGEMENT ADMINISTRATION
PROJECT MANAGEMENT DIVISION

PENNSYLVANIA AVE. SE /MINNESOTA AVE. SE
INTERSECTION IMPROVEMENTS

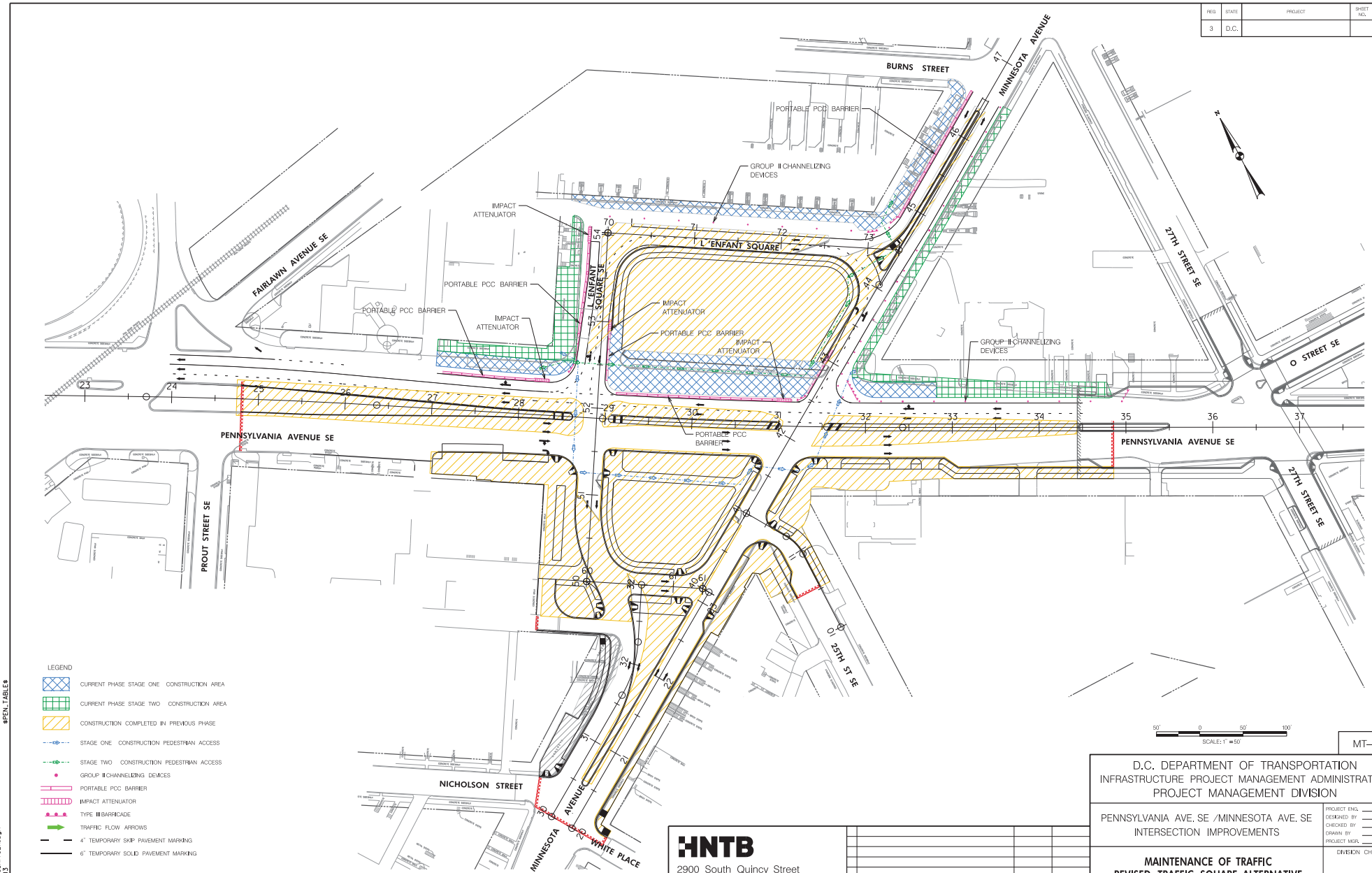
MAINTENANCE OF TRAFFIC
REVISED TRAFFIC SQUARE ALTERNATIVE
PHASE THREE

PROJECT ENG. XX
DESIGNED BY XX
CHECKED BY XX
DRAWN BY XX
PROJECT MGR. XX
DIVISION CHIEF
DATE
FILE
SHEET OF

HNTB
2900 South Quincy Street
Suite 200, Arlington, VA 22206
(703) 824–5100

NO.	DESCRIPTION	NAME	DATE
	REVISIONS		

PEN_TABLE
pMT-P300, AI102A.dgn
4/25/2013



REG.	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
3	D.C.			

MT–04

D.C. DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE PROJECT MANAGEMENT ADMINISTRATION
PROJECT MANAGEMENT DIVISION

PENNSYLVANIA AVE. SE /MINNESOTA AVE. SE
INTERSECTION IMPROVEMENTS

MAINTENANCE OF TRAFFIC
REVISED TRAFFIC SQUARE ALTERNATIVE
PHASE FOUR

PROJECT ENG. XX
DESIGNED BY XX
CHECKED BY XX
DRAWN BY XX
PROJECT MGR. XX
DIVISION CHIEF
DATE
FILE
SHEET OF

HNTB
2900 South Quincy Street
Suite 200, Arlington, VA 22206
(703) 824–5100

NO.	DESCRIPTION	NAME	DATE
	REVISIONS		

PEN_TABLE
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4/25/2013