EISENHOWER AVENUE WIDENING

CITY OF ALEXANDRIA, VIRGINIA

CORRIDOR-WIDE TRAFFIC IMPACT STUDY REPORT

AMT Project File 106-425.001T

PREPARED FOR:

City of Alexandria
Transportation and Environmental Services

PREPARED BY:

A. Morton Thomas and Associates, Inc.
Consulting Engineers

DATE:

November 16th, 2009

This revised report, dated November 16th, 2009, supersedes any previously submitted traffic impact study report prepared by AMT (i.e. the original June 2, 2008 and July 28, 2008 reports).

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SECTION 1: INTRODUCTION

This report presents the results of a corridor-wide traffic impact analyses conducted along Eisenhower Avenue. The project limits are bound between the "Gateway" traffic circle at Holland Lane and Stovall Street just east of the Telegraph Road bridge approach, in the City of Alexandria, Virginia. The study area is shown on Figure 1.

The cornerstone of this project is the Eisenhower East Small Area Plan, which establishes the growth characteristics and vision that the City, business owners, and residents have collectively established for the East Eisenhower corridor. Similarly, the East Eisenhower Valley Traffic Study and recently approved Eisenhower East Design Guidelines helped to shape the criteria and conceptual guidelines used to plan the development of this gateway corridor.

The East Eisenhower corridor is to develop as an anchor for commercial development with thriving retail centers at street level and a mixture of residential and business uses above. In order to accomplish the long-term goal, Eisenhower Avenue is to become the arterial roadway for the development of a supporting street grid system. In addition, Eisenhower Avenue will welcome visitors to the City's Old Towne section with the vision of a "Gateway" or "Grand Boulevard." The concept of Eisenhower Avenue is to increase the median green space from west to east as one approaches the vast green spaces of the African American Heritage Park and the Alexandria National Cemetery.

As part of the planning process, AMT developed traffic roadway network models to evaluate the impacts of the new Beltway ramps at Mill Road and Stovall Street, numerous planned developments as per the East Eisenhower Valley plan, annual growth along the corridor and surrounding areas, and the redevelopment of the Eisenhower Avenue Metro Station. Traffic forecasts were developed for the years 2010 and 2032. Left-turn queues, delays along eastbound and westbound Eisenhower Avenue, levels of service at all approaches, and travel times through the corridor during both the AM and PM peak hours were measured for existing and future conditions and improvements options were recommended as necessary.

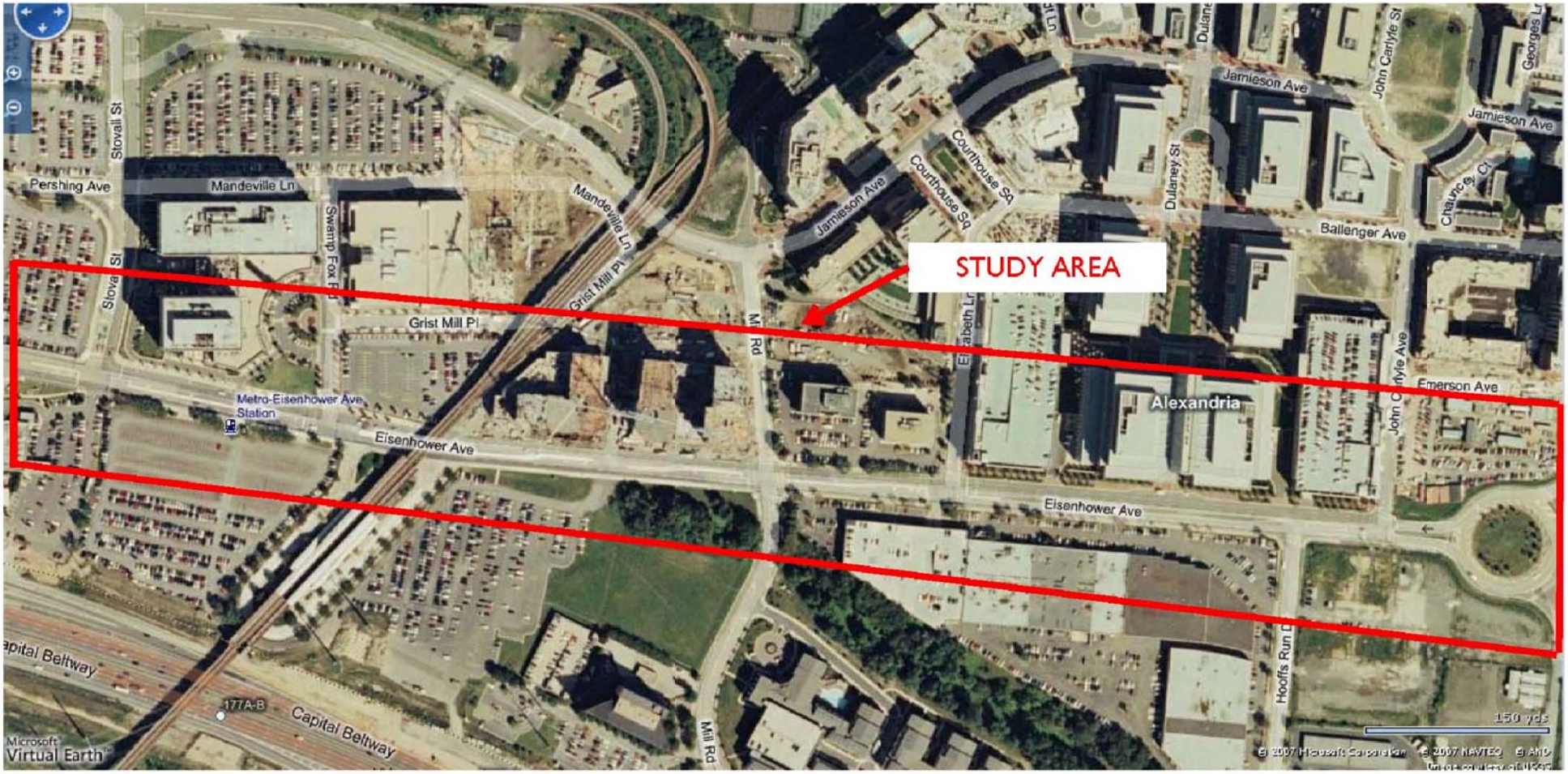

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								FIGURE 1 SITE LOCATION			N/A	106-425.001T
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SECTION 2: EXISTING CONDITIONS

2-1 Existing Turning Movement and Directional Counts

Existing AM and PM turning movement counts were conducted by A. Morton Thomas & Associates on Tuesday, January 29, 2008, and Wednesday, January 30, 2008, from 6:00AM to 7:00PM at the following locations:

1. Eisenhower Avenue at John Carlyle Street.
2. Eisenhower Avenue at Elizabeth Lane.
3. Eisenhower Avenue at Mill Road.
4. Eisenhower Avenue at Mill Race Lane.
5. Eisenhower Avenue at Swamp Fox Road and WMATA Drive.
6. Eisenhower Avenue at Stovall Street and Holiday Inn Driveway.

The peak hour turning movements at Holland Lane were determined using the available through movement count information at John Carlyle Street. No additional turning movement counts were collected and any assumptions were based on field observations.

The existing lane use and traffic control at the key intersections is shown on Figure 2.

In addition, AM and PM peak hour turning movement counts were also collected by AMT on Wednesday, June 11, 2008, at the intersection of Mill Road and the existing Apartment Complex driveway. The purpose of this data collection was to understand existing field conditions along Mill Road, south of Eisenhower Avenue, where the then-planned I-495 on/off-ramps were to be located.

The traffic turning movement counts indicated that the AM peak hour occurred generally between 7:00AM and 8:00AM, and the PM peak hour occurred generally between 5:00PM and 6:00PM. The majority of the traffic along Eisenhower Avenue traveled eastbound during the AM peak hour towards the District of Columbia and businesses and westbound during the PM peak hour towards residential neighborhoods. The turning movement count sheets are included in Appendix A.

The existing 2008 AM and PM peak hour volumes were balanced in order to obtain a percentage error of less than 10% between adjacent intersections along Eisenhower Avenue. However, parking lot and business entrances were taken into consideration when balancing traffic. The 2008 balanced AM and PM peak hour traffic volumes are shown on Figure 3.

Directional counts were also collected along Eisenhower Avenue at four separate locations and indicated that the current ADT is approximately 13,550 vehicles. The directional count data sheets are included in Appendix A.

2-2 Existing Traffic Signal Timings/Phasing

The existing traffic signal timings/phasing were obtained from the City of Alexandria and checked against field conditions. These signal timings/phasing are included in the Synchro models for both AM and PM peak hour conditions.

2-3 Analysis Methodology

The levels of service (LOS), delays, queues, volume to capacity ratios (v/c) and travel times were determined based on the existing and proposed lane use and traffic control, the AM and PM peak hour volumes, and the Synchro/SimTraffic methodology based on the 2000 Highway Capacity Manual (HCM).

Synchro is a macroscopic capacity analysis and optimization modeling program, where the user can enter the traffic data into a single file and obtain a measure of delays, queues, and levels of service at unsignalized and signalized intersections. Synchro considers all the intersections along a road network and can optimize traffic signals, as well as minimize delays and stops.

Levels of service are a qualitative measure of the operations of an intersection whereby a letter grade of A through F is assigned in order of decreasing performance. "Average control delay per vehicle" or average delay per vehicle due to any intersection traffic control device is used to select the appropriate LOS. Two-way stop-controlled and signalized intersections use slightly different threshold values as follows:

Level of Service	Description	Delay per Vehicle (Seconds/Vehicle)	
		Signalized Intersection	Stop-Sign Controlled Intersection
A	Free Flow	≤ 10	0 - 10
B	Stable Flow (slight delay)	> 10 - 20	> 10 - 15
C	Stable Flow (acceptable delay)	> 20 - 35	> 15 - 25
D	Approaching Unstable Flow (tolerable delay)	> 35 - 55	> 25 - 35
E	Unstable Flow (approaching intolerable delay)	> 55 - 80	> 35 - 50
F	Forced Flow (jammed)	> 80	> 50

SimTraffic is a microscopic simulation program that uses the Synchro outputs to visually illustrate how well the unsignalized/signalized intersections or corridor operates. It visually represents congested intersections, bottlenecks, and provides measures of effectiveness (MOE's) such as network vehicle delay, travel times, etc.

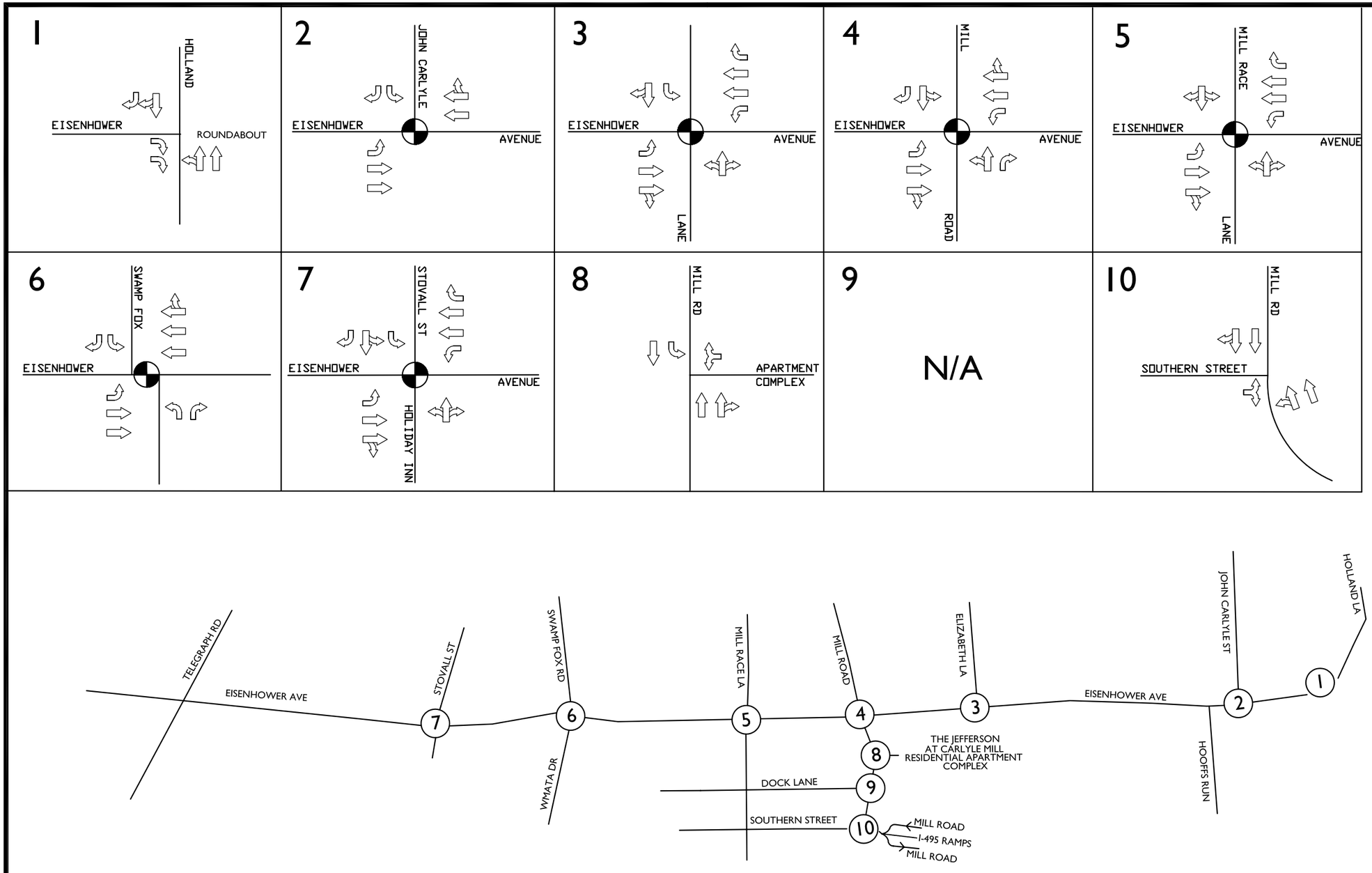
2-4 Existing Conditions Analyses

Existing levels of service (LOS) were determined at each of the key intersections based on the existing lane use and traffic control (Figure 2), existing AM and PM peak hour volumes (Figure 3), and the Synchro methodology based on the 2000 Highway Capacity Manual (HCM).

The results of the existing analyses are summarized in Tables 1 and 2.

Table 1 indicates that all key intersections currently operate at overall acceptable LOS during both the AM and PM peak hours. The individual approaches at each key intersection were also found to operate at acceptable LOS during both the AM and PM peak hours.

Table 2 contains the existing left turning 95th percentile queues (as reported by Synchro) compared to the existing left turn storage lengths. The left turning queues are generally well contained by the available storage lengths, except at the intersection of Eisenhower Avenue/Stovall Street, where the southbound left turns are not contained in the dual-left turning lanes currently provided.



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EISENHOWER AVENUE WIDENING CORRIDOR-WIDE TRAFFIC IMPACT ANALYSIS

FIGURE 2
EXISTING LANE USE AND TRAFFIC CONTROL

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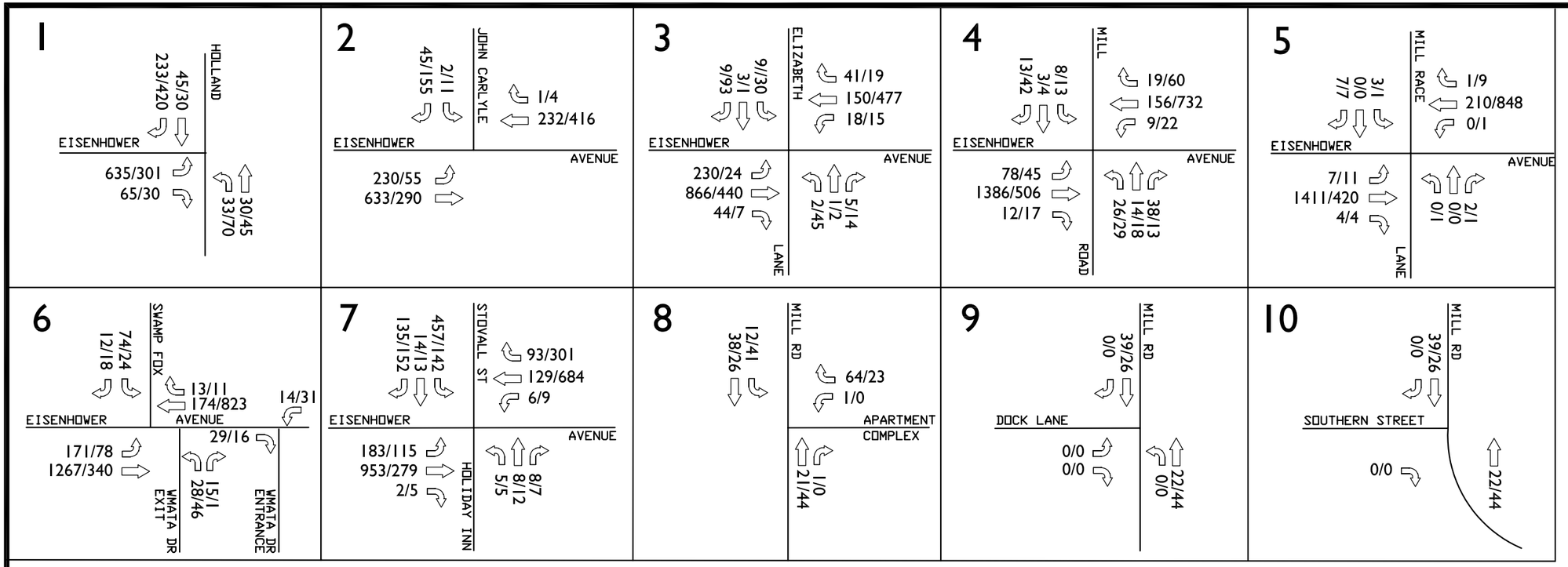

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EISENHOWER AVENUE WIDENING CORRIDOR-WIDE TRAFFIC IMPACT ANALYSIS

FIGURE 3

2008 EXISTING AM/PM PEAK HOUR VOLUMES

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Table 1
Intersection Level of Service Summary [1]
Eisenhower Avenue Widening

Location	Control	Existing Conditions AM Peak Hour	Existing Conditions PM Peak Hour
1. Eisenhower Ave./Holland Lane	Roundabout	B	A
2. Eisenhower Ave/John Carlyle Street	Signal		
Eastbound		A(0.2)	A(3.7)
Westbound		A(4.0)	A(4.9)
Southbound		D(51.3)	D(50.4)
Overall		**A(3.1)**	**B(12.6)**
3. Eisenhower Ave/Elizabeth Lane	Signal		
Eastbound		A(1.0)	B(12.2)
Westbound		B(10.2)	A(7.0)
Northbound		C(33.9)	D(39.5)
Southbound		C(34.1)	D(37.3)
Overall		**A(3.1)**	**B(14.0)**
4. Eisenhower Ave/Mill Road	Signal		
Eastbound		C(29.0)	B(12.9)
Westbound		B(10.4)	C(20.8)
Northbound		C(24.7)	C(24.9)
Southbound		C(24.3)	C(24.5)
Overall		**C(26.8)**	**B(18.1)**
5. Eisenhower Ave/Mill Race Lane	Signal		
Eastbound		A(1.2)	A(1.5)
Westbound		A(2.9)	A(1.4)
Northbound		D(51.5)	D(51.6)
Southbound		D(51.8)	D(51.6)
Overall		**A(1.8)**	**A(1.8)**
6. Eisenhower Ave/Swamp Fox Road	Signal		
Eastbound		B(18.2)	B(14.5)
Westbound		C(32.1)	A(7.2)
Northbound		D(54.7)	D(53.8)
Southbound		D(37.1)	D(35.1)
Overall		**C(21.5)**	**B(12.0)**
7. Eisenhower Ave/Stovall Street	Signal		
Eastbound		B(15.3)	A(7.5)
Westbound		A(4.4)	C(28.1)
Northbound		D(53.1)	D(51.9)
Southbound		D(47.1)	D(45.1)
Overall		**C(24.1)**	**C(26.7)**

[1] Based on the Synchro/SimTraffic 6.0 methodology

Table 2
Left Turn Queue Summary
Eisenhower Avenue Widening

Location	Storage Length (ft)	Existing Conditions AM Queue (ft)	Existing Conditions PM Queue (ft)
1. Eisenhower Ave./Holland Ln.			
Eastbound L	N/A	0	0
Eastbound R	N/A	0	0
2. Eisenhower Ave/John Carlyle Street			
Eastbound L	160	5	42
3. Eisenhower Ave/Elizabeth Lane			
Eastbound L	110	m8	25
Westbound L	105	11	m7
4. Eisenhower Ave/Mill Road			
Eastbound L	150	22	14
Westbound L	180	6	12
5. Eisenhower Ave/Mill Race Lane			
Eastbound L	125	5	5
6. Eisenhower Ave/Swamp Fox Road			
Eastbound L	65	m68	42
Northbound L	N/A	52	74
Southbound L	80	94	40
7. Eisenhower Ave/Stovall Street			
Eastbound L	150	139	83
Westbound L	350	5	m14
Southbound L	130	286	110

[1] Based on the Synchro/SimTraffic 6.0 methodology & the 95th percentile queue methodology.

SECTION 3: FUTURE CONDITIONS

3-1 Annual Growth Rate

An annual growth rate of 2.0% was applied directly to all movements at each key intersection to the future conditions year 2010, similarly to the annual growth rate of 2% utilized for the *East Eisenhower Valley Traffic Study*, prepared by Wilbur Smith Associates and dated January 2002.

For the 2032 design year forecasts (plus 22 years per VDOT requirements), the forecasts were based on the 2010 forecasts plus an annual growth rate of 2.0% to the year 2020, after which a smaller growth rate was applied to the year 2032. The smaller annual growth rate was applied to the year 2032 using careful engineering judgment to avoid using both an unrealistic growth rate and extensive pipeline development information, which would eliminate all available capacity at the key intersections during future conditions.

3-2 2010 and 2032 Pipeline Developments (Trip Generation and Assignments)

Through scoping meetings with the City of Alexandria staff in April 2008 and February 2009, several pipeline developments were identified and included in the future conditions forecasts for the years 2010 and 2032. Approximately a week after the turning movement counts were collected, AMT staff conducted an extensive field visit to identify the pipeline developments where construction has not begun, those under construction at the time of the counts, and those completed and in use by the intended users. The intent was to ensure that no trips were double-counted. A map included in Appendix C also shows the location of each pipeline development (both for 2010 and 2032) along the Eisenhower Avenue corridor.

Ten (10) pipeline developments were identified to be built and occupied by the year 2010 future conditions and are included in Table C-1 in Appendix C. The site trip generation was conducted per the Institute of Transportation Engineers (ITE) Trip Generation Manual Rates, 7th Edition. It is anticipated that the planned developments in 2010 will generate an additional 2,153 AM peak hours trips (1,381 in and 772 out), 2,722 PM peak hour trips (1,084 in and 1,638 out), and 25,544 ADT. The total site trip distribution and assignments for these pipeline developments are shown on Figure C-1.

Fifteen (15) additional pipeline developments were identified to be built and occupied by the year 2032 future conditions and are included in Table C-2, also in Appendix C. The site trip generation for these pipeline developments was also generated using the ITE Trip Generation Manual Rates. It is anticipated that the planned developments in 2032 will generate an additional 4,554 AM peak hour trips (3,406 in and 1,148 out), 5,171 PM peak hour trips (1,615 in and 3,556 out), and 43,965 ADT. The total site trip distribution and assignments for these pipeline developments are shown on Figure C-2.

For both the 2010 and 2032 future years, the following trip reductions were applied to the various land uses: a) a transit reduction was assumed based on the 2000 US Census Data (Table P30 – Means of Transportation to Work data), b) trip reductions assumed for both the *East Eisenhower Valley Traffic Study*, prepared by Wilbur Smith Associates and dated January 2002, and the *Hoffman Master Plan, Traffic Impact Analysis*, prepared by BMI-SG/VHB and dated August 2005, c) *Eisenhower Avenue Station Access Improvement Study* prepared by Washington Metropolitan Area Transit Authority and dated September 2008, d) existing transit services provided along Eisenhower

Avenue, as well as future anticipated increased service as shown below in the table titled *Transit Service on Eisenhower Avenue*, and e) internal capture.

Transit Service on Eisenhower Avenue

Route	Limits	Buses/Hr. Existing	Buses/Hr. 2020	Buses/Hr. 2030
DASH AT1	Eisenhower Metro to Points West	2 (peak hours only)	4	4
DASH AT6	Eisenhower Metro to Mill Road	2 (peak hours only)	4	4
DASH AT7	West of Mill Street	2	4	4
DASH Eisenhower Collector (NEW)	Holland to Stovall	0	6	6
Rex (WMATA)	Mill to Telegraph	5	5	5
Total		11	23	23

Source: DASH Transit Performance and Service Expansion Plan-September 2008

3-3 2010 and 2032 Future Conditions Forecasts

The 2010 and 2032 future conditions forecasts were determined based on the combination of the existing AM and PM peak hour volumes (Figure 3), the annual growth rate, and the pipeline development site trips (Figures C-2 or C-4). The forecasts for both 2010 and 2032 future conditions are located in Appendix D. The total 2010 future conditions peak hour forecasts are shown on Figure 4 and the total 2032 future conditions peak hour forecasts are shown on Figure 5.

In addition, the following proposed modifications to the existing roadway network were taken into consideration when the 2010 and 2032 future conditions forecasts were prepared:

1. Existing Parking Garage and Lots:
   The trips generated by the existing parking garage and lots across from Elizabeth Lane were removed from the road network for both 2010 and 2032 future conditions forecasts.

2. Mill Road/I-495 Ramps:
   As part of the Woodrow Wilson Bridge Project, Ramps K and L were constructed to tie-into Mill Road, just south of Eisenhower Avenue. Ramp K will route traffic from westbound I-495 onto Mill Road and Ramp L will route traffic from Mill Road to eastbound I-495. The proposed ramps are currently completed and open to traffic in both directions. This has and will continue to affect existing traffic patterns and the ramps were therefore taken into consideration for both the 2010 and 2032 future conditions forecasts.

3. Stovall Street/I-495/Telegraph Road Ramps:
   As part of the Woodrow Wilson Bridge Project, Ramps A-1 and A-2 are proposed to tie-into Eisenhower Avenue across from Stovall Street to provide congestion relief along

southbound Stovall Street. Ramp A-1 will route traffic from eastbound I-495 onto Eisenhower Avenue or northbound Telegraph Road, while Ramp A-2 will route northbound Telegraph Road traffic onto Eisenhower Avenue. The proposed ramps will affect existing traffic patterns and were taken into consideration for the 2032 future conditions forecasts only since construction is planned to be completed after the year 2010 (as discussed during the scoping process with the City of Alexandria).

4. Holland Lane and Eisenhower Avenue:
   The traffic circle at this intersection is proposed to be converted to a 3-way signalized intersection.

5. WMATA Metro Station:
   At the time of the turning movement counts, the majority of the parking lots associated with the Metro Station were not in use and access was restricted. The WMATA Station at the entrance-only (used primarily for buses) was added using traffic projections from previously approved traffic studies (*Hoffman Master Plan, Traffic Impact Analysis*). The proposed lane configuration at the WMATA Metro Station is included in Appendix C and was taken from *Eisenhower Avenue Station Access improvement Study* prepared by WMATA, dated September 2008.

6. Southern Street/Dock Lane
   As part of the redevelopment program, the redevelopment of Parcels 19 and 20 includes additional internal access via Southern Street and Dock Lane. Southern Street currently exists and is not in use. Dock Lane is proposed to be located just north of Southern Street, with access via Mill Road and Mill Race Lane. Since access to/from Southern Street is still under discussion (due mainly to restrictions from the newly opened I-495 ramps), traffic operations for purposes of this study have temporarily been assumed to be as follows: Southern Street operates as right-in/right-out and is un-signalized, while Dock Lane operates with all movements allowed with signal control. As the planning and design for Parcels 19 and 20 are finalized, this study will be revised to include the final configuration of both roadways, as well as discuss their impacts on the overall corridor.

Based on the 2032 forecasts, trip generation, and trip assignments, the 2032 ADT was determined to be approximately 45,000 throughout the corridor. It is important to note that this ADT is based on the assumptions assumed to develop the forecasts and may vary as traffic conditions stabilize. The ADT for 2032 conditions is likely to increase (closer to ~50,000) as additional traffic utilizes the I-495 ramps to access the businesses and retail areas along Eisenhower Avenue, Duke Street, and others.

In addition, it is anticipated that the heavy vehicle/truck traffic percentage throughout the corridor will range between 3- to 7-percent, which is acceptable compared to the latest I-495, Route 1, Washington Street, and Woodrow Wilson Bridge traffic studies that have been conducted recently.

3-4 Planned/Full Build-Out Lane Use

The planned/full build-out lane use and traffic control are based on the proposed improvements from the *East Eisenhower Valley Traffic Study* and the *Hoffman Master Plan, Traffic Impact Analysis*, and supplemented by various reviews and monthly meeting updates with the City of Alexandria agencies. The 2010 and 2032 future conditions modeling analyses are based on these recommended improvements, shown on Figure 6. It is important to note that as the design process continues,

some of the recommended improvements will likely be included in the final plans, while right-of-way and other constraints may hinder or prevent the construction of others.

3-5 Pedestrian Facilities

Numerous pedestrian improvements are recommended as part of this widening project, including ADA compliant sidewalks, sufficient crosswalks (especially to serve the WMATA Metro station, retail, residential, office areas, etc), sufficient crossing clearance, and efficient pedestrian signals throughout the corridor. As part of the Synchro/SimTraffic modeling efforts, pedestrian walking speeds were assumed at 3.5 ft/sec throughout the corridor, which meets the City of Alexandria's criteria for safe and sufficient pedestrian crossing.

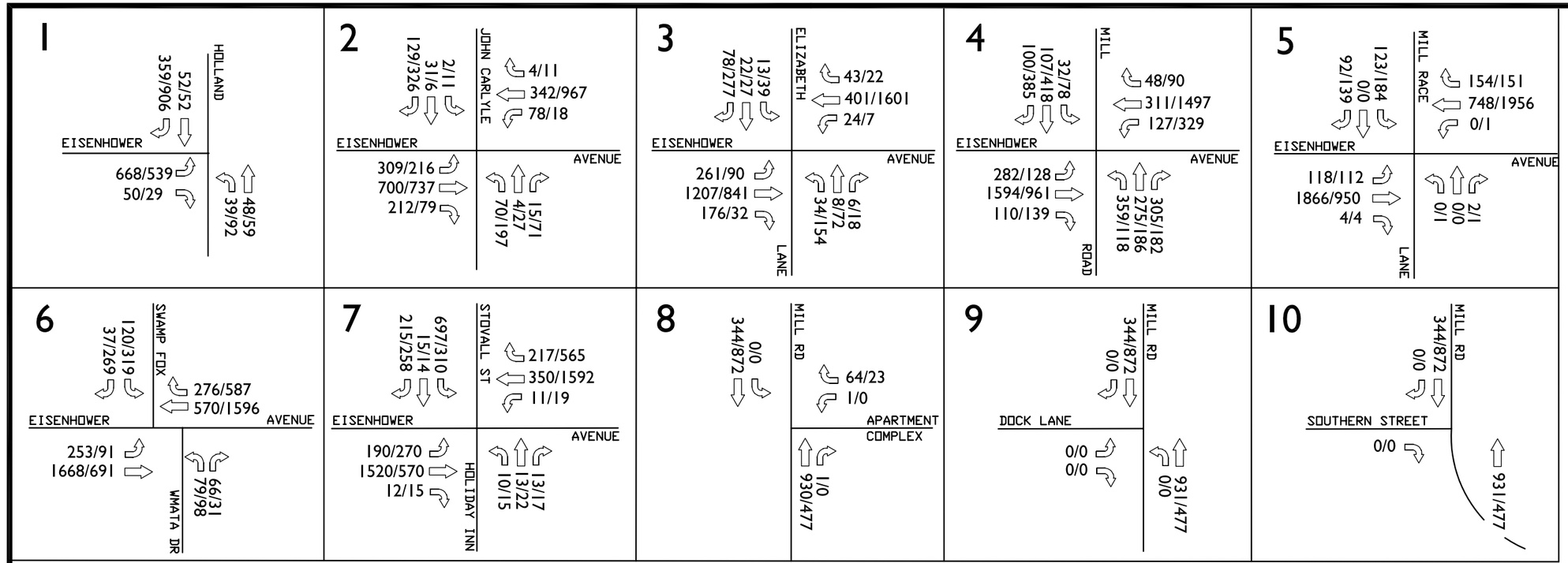

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FIGURE 4

2010 FUTURE CONDITIONS AM/PM PEAK HOUR VOLUMES

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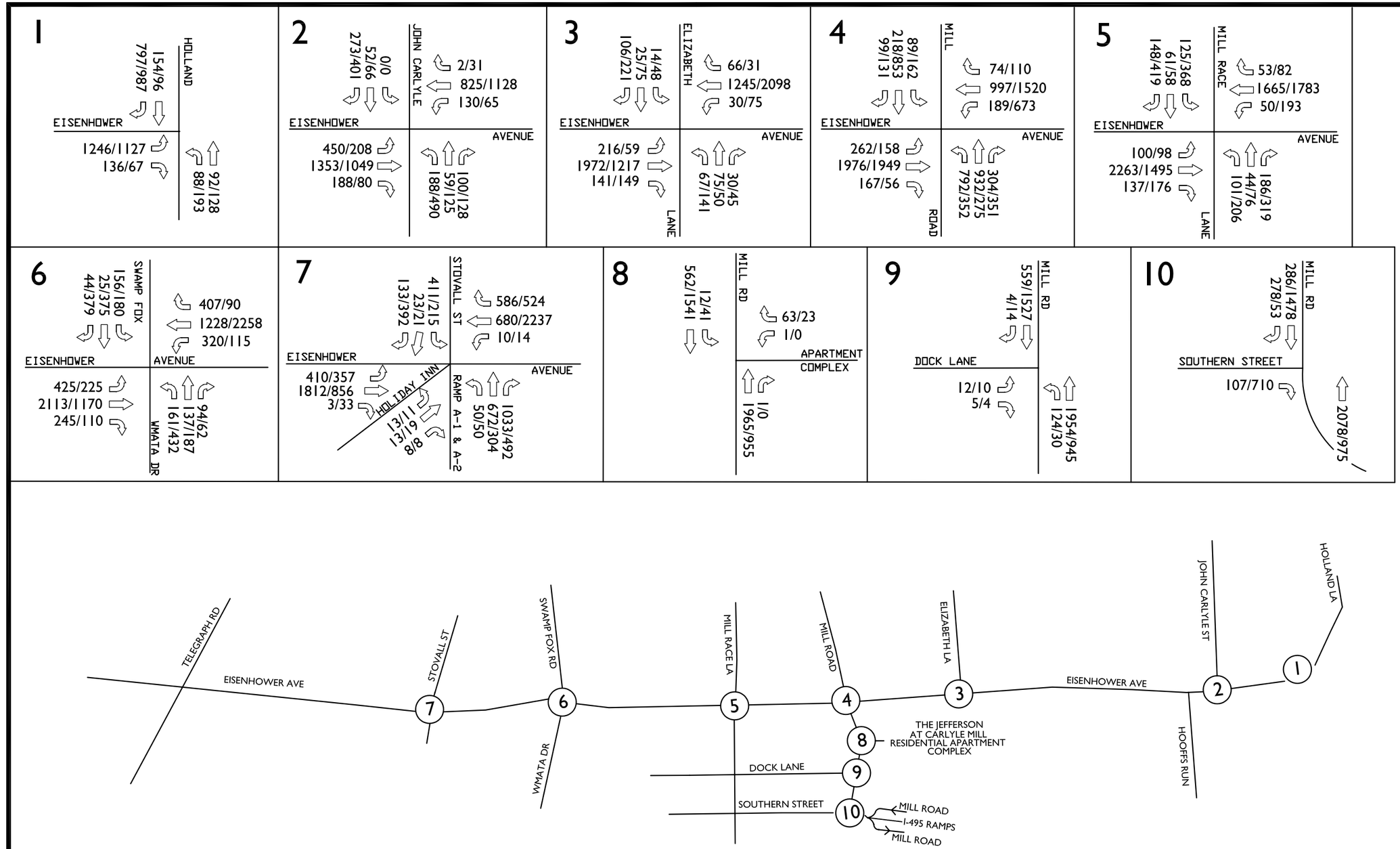

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EISENHOWER AVENUE WIDENING CORRIDOR-WIDE TRAFFIC IMPACT ANALYSIS

FIGURE 5

2032 FUTURE CONDITIONS AM/PM PEAK HOUR VOLUMES

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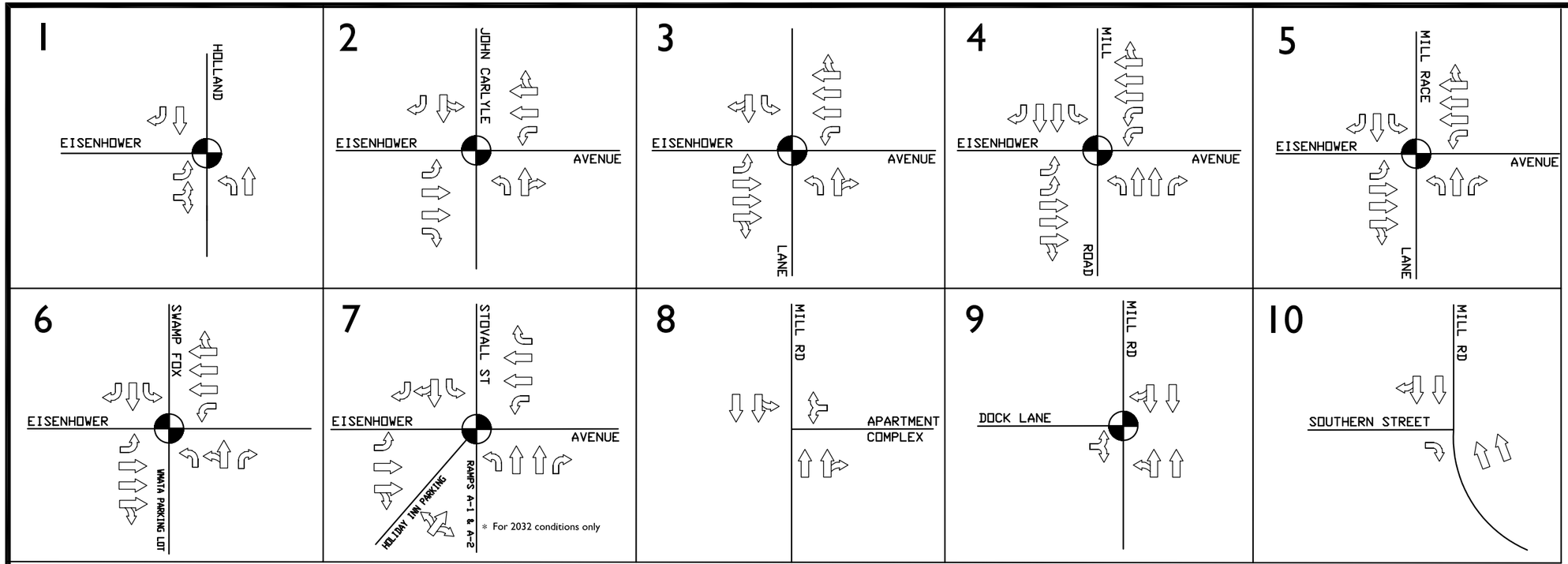
3-6 2010 Future Conditions Analyses

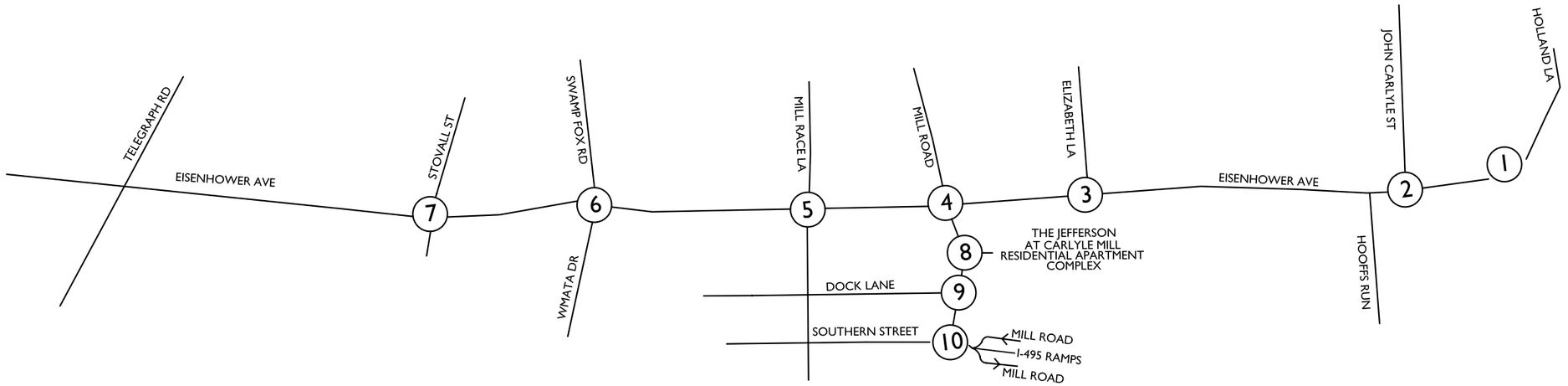
The 2010 future conditions levels of service, delays and queues were determined at each of the key intersections based on the planned/full build-out lane use and traffic control (Figure 6), the 2010 future conditions AM and PM peak hour volumes (Figure 4) and the Synchro methodology based on the 2000 Highway Capacity Manual (HCM).

The results of the 2010 future conditions analyses are summarized in Tables 3 and 4 and are included in Appendix E.

Table 3 summarizes the Synchro results and indicates that the majority of the key intersections will continue to operate at acceptable overall levels of service (with some reduction in capacity) during both AM and PM peak hours, except for the intersections of Swamp Fox Road and Stovall Street during the PM peak hour. Both are anticipated to operate at unacceptable LOS due mostly significantly high westbound traffic as users leave to return home.

Table 4 summarizes the left turning queues and indicates that they will continue to be generally well contained by the available storage lengths, except at the intersection of Eisenhower Stovall Street, Swamp Fox Road, and Mill Road. These excessive queues can be attributed to significantly high traffic volumes where traffic could be expected to spill over into the through lanes. It is important to note that the Synchro modeling has been calibrated to obtain the most efficient and safe vehicular and pedestrian timings and phasing, so it is expected that queues and delays will form along the corridor in certain key locations during the peak hours.





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AMT	AMT	AMT	AMT	ACAD	AMT

DATE	REVISION	BY	APP'R.

EISENHOWER AVENUE WIDENING CORRIDOR-WIDE TRAFFIC IMPACT ANALYSIS

FIGURE 6

2010 AND 2032 FUTURE/BUILD-OUT LANE USE AND TRAFFIC CONTROL

Scenario 1: 3 Through Lanes and Dual Left Turn Lanes

CITY OF ALEXANDRIA, VIRGINIA

SCALE	CONTOUR INTERVAL	A.M.T. FILE No.
	N/A	106-425.001T
DATE	TAX MAP No.	SHEET
OCTOBER 2009	N/A	

Table 3
Intersection Level of Service Summary [1]
Eisenhower Avenue Widening

Location	Control	Existing Conditions		2010 Future Conditions	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
1. Eisenhower Ave./ Holland Ln.	Roundabout Signal (2010)	B	A	A(9.4)	A(9.7)
2. Eisenhower Ave/John Carlyle Street	Signal	A(3.1)	B(12.6)	B(14.8)	C(22.1)
3. Eisenhower Ave/Elizabeth Lane	Signal	A(3.9)	B(14.0)	C(27.1)	C(26.6)
4. Eisenhower Ave/Mill Road	Signal	C(24.9)	B(18.1)	D(44.5)	D(39.8)
5. Eisenhower Ave/Mill Race Lane	Signal	A(1.6)	A(1.8)	A(8.6)	C(21.2)
6. Eisenhower Ave/Swamp Fox Road	Signal	C(21.8)	B(12.0)	E(56.7)	F(174.5)
7. Eisenhower Ave/Stovall Street	Signal	C(24.4)	C(26.7)	D(41.8)	F(128.7)

[1] Based on the Synchro/SimTraffic 6.0 methodology

Table 4
Left Turn Queue Summary
Eisenhower Avenue Widening

Location	Storage Length (ft)	Existing Conditions		Storage Length (ft)	2010 Future Conditions	
		AM Queue (ft)	PM Queue (ft)		AM Queue (ft)	PM Queue (ft)
1. Eisenhower Ave./ Holland Ln						
Eastbound L	N/A	0	0	450	197	71
Northbound L	N/A	0	0	75	78	156
2. Eisenhower Ave/John Carlyle Street						
Eastbound L	160	5	42	400	188	289
Westbound L	-	-	-	100	41	m12
Northbound L	-	-	-	400	113	280
3. Eisenhower Ave/Elizabeth Lane						
Eastbound L	110	m8	25	200	m151	m111
Westbound L	105	11	m7	150	16	m2
4. Eisenhower Ave/Mill Road						
Eastbound L	150	22	14	100	233	103
Westbound L	180	6	12	250	118	m242
Northbound L	-	-	-	300	383	134
Northbound R	-	-	-	200	251	82
Southbound R	-	-	-	100	42	455
5. Eisenhower Ave/Mill Race Lane						
Eastbound L	125	5	5	100	m12	m139
6. Eisenhower Ave/Swamp Fox Road						
Eastbound L	65	m68	42	200	398	m129
Northbound L	N/A	52	74	100	71	86
Northbound R	-	-	-	75	42	30
Southbound L	80	94	40	80	171	519
7. Eisenhower Ave/Stovall Street						
Eastbound L	150	139	83	150	127	533
Westbound L	350	5	m14	100	m12	m7
Westbound R	-	-	-	150	91	m2
Southbound L	130	286	110	200	634	448

[1] Based on the Synchro/SimTraffic 6.0 methodology & the 95th percentile queue methodology.

3-7 2032 Future Conditions Analyses

The 2032 future conditions levels of service, delays and queues were determined at each of the key intersections based on the proposed lane use (Figures 6,7 or 8), the 2032 future conditions AM and PM peak hour volumes (Figure 5), and the Synchro methodology based on the 2000 Highway Capacity Manual (HCM).

Three scenarios were analyzed to determine the full impacts of the anticipated traffic on the road network and the critical roadway improvements required to address these:

1. **Scenario 1** (as shown on Figure 6) proposes three-through lanes along Eisenhower Avenue in each direction (except in the vicinity of John Carlyle Street and Holland Lane, where two-through lanes in each direction would suffice). This scenario also includes dual westbound left turn lanes at Mill Road, to accommodate the heavy traffic traveling south towards the I-495 on-ramps.

2. **Scenario 2** (as shown on Figure 7) proposes two-through lanes along Eisenhower Avenue in each direction throughout the corridor, with exclusive right turn lanes between Swamp Fox Road and Elizabeth Lane. This scenario also includes single eastbound and westbound left turn lanes at Mill Road.

3. **Scenario 3** (as shown on Figure 8) proposes three-through lanes along Eisenhower Avenue in each direction (except in the vicinity of John Carlyle Street and Holland Lane, where two-through lanes in each direction would suffice). This scenario also includes single eastbound and westbound left turns at Mill Road.

The results of the 2032 future conditions analyses for all three scenarios are summarized in Tables 5 (LOS) and Table 6 (queues) and are included in Appendix F.

For all three scenarios, the results indicate that due to the high development growth rate along Eisenhower Avenue, the key intersections at Mill Road, Mill Race Lane, Swamp Fox Road, and Stovall Street will operate at unacceptable LOS during both the AM and PM peak hours. The roadway models include proposed roadway and traffic signal improvements along both Eisenhower Avenue and the side-streets required to provide enough capacity to handle the anticipated growth to 2032 future conditions and beyond.

A comparison of Scenarios 1 and 2 reveals that a three-through lane scenario handles anticipated 2032 traffic volumes more efficiently than a two-through lane scenario, especially at the key intersections of Mill Road, Swamp Fox Road, and Stovall Street. A two-through lane scenario results in extensive queues along both eastbound and westbound Eisenhower Avenue, especially in the vicinity of Mill Road, due in part to the I-495 future traffic.

A comparison of Scenarios 1 and 3 reveals that dual westbound and eastbound left turn lanes are critical to the successful operation of Mill Road at Eisenhower Avenue, especially from a vehicular capacity and pedestrian safety standpoint. Due to significant traffic traveling southbound towards the I-495 ramps, as well as traffic traveling northbound towards future pipeline developments, it is crucial that eastbound and westbound dual left turn lanes be provided at Mill Road in 2032 future conditions to alleviate traffic congestion and reduce queues and wait times that are anticipated to spill back through numerous intersections along the corridor.

AMT recommends that the following improvements be considered to mitigate anticipated traffic volumes during 2032 future conditions to address levels of service and 95th percentile queues impacts (these are included on Figure 6):

Eisenhower Avenue/Holland Lane
- ⇨ Proposed new traffic signal (overall 150 seconds cycle length) *ON FINAL PLANS*
- ⇨ New NB left turn lane with a storage length of 100 ft *ON FINAL PLANS*
- ⇨ Re-stripe EB Eisenhower Avenue to separate left and shared left/right turn lanes *ON FINAL PLANS*
- ⇨ Re-stripe SB Holland Lane to separate right and through lanes *ON FINAL PLANS*

Eisenhower Avenue/John Carlyle Street
- ⇨ New separate EB right turn lane (lane drops at Hoofs Run Drive) *ON FINAL PLANS*
- ⇨ Increase EB left turn lane storage length from 160 ft. to 400 ft *ON FINAL PLANS*
- ⇨ Separate single NB left turn lane with a storage length of 400 ft. with single shared through/right lane *ON FINAL PLANS*
- ⇨ New separate WB left turn lane with a storage length of 100 ft *ON FINAL PLANS*
- ⇨ Re-stripe SB left turn lane to shared through/left lane *ON FINAL PLANS*

Eisenhower Avenue/Elizabeth Lane
- ⇨ Additional EB through lane *ON FINAL PLANS*
- ⇨ New single separate NB left turn lane with a storage length of 75 ft *ON FINAL PLANS*
- ⇨ Additional WB through lane *ON FINAL PLANS*
- ⇨ Increase EB left turn lane storage length from 110 ft. to 200 ft *ON FINAL PLANS (140' max allowed)*
- ⇨ Increase WB left turn storage length from 105 ft. to 150 ft. *ON FINAL PLANS*

Eisenhower Avenue/Mill Road
- ⇨ New second separate EB left turn lane with a storage length of 100 ft *ON FINAL PLANS*
- ⇨ New second NB through lane *ON FINAL PLANS*
- ⇨ New NB left turn lane with a storage length of 300 ft *ON FINAL PLANS*
- ⇨ New NB right turn lane with a storage length of 200 ft *ON FINAL PLANS*
- ⇨ New second separate WB left turn lane with a storage length of 250 ft. and additional WB through lane *ON FINAL PLANS (210' max allowed)*
- ⇨ Additional SB through lane *ON FINAL PLANS*
- ⇨ New SB right turn lane with a storage length of 100 ft *ON FINAL PLANS*

Eisenhower Avenue/Mill Race Lane
- ⇨ Additional EB through lane *ON FINAL PLANS*
- ⇨ Reduce EB left turn lane storage length from 125 ft. to 100 ft *ON FINAL PLANS*
- ⇨ Increase WB left turn storage length from 95 ft. to 100 ft *ON FINAL PLANS (80' max. allowed)*
- ⇨ New single separate NB left turn lane with a storage length of 75 ft *ON FINAL PLANS*
- ⇨ Additional WB through lane (shared through/right lane) *ON FINAL PLANS*
- ⇨ New single separate SB left turn lane with a storage length of 75 ft *ON FINAL PLANS*

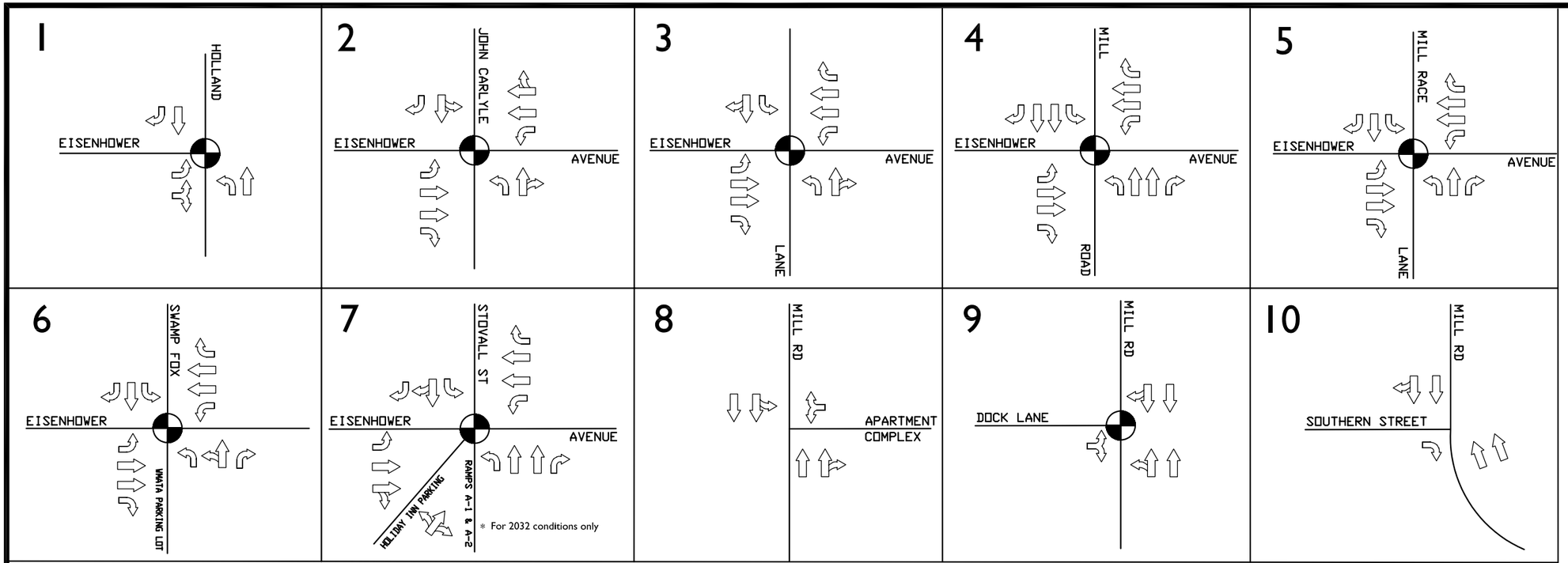
Eisenhower Avenue/Swamp Fox Road
- ⇨ Additional EB through lane *ON FINAL PLANS*
- ⇨ Increase EB left turn lane storage length from 65 ft. to 200 ft *ON FINAL PLANS*
- ⇨ New separate NB shared left/through lane and left turn lane with a storage length of 100 ft *ON FINAL PLANS*
- ⇨ New separate NB right turn lane with a storage length of 75 ft *ON FINAL PLANS*
- ⇨ New separate WB left turn lane with a storage length of 100 ft *ON FINAL PLANS*

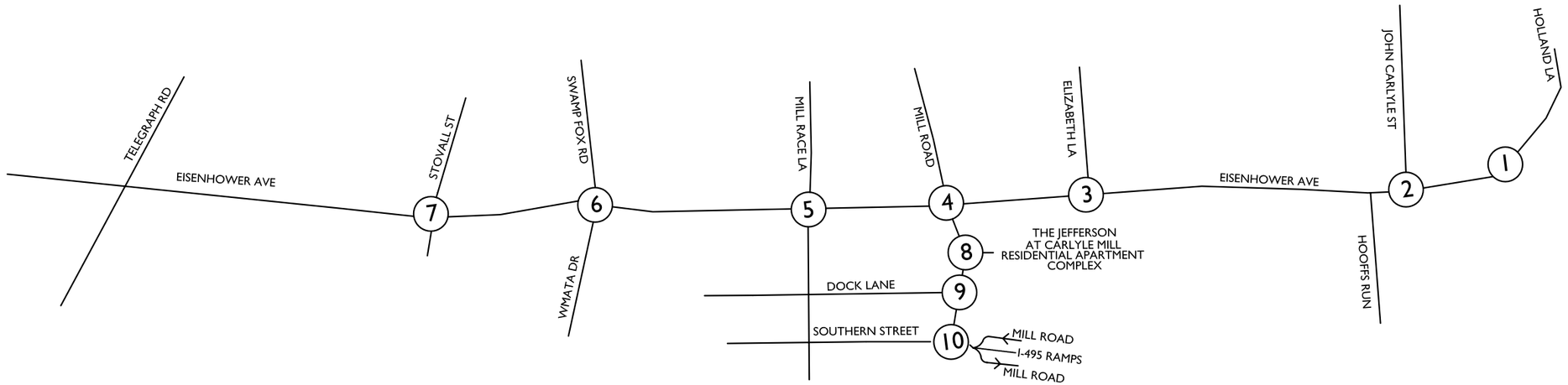
- ⇨ New second SB left turn lane with a storage length of 80 ft *NOT ON FINAL PLANS, insufficient right-of-way*

Eisenhower Avenue/Stovall Street

- ⇨ New NB left turn lane (storage length to be decided), dual through lanes and a right turn lane with a storage length of 100 ft *ON FINAL PLANS*
- ⇨ WB left turn lane storage length is reduced from 350 ft. to 100 ft., reduce WB right turn lane storage length from 350 ft. to 150 ft *ON FINAL PLANS*

Note: all traffic signals are optimized and coordinated along Eisenhower Avenue, with an extended cycle length of 150 seconds during both the AM and PM peak hours.





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DATE	REVISION	BY	APP'R.

EISENHOWER AVENUE WIDENING CORRIDOR-WIDE TRAFFIC IMPACT ANALYSIS

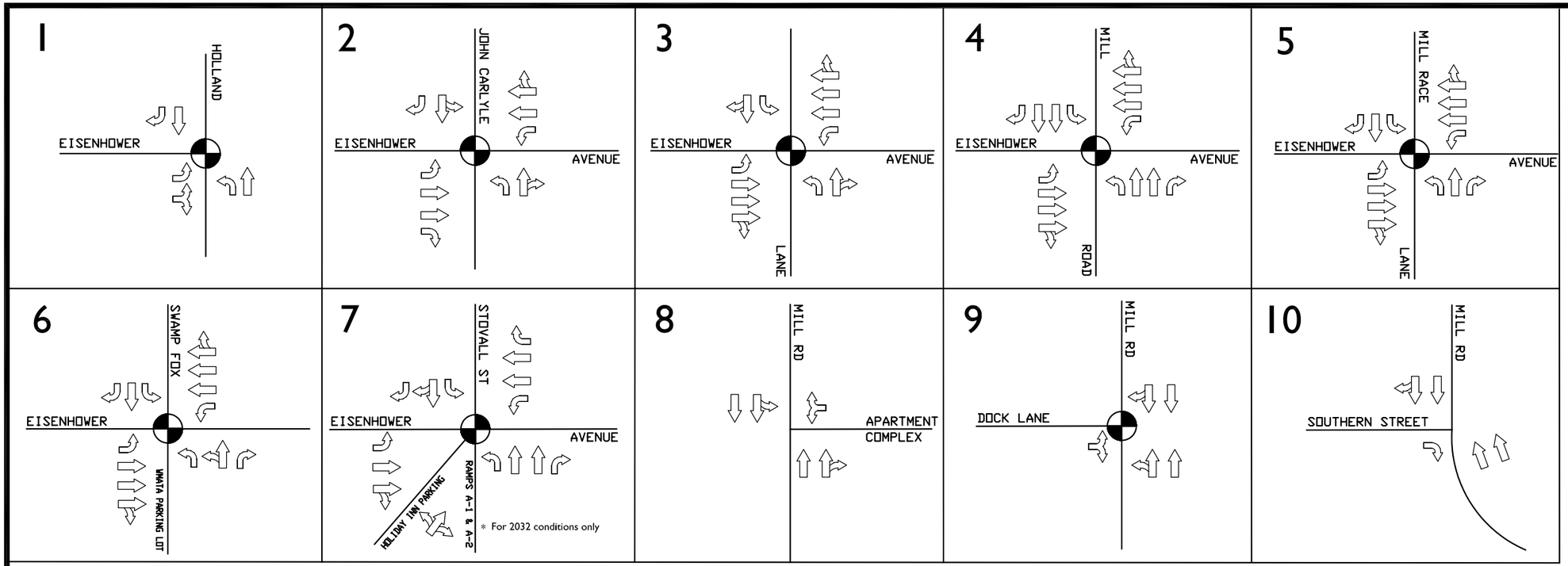
FIGURE 7

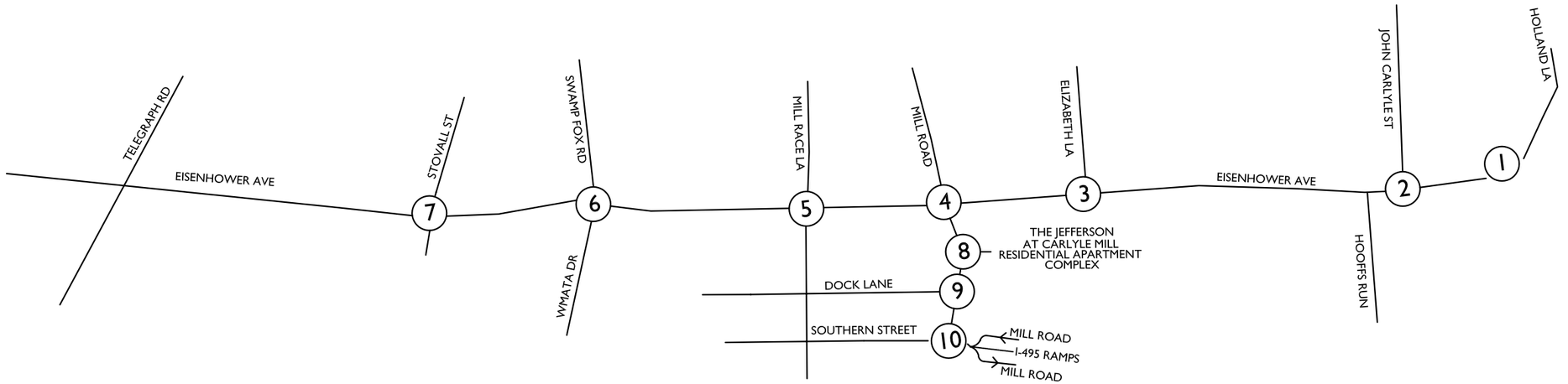
2032 FUTURE/BUILD-OUT LANE USE AND TRAFFIC CONTROL

Scenario 2: 2 Through Lanes and Single Left Turn Lanes

CITY OF ALEXANDRIA, VIRGINIA

SCALE	CONTOUR INTERVAL	A.M.T. FILE No.
	N/A	106-425.001T
DATE	TAX MAP No.	SHEET
OCTOBER 2009	N/A	





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AMT	AMT	AMT	AMT	ACAD	AMT

DATE	REVISION	BY	APP'R.

EISENHOWER AVENUE WIDENING CORRIDOR-WIDE TRAFFIC IMPACT ANALYSIS

FIGURE 8

2032 FUTURE/BUILD-OUT LANE USE AND TRAFFIC CONTROL

Scenario 3: 3 Through Lanes and Single Left Turn Lanes

CITY OF ALEXANDRIA, VIRGINIA

SCALE	CONTOUR INTERVAL	A.M.T. FILE No.
	N/A	106-425.001T
DATE	TAX MAP No.	SHEET
OCTOBER 2009	N/A	

Table 5

Final Intersection Level of Service Summary [1]

Eisenhower Avenue Widening

Location	Control	Existing Conditions		2010 Future Conditions		2032 Future Conditions *Scenario 1*		2032 Future Conditions *Scenario 2*		2032 Future Conditions *Scenario 3*	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
1. Eisenhower Ave/Holland Ln	Roundabout	B	A	C	D	N/A	N/A	N/A	N/A	N/A	N/A
Eastbound	Signal (2032)	N/A	N/A	A(2.6)	A(1.6)	B(14.8)	B(15.6)	A(9.3)	B(14.3)	B(13.5)	B(15.6)
Northbound		N/A	N/A	E(67.5)	E(73.1)	F(117.8)	E(79.5)	F(117.8)	E(79.5)	F(117.8)	E(79.5)
Southbound		N/A	N/A	A(8.9)	A(4.6)	B(12.3)	A(6.1)	B(12.3)	A(6.1)	B(12.3)	A(6.1)
Overall		**N/A**	**N/A**	**A(9.4)**	**A(9.7)**	**C(21.2)**	**B(19.5)**	**B(18.2)**	**B(19.0)**	**C(20.5)**	**B(19.5)**
2. Eisenhower Ave/John Carlyle Street	Signal										
Eastbound		A(0.2)	A(3.7)	B(11.9)	B(14.8)	C(30.7)	E(60.3)	C(32.7)	D(44.8)	C(31.8)	D(46.0)
Westbound		A(4.0)	A(4.9)	B(11.5)	C(22.8)	C(32.9)	E(58.1)	C(34.2)	E(56.1)	C(33.6)	E(58.9)
Northbound		N/A	N/A	E(63.4)	E(65.9)	E(65.8)	E(77.7)	E(65.8)	E(77.7)	E(65.8)	E(77.7)
Southbound		D(51.3)	D(50.4)	B(18.6)	A(4.1)	C(21.7)	C(21.5)	C(21.7)	C(21.5)	C(21.7)	C(21.5)
Overall		**A(3.1)**	**B(12.6)**	**B(14.8)**	**C(22.1)**	**C(33.8)**	**E(58.2)**	**D(35.3)**	**D(52.1)**	**C(34.6)**	**D(53.2)**
3. Eisenhower Ave/Elizabeth Lane	Signal										
Eastbound		A(1.0)	B(12.2)	C(28.5)	B(14.8)	D(39.1)	C(21.0)	F(90.9)	C(25.6)	B(17.8)	C(28.3)
Westbound		B(10.2)	A(7.0)	B(17.1)	C(20.8)	C(25.0)	C(27.3)	C(25.6)	F(117.3)	C(20.4)	C(28.7)
Northbound		C(33.9)	D(39.5)	D(39.5)	E(55.8)	D(43.1)	D(48.4)	D(43.1)	F(107.3)	D(43.1)	D(48.4)
Southbound		C(34.1)	D(37.3)	D(44.2)	E(66.8)	D(45.6)	E(65.4)	D(45.6)	E(65.6)	D(45.6)	E(65.4)
Overall		**A(3.1)**	**B(14.0)**	**C(27.1)**	**C(26.6)**	**C(34.8)**	**C(29.5)**	**E(65.2)**	**F(81.5)**	**C(20.8)**	**C(32.6)**
4. Eisenhower Ave/Mill Road	Signal										
Eastbound		C(29.0)	B(12.9)	D(53.5)	D(45.7)	F(134.0)	F(126.4)	F(224.7)	F(300.4)	F(188.0)	F(154.7)
Lefts		*A(4.3)*	*A(9.8)*	*F(91.9)*	*E(62.7)*	*F(89.5)*	*F(81.8)*	*F(91.6)*	*F(443.7)*	*F(399.8)*	*F(101.2)*
Shared Through/Right (or Through)		*C(30.4)*	*B(13.2)*	*D(47.2)*	*D(43.7)*	*F(139.5)*	*F(129.9)*	*F(259.0)*	*F(296.9)*	*F(162.1)*	*F(158.9)*
Rights		*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*C(29.2)*	*B(18.9)*	*N/A*	*N/A*
Westbound		B(10.4)	C(20.8)	D(36.1)	C(34.1)	D(42.3)	F(130.5)	F(92.7)	F(304.1)	E(75.5)	F(240.7)
Lefts		*B(17.0)*	*B(10.6)*	*E(71.4)*	*F(94.9)*	*F(174.1)*	*F(397.8)*	*F(385.1)*	*F(977.8)*	*F(337.9)*	*F(774.9)*
Shared Through/Right (or Throughs)		*B(10.0)*	*C(21.1)*	*C(23.6)*	*C(21.5)*	*B(19.0)*	*C(20.1)*	*D(42.8)*	*C(27.5)*	*C(29.3)*	*C(20.1)*
Rights		*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*B(18.9)*	*A(2.3)*	*N/A*	*N/A*
Northbound		C(24.7)	C(24.9)	C(31.4)	C(34.2)	F(173.6)	F(174.6)	F(261.0)	F(279.3)	F(196.7)	F(234.8)
Southbound		C(24.3)	C(24.5)	D(37.9)	D(47.2)	D(46.2)	F(111.8)	D(54.8)	F(122.8)	D(51.3)	F(121.2)
Overall		**C(26.8)**	**B(18.1)**	**D(44.5)**	**D(39.8)**	**F(122.4)**	**F(132.4)**	**F(198.2)**	**F(267.7)**	**F(158.5)**	**F(190.8)**
5. Eisenhower Ave/Mill Race Lane	Signal										
Eastbound		A(1.2)	A(1.5)	A(1.3)	C(25.0)	B(11.6)	E(76.0)	E(61.3)	D(45.9)	B(11.6)	D(46.7)
Westbound		A(2.9)	A(1.4)	B(11.2)	B(12.3)	B(11.4)	C(32.0)	B(13.1)	F(83.5)	B(11.8)	C(27.1)
Northbound		D(51.5)	D(51.6)	D(53.1)	D(47.5)	E(61.3)	D(35.3)	E(61.6)	D(43.9)	E(61.3)	D(35.3)
Southbound		D(51.8)	D(51.6)	E(64.7)	E(66.7)	E(62.0)	E(62.7)	E(62.2)	F(104.3)	E(62.0)	E(62.7)
Overall		**A(1.8)**	**A(1.8)**	**A(8.6)**	**C(21.2)**	**B(18.3)**	**D(52.1)**	**D(44.1)**	**E(69.7)**	**B(18.4)**	**D(40.3)**
6. Eisenhower Ave/Swamp Fox Road	Signal										
Eastbound		B(18.2)	B(14.5)	E(68.0)	D(40.9)	F(466.0)	F(138.1)	F(595.1)	F(189.0)	F(466.0)	F(138.1)
Westbound		C(32.1)	A(7.2)	C(34.8)	F(258.8)	F(266.4)	F(261.1)	F(273.0)	F(485.6)	F(263.1)	F(256.0)
Northbound		D(54.7)	D(53.8)	D(44.8)	D(45.3)	D(50.6)	F(81.1)	D(50.6)	F(81.1)	D(50.6)	F(81.1)
Southbound		D(37.1)	D(35.1)	D(48.3)	E(68.0)	D(49.8)	F(156.8)	D(49.8)	F(156.8)	D(49.8)	F(156.8)
Overall		**C(21.5)**	**B(12.0)**	**E(56.7)**	**F(174.5)**	**F(345.2)**	**F(188.5)**	**F(414.7)**	**F(301.3)**	**F(344.0)**	**F(186.3)**
7. Eisenhower Ave/Stovall Street	Signal										
Eastbound		B(15.3)	A(7.5)	B(19.7)	C(26.1)	F(444.4)	C(31.8)	F(444.4)	C(31.9)	F(444.4)	C(31.8)
Westbound		A(4.4)	C(28.1)	B(10.5)	F(183.9)	C(33.7)	F(547.7)	C(29.2)	F(567.3)	C(33.6)	F(547.7)
Northbound		D(53.1)	D(51.9)	E(70.5)	E(69.3)	C(27.2)	C(27.4)	C(27.2)	C(27.4)	C(27.2)	C(27.4)
Northeastbound		N/A	N/A	N/A	N/A	E(69.6)	E(69.5)	E(69.6)	E(69.5)	E(69.6)	E(69.5)
Overall		**C(24.1)**	**C(26.7)**	**D(41.8)**	**F(128.7)**	**F(195.8)**	**F(298.7)**	**F(194.8)**	**F(308.5)**	**F(195.8)**	**F(298.7)**

[1] Based on the Synchro/SimTraffic 6.0 methodology

Table 6

Left Turn Queue Summary for 2032 Future Conditions

Eisenhower Avenue Widening

Location	2032 Future Conditions *Scenario 1*		2032 Future Conditions *Scenario 2*		2032 Future Conditions *Scenario 3*	
	AM Queue (ft)	PM Queue (ft)	AM Queue (ft)	PM Queue (ft)	AM Queue (ft)	PM Queue (ft)
1. Eisenhower Ave./ Holland Ln						
Eastbound L	594	443	350	461	594	443
Northbound L	150	275	150	275	150	275
2. Eisenhower Ave/John Carlyle Street						
Eastbound L	m#542	#355	m375	#358	m#542	#342
Westbound L	m#132	m48	m#136	m46	m#134	m51
Northbound L	277	#785	277	#785	277	#785
3. Eisenhower Ave/Elizabeth Lane						
Eastbound L	m163	m34	m132	m24	m144	m37
Westbound L	m20	m20	m18	m23	m17	m22
Northbound L	98	#184	98	#292	98	#184
Southbound L	30	70	30	74	30	70
4. Eisenhower Ave/Mill Road						
Eastbound L	m#182	m100	m287	m#273	m#561	m210
Westbound L	#199	m#620	m#2304	m#1043	#455	m#1356
Northbound L	#1496	#731	#1593	#786	#1529	#764
Southbound L	#112	181	#163	194	#141	190
5. Eisenhower Ave/Mill Race Lane						
Eastbound L	m34	m#116	m35	m91	m34	m#117
Westbound L	m22	m#197	m12	m#163	m18	m#184
Northbound L	160	251	160	277	160	251
Southbound L	195	#597	195	#668	195	#597
6. Eisenhower Ave/Swamp Fox Road						
Eastbound L	m#659	m#492	m#692	m#491	m#659	m#492
Westbound L	#772	m#128	m#719	m#96	#772	m#131
Northbound L	217	#524	217	#524	217	#524
Southbound L	220	253	220	253	220	253
7. Eisenhower Ave/Stovall Street						
Eastbound L	#885	#518	#885	#518	#885	#518
Westbound L	m6	m4	m5	m4	m6	m4
Northbound L	80	89	80	89	80	89
Southbound L	#787	#472	#787	#472	#787	#472

[1] Based on the Synchro/SimTraffic 6.0 methodology & the 95th percentile queue methodology.

m - queue volume metered by upstream signal

- queue may be longer, volume exceeds capacity

CONCLUSIONS

1. Based on the Synchro analyses conducted for this traffic impact study, the key intersections along Eisenhower Avenue currently operate at acceptable levels of service during both the AM and PM peak hours. The left turning queues are generally well contained by the available storage lengths, except at the intersection of Eisenhower Avenue/Stovall Street, where the southbound left turns are not contained in the dual-left turning lanes currently provided.

2. The 2010 and 2032 future forecasts were developed using the existing AM and PM peak hour volumes, a 2.0% annual growth rate, and numerous pipeline developments identified by the City of Alexandria. In addition, the forecasts included the elimination of the parking garage/parking lots located across from Elizabeth Lane, as well as the completed Ramps K and L at Mill Road, the proposed Ramps A-1 and A-2 at Stovall Street, and updated forecasts at the WMATA Metro Station.

3. The 2010 future conditions indicate that the majority of the key intersections will continue to operate at acceptable overall levels of service (with some reduction in capacity) during both AM and PM peak hours, except for the intersections of Swamp Fox Road and Stovall Street during the PM peak hour. Both are anticipated to operate at unacceptable LOS due mostly significantly high westbound traffic as users leave to return home.

4. Three scenarios were analyzed to determine the full impacts of the anticipated traffic on the road network and the critical roadway improvements recommended to be considered to address 2032 future conditions:

    1. **Scenario 1** proposes three-through lanes along Eisenhower Avenue in each direction (except in the vicinity of John Carlyle Street and Holland Lane, where two-through lanes in each direction would suffice). This scenario also includes dual westbound left turn lanes at Mill Road, to accommodate the heavy traffic traveling south towards the I-495 on-ramps.

    2. **Scenario 2** proposes two-through lanes along Eisenhower Avenue in each direction throughout the corridor, with exclusive right turn lanes between Swamp Fox Road and Elizabeth Lane. This scenario also includes single eastbound and westbound left turn lanes at Mill Road.

    3. **Scenario 3** proposes three-through lanes along Eisenhower Avenue in each direction (except in the vicinity of John Carlyle Street and Holland Lane, where two-through lanes in each direction would suffice). This scenario also includes single eastbound and westbound left turns at Mill Road.

       A comparison of Scenarios 1 and 2 reveals that a three-through lane scenario handles anticipated 2032 traffic volumes more efficiently than a two-through lane scenario, especially at the key intersections of Mill Road, Swamp Fox Road, and Stovall Street. A two-through lane scenario results in extensive queues along both eastbound and westbound Eisenhower Avenue, especially in the vicinity of Mill Road, due in part to the I-495 future traffic.

       A comparison of Scenarios 1 and 3 reveals that dual westbound and eastbound left turn lanes are critical to the successful operation of Mill Road at Eisenhower Avenue, especially from a vehicular capacity and pedestrian safety standpoint. Due to significant traffic traveling southbound towards the I-495 ramps, as well as traffic traveling northbound towards future

pipeline developments, it is crucial that eastbound and westbound dual left turn lanes be provided at Mill Road in 2032 future conditions to alleviate traffic congestion and reduce queues and wait times that are anticipated to spill back through numerous intersections along the corridor.