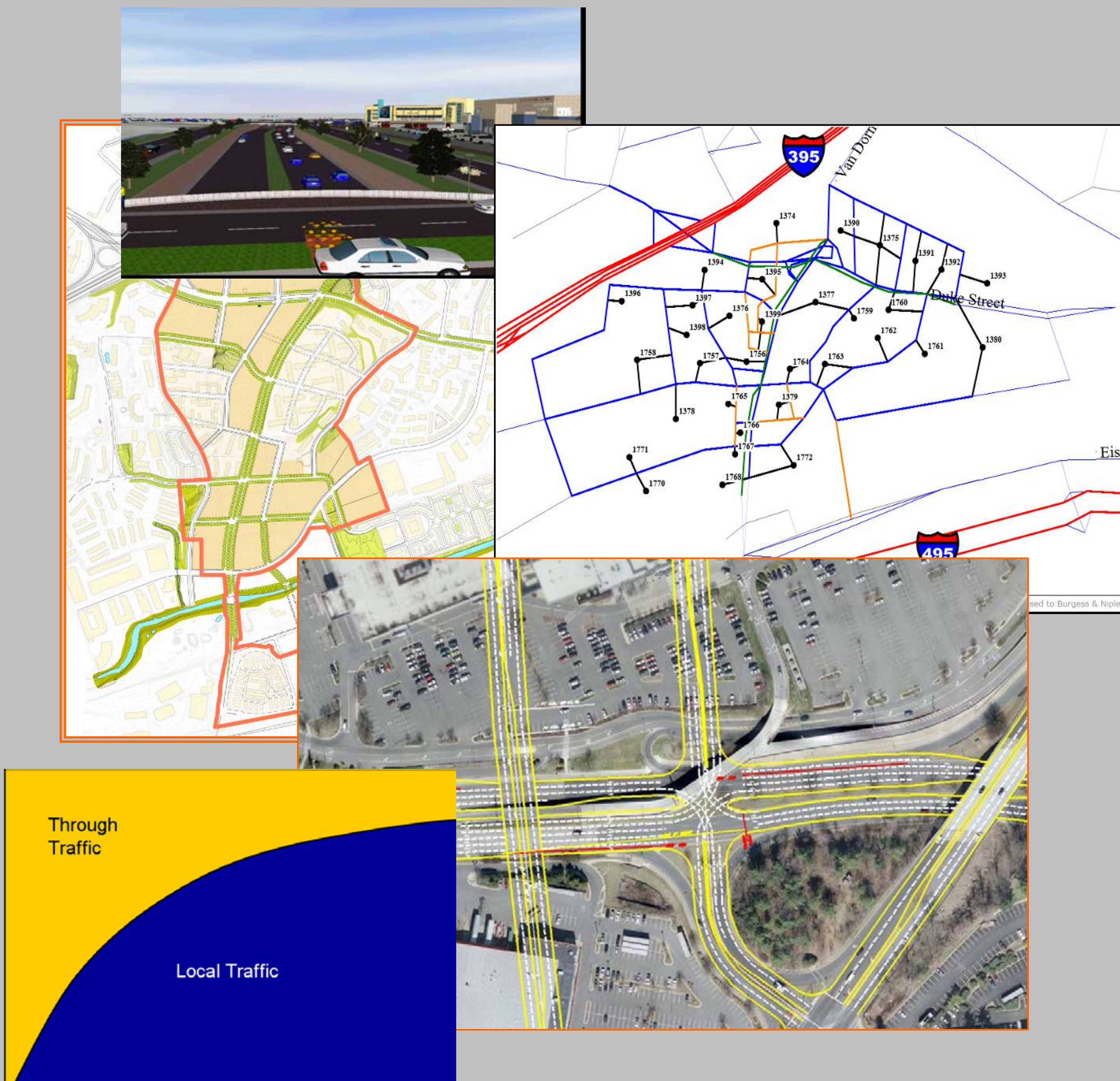
Landmark Van Dorn Area Plan

Transportation Element Technical Report



Overview of the Transportation Element

The purpose of the *Transportation Element* is to recommend future transportation infrastructure and policy to achieve the objectives of the Landmark Van Dorn Area Plan. The Transportation Element also compiles the results of the traffic analysis and transportation planning conducted in support of the Landmark Van Dorn Area Plan.

Guiding Principles for Transportation

The Landmark/Van Dorn Advisory Group developed four guiding principles for transportation:

1. Create a more connected, urban grid system, with walkable blocks, to increase mobility for both pedestrians and vehicles.
2. Increased transit ridership through reliable, convenient and coordinated transit services, with emphasis on effective transit service on Van Dorn Street between Landmark Mall and the Van Dorn Street Metro Station
3. Provide safe, convenient and attractive pedestrian and bicycle access to all transit nodes, centers and stations
4. Provide off-street, dedicated pedestrian and bicycle paths to connect transit, activity centers, neighborhoods, open space, and community facilities.

II. Existing Conditions

This section describes existing conditions first from a general context, and then reports on the results of detailed traffic analysis.

General Context: Opportunities and Challenges

The Landmark Van Dorn area is located at a transportation crossroads. Two interstates, a heavy rail line, a Metrorail line, and one of the region's primary east-west routes pass through or on the boundary of the area.

Transit

The Plan area is served by both bus and Metrorail and use of transit is above average. Furthermore, with mixed use and transit oriented development, the backbone exists for very high transit use. The share of area commuters using transit is 18% as compared with 14% for the region. As a percentage of all trips 5% use transit.

The Plan area is served by Metro rail service at the Van Dorn Street Station on the Metro Blue Line. However, Backlick Run and the CSX rail lines provide a barrier between the station and the rest of the Plan area. An average of 3,910 daily boardings was reported at the Van Dorn Street Metro in the 2005 Metro statistics. This is less than half the average of all Metro stations in the system, and is typical of an outer suburban station.

There is an abundance of bus service. Three of the region's bus systems serve the Plan area directly. Fairfax Connector buses stop at Landmark Mall, on a route that connects George Mason University and the Pentagon along Braddock Road and Interstate 395. The Washington Metropolitan Transit Authority

(WMATA) operates 5 separate lines through the planning area. Alexandria's DASH buses on lines 2, 5, 7, and 8 serve the Van Dorn Street Metro Station and Landmark Mall with connections to Old Town and the King Street Metro Station along different east-west streets.

Service has large headways and service by different transit providers is generally uncoordinated. Peak-hour commuter service on DASH buses is typically every 20 to 30 minutes, with 30-minute to 1-hour headways typical through the remainder of the day from 5:30 AM until 10:00 PM or later. WMATA and Fairfax Connector buses in the Plan area run less frequently. Service on most lines is less frequent on weekends.

Highway and Street System

The area is defined by its proximity to the intersection of the region's two major interstates, I-95/395 and I-495. While this proximity provides excellent regional access, the interstates form a physical barrier to local roads. Furthermore, traffic congestion on these interstates spill onto local roadways.

Two other roadways provide regional access: Duke Street and Van Dorn Street. Duke Street (Route 236) is Alexandria's most important east-west arterial. It begins at Alexandria's waterfront and terminates in Fairfax City in the heart of Fairfax County. Route 236 carries regional through traffic and links the City to residential and employment areas to the west.

Van Dorn Street (Route 401) begins south of the City at Telegraph Road in Fairfax County, and terminates at King Street, a distance of a little more than six miles. It is the only north-south non-interstate between Backlick Road and Telegraph Road, a distance of approximately six miles. For this reason, traffic to and from the Plan area from adjacent areas is funneled onto Van Dorn Street.

Duke and Van Dorn Street are not supported by parallel routes. The area lacks a roadway grid; the few local roads create "superblocks" that further funnel traffic.

Currently, the area has some congestion during peak hours. This congestion results in reduced speeds and longer wait times at signalized intersections. However, under normal circumstances, traffic continues to flow and most signals clear during a normal cycle. See the following section for a more detailed description of current traffic conditions.

Pedestrians and Bicycles

The Landmark/Van Dorn Corridor area was developed in a classic suburban pattern of isolated large blocks of development designed for automobile access. The development pattern and transportation network that resulted offer many options for autos, but disadvantages for pedestrians.

The presence of the large "superblocks" means long distances between crosswalks (as much as 1/4 mile on Van Dorn Street and 1/2 mile on Duke Street) and long-way-around walks to destinations. Blocks are two to five times as long as traditional blocks in Old Town, creating long barriers to pedestrian movement between local destinations.

Streets throughout the industrial areas in the south of the Plan area often do not have sidewalks, creating a key disconnect from the very important Van Dorn Street Metro. Where sidewalks do exist, they are often narrow and cluttered with utility poles and guy wires. Pedestrians must often walk in driveways or through parking lots to reach residences or businesses from the street.

Roadway characteristics, especially along Duke Street and Van Dorn Street include wide vehicle travel lanes, wide turn radii and free right-turn lanes. These conditions lengthen pedestrian crossings of arterials, put pedestrians out of drivers' cone of vision, and encourage high speed turns that are a hazard to pedestrians.

There is no provision for pedestrians on the Van Dorn Street bridge over Duke Street, creating a half-mile barrier to pedestrian circulation across Duke Street.

North to south, the Study Area is less than 1.5 miles long. While a lengthy walk, this distance is easily covered by bicycle in less than 15 minutes. Even biking from the Mall to Old Town would take less than 45 minutes. (Both of those travel times, however, assume the availability of safe, accommodating bicycle facilities.)

However, lack of bicycle infrastructure and the very hilly terrain in the Landmark/Van Dorn area create obstacles to bicycle travel. Relatively steep grades on Van Dorn Street make operating bicycles in traffic more difficult on these routes. Holmes Run along the area's eastern edge does provide one dedicated bicycle route; however, this route is used mostly for recreational riding.

Existing Conditions: Results of Detailed Traffic Analysis

Average travel times were analyzed for Duke Street and Van Dorn Street and average delay was analyzed for eight intersections. This analysis was performed using traffic counts conducted in January and February, 2008, and standard traffic analysis techniques.

This analysis was conducted to provide an assessment of current roadway congestion. Congestion is commonly described using Level of Service (LOS) criteria established by the Transportation Research Board and explained in the Highway Capacity Manual. The Highway Capacity Manual using six letters, "A" through "F", to describe roadway conditions.

Table 1. Level of Service Criteria for Signalized Intersections Level-of-Service (LOS)

LOS	Average Control Delay (seconds/vehicle)	Description
A	≤ 10.0	Very low vehicle delays, free flow, signal progression extremely favorable, most vehicles arrive during given signal phase.
B	10.1 to 20.0	Good signal progression, more vehicles stop and experience higher delays than for LOS A.
C	20.1 to 35.0	Stable flow, fair signal progression, significant number of vehicles stop at signals.
D	35.1 to 55.0	Congestion noticeable, longer delays and unfavorable signal progression, many vehicles stop at signals.
E	55.1 to 80.0	Limit of acceptable delay, unstable flow, poor signal progression, traffic near roadway capacity, frequent cycle failures
F	> 80.0	Unacceptable delays, extremely unstable flow and congestion, traffic exceeds roadway capacity, stop-and-go conditions.

SOURCE: Highway Capacity Manual, HCM2000, Transportation Research Board, 2000

Table 1 shows criteria to grade intersections based on average delay from intersection signals. Table 2 shows criteria to grade an arterial corridor based on average speed.

Table 2. Level of Service Criteria for Arterial Corridor based on Average Speed.

Urban Street Class	I Sparse Suburban	II Suburban	III Urban	IV Metropolitan Core
Range of free-flow speeds (FFS)	55 to 45 mi/h	45 to 35 mi/h	35 to 30 mi/h	35 to 25 mi/h
Typical FFS	50 mi/h	40 mi/h	35 mi/h	30 mi/h
LOS	Average Travel Speed (mi/h)			
A	>42	>35	>30	>25
B	>34-42	>28-35	>24-30	>19-25
C	>27-34	>22-28	>18-24	>13-19
D	>21-27	>17-22	>14-18	>9-13
E	>16-21	>13-17	>10-14	>7-9
F	<=16	<=13	<=10	<=7

Traffic counts were taken at eight key intersections. These counts were taken for AM and PM peak hour, and in the vicinity of the Landmark Mall, for Saturday mid day. In addition, 24 hour “tube counts” were taken on Duke Street and Van Dorn Street. The traffic counts were taken at a time when both I-395 and I-95 were functioning normally.

Intersection Level of Service (LOS)

The intersections that were analyzed for existing conditions are:

1. Van Dorn and Pickett
2. Van Dorn and Edsall
3. Van Dorn and Stevenson
4. Van Dorn at Mall
5. Duke and Walker
6. Van Dorn and EB Duke Ramps
7. Duke and Pickett
8. Edsall and Pickett

Table 3 shows AM and PM Average Control Delay. Although average control delay summarizes the performance of the intersection; it is also informative to analyze the approaches. For example, an intersection with a low average control delay may be serving the major volumes very well, but the minority movements may have unacceptable delays. Table 3 shows the average delay for all vehicles passing through the intersection, and Table 4 shows the averages by approach for the PM peak period.

Table 3: Average Control Delay

Intersection	AM	PM
Van Dorn and Pickett	65 / E	40 / D
Van Dorn and Edsall	29 / C	66 / E
Van Dorn and Stevenson	42 / D	18 / B
Van Dorn at Mall	11 / B	11 / B
Duke and Walker	40 / D	51 / D
Van Dorn and EB Duke Ramps	11 / B	14 / B
Duke and Pickett	23 / C	26 / C
Edsall and Pickett	31 / C	24 / C

Table 4: Average Control Delay, PM by Approach				
Intersection	EB	WB	NB	SB
Van Dorn and Pickett	56 / E	64 / E	40 / D	30 / C
Van Dorn and Edsall	57 / E	114 / F	64 / E	52 / D
Van Dorn and Stevenson	26 / C	39 / D	19 / B	15 / B
Van Dorn at Mall	35 / D	6 / A	6 / A	35 / D
Duke and Walker	54 / D	52 / D	43 / D	42 / D
Van Dorn and EB Duke Ramps	45 / D	26 / C	4 / A	12 / B
Duke and Pickett	30 / C	15 / B	43 / D	Na
Edsall and Pickett	17 / B	21 / C	9 / A	39 / D

Findings:

1. In the AM, all but one intersection operate at LOS D or better. Van Dorn and Pickett operate at LOS E.
2. In the PM, all but one intersection operate at LOS D or better. Van Dorn and Edsall operate at LOS E.
3. In the PM, the only movement to operate at LOS F is westbound Edsall Road at Van Dorn.

The eight intersections all function in the AM and PM peak hours without significant delays. During peak hours, when the nearby interstates are operating without significant backups, traffic in the study area operates with only minor congestion.

Arterial Corridor Average Speeds

The average corridor speeds are LOS C and D for Duke Street and LOS D and E for Van Dorn Street. Again, the analysis shows moderately heavy traffic progressing through the system.

Table 5. Average Existing Corridor Speeds.		
	Duke Street	**Van Dorn Street**
AM		
Average Speed EB / NB	16 / D	11 / E
Average Speed WB / SB	21 / C	17 / D
PM		
Average Speed EB / NB	15 / D	16 / D
Average Speed WB / SB	21 / C	14 / D

III Transportation Elements

The existing transportation network lacks choices. It is an auto-oriented system, and the large “superblocks” funnel traffic onto two arterials. To meet the guiding principles new infrastructure, transit service, and policies are needed.

This section describes this infrastructure, transit service and policies for each mode and for a Travel Demand Management program.

Pedestrian Elements

The following elements are proposed to create a pedestrian-oriented place:

New Infrastructure:

- Grid of walkable streets.
- Improvements to Van Dorn Street Bridge over Duke Street.
- New Bridge over Duke Street south of Landmark Mall.
- Multimodal link from Eisenhower Avenue (near Van Dorn Street Metro Station) to Pickett Street.

Development Policy and Guidelines:

- Provide sufficient density and an appropriate mix of uses to ensure a high level of pedestrian activity in daytime and evening hours.
- Locate and design parking and parking access so that it does not interfere with walking, to support the transformation of Landmark/Van Dorn.
- Place parking garages below grade to minimize auto storage areas as an obstacle to ground-level pedestrian activities and connections.
- Provide on-street parking.
- Provide pedestrian-level lighting along pedestrian walkways and on retail streets.
- Provide regular, convenient pedestrian connections across roadways.
- In retail and residential areas, design for low vehicle speeds and provide curb parking so pedestrians feel safe walking and crossing.

<u>Grid of Walkable Streets</u>

The addition of a roadway grid is critical to create a walkable environment. The grid will provide walkable areas that are active, safe and host destinations. They also provide capacity for transit and vehicles near activity centers.

<u>Van Dorn Street Bridge over Duke Street</u>

Duke Street poses an impediment to pedestrians and isolates the planned multiuse development at the current site of the Landmark Mall. The Van Dorn Street Bridge will be widened to provide another connection across Duke Street.

Van Dorn Street will be transformed into a multimodal corridor with wide sidewalks, dedicated transit and pedestrian/bike friendly features. Improvements to Van Dorn and the proposed typical section are discussed in the next section.

<u>New Bridge over Duke Street south of Landmark Mall</u>. A new bridge between the Landmark Mall site at its new main entrance and the property now occupied by BJ's to the south would connect over Duke Street at a point where the street is approximately 20 feet below the floor elevation of the stores on either side.

<u>Multimodal link from Eisenhower Avenue to Pickett Street</u>. New access to the Van Dorn Metro station will be provided by the proposed new multimodal bridge, described in the following section. The link will

connect the Metro station and activities on Eisenhower Avenue with Cameron Station and development along South Pickett Street.

Transit Elements

"Increased transit ridership through reliable, convenient and coordinated transit services, with emphasis on effective transit service on Van Dorn Street between Landmark Mall and the Van Dorn Street Metro Station"(City Transportation Master Plan).

On average, 18% of commuters in the City of Alexandria use transit. This is substantial for a non-urbanized area, however it is much lower what could be achieved with higher density, transit oriented development and well placed and reliable transit service.

The Transit Concept Plan from the City's Transportation Master Plan explains goals, objectives, technologies and dedicated corridors to make transit a preferred mode of travel. The plan proposes dedicated transit for both Duke Street and Van Dorn Street. The plan also proposes City wide improvements such as smart stations, real time information and shorter headways.

The following transit improvements in the Landmark/Van Dorn plan are recommended in addition to the City wide proposals:

New Infrastructure:
- Van Dorn Street Transit Boulevard.
- Dedicated lanes and stations for BRT/LRT on Duke Street
- Transit Transfer Center.
- Multimodal bridge connection to Van Dorn Street Metro.

New Service
- Light Rail Transit / Bus Rapid Transit.
- Local Transit Circulators.
- Transit Features. Upgrade individual bus stops with shelters, lighting, information, and other passenger amenities.

Light Rail Transit / Bus Rapid Transit

The City Transportation Master Plan has designated Duke Street and Van Dorn Street as corridors for a Primary Transit Network (PTN). This service will operate on dedicated lanes, it will have short headways and run nearly 24 hours per day. It will be convenient, reliable and heavily used.

It has not been determined what technology or type of vehicle will be used for these corridors. A feasibility study is funded to decide if the service will be light rail, bus rapid transit or some other alternative.

Van Dorn Street Transit Boulevard

The Light Rail Transit or Bus Rapid Transit will travel on dedicated lanes in a mixed-mode corridor (see typical section). In addition to providing transit improvements, the broad, landscaped boulevard will create a strong image for the Van Dorn Street corridor from the Beltway, as viewed along Van Dorn Street and from cross streets at intersections.

Because the travel lanes and median would take up much of the 100-foot right-of-way, additional space on each side of the roadway is required for sidewalks and landscaping. To create a broad urban boulevard as an image-creating street for the area, a 25-foot setback area for sidewalks, street trees, landscaping and streetside activity spaces is proposed. Full development of improvements in this setback area is proposed at the time of site redevelopment.

The new typical section will extend past to Eisenhower Avenue. If the southernmost section is completed before a new multimodal bridge from Eisenhower Avenue to Pickett Street, this section will provide an interim pedestrian friendly connection from Metro to the study area.

Transit Transfer Center

Landmark Mall is a stop on several bus lines and provides the opportunity to transfer between DASH, WMATA and Fairfax Connector buses to access a number of regional destinations. Direct bus service is provided to the regional transit center and Metro station at the Pentagon.

DASH buses currently use the rear of the mall for the transit stop, requiring a circuitous route through the parking structure to reach the stop and adding substantial time to schedules. A transit transfer location with convenient access to and from Duke Street and Van Dorn Street would reduce the travel time on bus routes that stop at Landmark Mall and would make transfers more convenient for passengers. The center should be located so that transit riders have a comfortable place to wait and access to convenience retail areas while waiting for transfers.

Multimodal bridge connection to Van Dorn Street Metro

This proposed walkway and bridge located at or just west of Armistead Boothe Park would cut the current one-mile walk from the western end of Cameron Station to the Van Dorn Street Metro Station in half. The location away from Van Dorn Street would provide a much quieter and more pleasant pedestrian and bicycle route than the existing sidewalk on the Van Dorn Street bridge. This connection could also be developed as a pedestrian/transit bridge with either one lane or two lanes for buses. If a bus connection is provided, transit circulator buses could avoid Van Dorn Street during congested periods to provide local circulation to Metro.

Local Transit Circulators

Local transit circulators running regular short loops between Van Dorn Street Metro, residential areas, Landmark Mall, and other local destinations have the potential to reduce total travel times for trips by Metro by 5 to 20 minutes compared to scheduled DASH service from locations within the planning area. Transit circulators can provide nonstop trips to the Van Dorn Street station from key trip generators and the proposed transit transfer center, and can provide more frequent service to supplement DASH and Metro buses along neighborhood routes. Local transit circulators can be funded by an areawide Transportation Management Program in which a number of stakeholders participate.

Local circulators may replace some current scheduled bus service serving the residential areas in and near the planning area. Cost savings from scheduled transit operations would help offset the cost of circulator service. An increased level of local DASH service could provide much of the benefit of circulators.

Roadway Network Improvements

In the previous sections many of the proposed projects are also roadway projects. The new grid of roadways, the Van Dorn multimodal boulevard, the new bridge over Duke Street and the new multimodal bridge are roadway and transit or pedestrian projects.

In general, roadway network improvements in the Landmark/Van Dorn Plan complement the other modes of travel. Furthermore, they are not intended to increase the capacity of the roadway system for *through* travel. Instead, they are intended to provide better connectivity and more choices.

Duke Street Enhancements

Duke Street must continue as major vehicular thoroughfare. It is a major east west corridor, and high capacity access to I-395 must be maintained. Duke Street enhancements must balance four competing requirements:

1. Provide direct access to the new West End Town Center.
2. Connect the Landmark Mall site with the sites just south of the Mall.
3. Provide for future Light Rail or Bus Rapid Transit.
4. Maintain traffic service.

To meet these requirements a number of alternatives were developed. The Advisory Group held a Charette on 19 May to develop ideas and concepts. In addition, General Growth Properties, the owners of a portion of the Landmark Mall proposed several alternatives.

Based on this extensive conceptual development process, Staff and the consultant team refined the concepts into three alternatives:

- At Grade Alternative
- At Grade with Bridge
- Depressed freeway with service roads

All of the alternatives remove the existing flyover just east of Walker Street. All add an intersection east of the Van Dorn Bridge at the location of the westbound ramps from Van Dorn Street.

At Grade Alternative

This alternative provides additional capacity for eastbound traffic to the existing Mall by maintaining three through lanes in each direction and by adding two intersections.

At Grade Alternative with Bridge

This alternative provides a bridge over Duke Street between Walker and the new, central intersection. The new intersection will be further east, as shown in the figure below.

The addition of the bridge adds geometric complications. To make sure this option is feasible a profile of the bridge was designed. In addition, the sight distance requirements were calculated to make sure that the signals at each intersection could be seen in time to stop at the intersection.

Depressed Roadway with Service Roads

This alternative adds one way service roads on each side of Duke Street. Because Duke Street will be lower than the service roads, this alternative attempts to move the higher speed, through traffic away from the local roadways. The local roadways would have an urban street frontage.

This type of depressed roadway with local street frontage is not uncommon. One local example is Connecticut Avenue at Dupont Circle. The concept was developed in plan and profile and found to be possible.

However, a number of factors combined to make this alternative unfeasible. First, the grade east of Van Dorn Street is too great to continue the local roadways. The entire dual roadway system would have to be west of Van Dorn, a distance of less than 1300 feet. Second, traffic to the dual system would be from the I-395 Interchange with Duke Street. High speed interstate traffic would have to weave and transition onto either the through roadways or the local streets.

Finally, the construction cost of over $80 million was much higher than the other alternatives. As a result, City Staff and the advisory group determined that it would not be considered for further consideration during the September meeting.

Parking and Travel Demand Management

Transportation Demand Management (TDM) is a set of specific strategies that influence travel behavior by mode, frequency, time, route, or trip length in order to help achieve a maximally efficient and sustainable use of transportation facilities, along with other Alexandria goals such as promoting access for all transportation system users, improving mobility, and minimizing the negative impacts of vehicular travel.

For the past twenty years, the City of Alexandria has had a program called the Transportation Management Plan (TMP) program which expressly identifies and funds TDM projects in new developments. Since this is a large area, which is likely to be completely rebuilt over the next 20 to 30 years, it is important that a separate TMP district be set up for the Landmark/Van Dorn area. The TMP district would be responsible for:

- Developing a program of TDM strategies for implementation by district employers and residential developments.
- Developing performance measures, including annual modal share targets, on which to evaluate effectiveness of TDM strategies;
- Collecting travel data via surveys and evaluate compliance with the modal share targets;
- Adjusting strategies, including allocation of transportation impact fees, based on results;
- Marketing the program's intents and benefits to all district employers, utilizing websites, printed materials, and on-site training and information sessions; and
- Assisting employers in identifying demand-management strategies for achieving performance measures.

The City will use all of the current methods of trip-reduction such as guaranteed ride home, ridesharing, car sharing, and transit subsidy programs and will work with members of the TMP district to aggressively promote these and other TMP actions to mitigate the impact of new developments on the performance of the areas streets. Participation in a coordinated TMP district would be a condition of approval for redevelopment in the Plan area.

Right-Size Parking

The price and availability of parking are important factors in any individual's choice of travel mode. In addition, the cost to construct parking is high, and minimizing these costs frees funds to be used for other public benefits. The following recommendations are designed to make optimal use of the existing parking supply, to manage demand for additional parking generated by future growth, and to reduce unnecessary construction costs.

This report recommends tailored parking standards for mixed-use projects in redevelopment areas for use as a local parking policy. For initial phases, parking could be somewhat reduced from current standards because of the potential for mixed-use development and greater pedestrian traffic to reduce parking needs for convenience retail uses. Uses competing regionally, such as mid-box stores or larger shopping centers, will need more parking initially in order to compete with other centers in the region.

Recognizing the sensitivity of parking requirements and the consequences of requiring too few or too many spaces, the requirements for retail, office uses other than professional, such as medical offices, and hotels should be evaluated during the development review process. Any increases or decreases from the ratios identified below would require approval of a special use permit.

While it is highly unlikely that there will be a high proportion of no-car households in the future, there will likely be many one-car households. As such, reduced requirements for new residential development are recommended. A reduction in the parking requirement for smaller dwelling units will ensure that one-car households will not pay a premium for two parking spaces when they only need one space.

Consistent with the City's current practice, all residential development provide 15% visitor parking.

Once improved transit is available, further reductions in parking will be possible because employees, residents and shoppers will become increasingly reliant on transit for travel.

Projects with unique potential for shared use, such as offices with weekday daytime demand only, and retail uses with highest demand on weekends and evenings, may have specific shared parking conditions that provide for lower parking ratios than those in the table. These will be determined as development projects are reviewed by the City. As new streets are constructed, new on-street parking will be provided, thereby increasing the supply of on-street parking over what exists today.

In addition to the benefit of reducing travel demand, reducing the number of parking spaces permitted has a number of other benefits for the Plan area. Lower parking ratios make it less expensive for developers to provide parking for projects, making it more possible to provide other community benefits including open space. Fewer parking spaces means it is easier for developers to provide parking underground rather than reducing the floor area to accommodate parking, or building above-grade structures that contribute to building mass and create obstacles to retail continuity and pedestrian circulation.

Existing and Proposed Parking Standards				
	Current Standards (minimum)		Proposed Standards (maximum)	
			Initial	Later phase with transit
Land Use	Existing Parking District 3	Existing Parking District 6 (near Metro)	Proposed (Mixed-use Projects)	Proposed, Class A phase with Transit in place
Residential	1 br: 1.3/unit 2 br: 1.75/unit 3 br: 2.2/unit Single-family: 2/unit	1 br: 1.3/unit 2 br: 1.75/unit 3 br: 2.2/unit Single-family: 2/unit	1.5/unit, plus 15% visitor parking	1.0/unit, plus 15% visitor parking
Office[1]	2.1/1000	1.67/1000	2/10002	1.5/10002
Hotel1	1/ 4 seats (rest) 1/room (less than 3 stories) 1/ 2 rooms (over 3 stories) 1 employee space/ 15 guest rooms		0.7/room	0.7/room
Retail[1] – convenience, neighborhood in mixed-use projects	5.2/1000 ground floor 3.64/1000 other floors	4.35/1000	3/1000	2/1000
Retail[1] – regional, community	5.2/1000 ground floor 3.64/1000 other floors	4.35/1000	4.0 /1000	3/1000

Notes:
1. Any increases or decreases from these ratios shall require approval of a special use permit.
2. Parking requirements for medical office use will be twice the requirement of general office uses.

The City is developing bicycle parking requirements, which are expected to be implemented through the zoning ordinance. The proposed parking standards include requirements for short-term and long-term bicycle parking spaces for residential, hotel, retail, restaurant, and office uses. Development in the Plan area should provide bicycle parking in accordance with the proposed standards until or unless they are superseded by adopted standards.

Major Infrastructure Project Costs

Project costs were estimate for the major infrastructure projects discussed previously. These costs were estimated using 14 cost elements. Each of the 14 cost elements are the basis of feet of roadway lanes or linear foot, or in the case of intersection control "each".

The 14 cost elements estimate construction costs. An additional 25% is added for design, supervision and overhead. Finally, 20% is added for contingency and unforeseen circumstances.

Table 6: Cost Elements[1]

	$ per M	$ per ft	$ each
Lane Mile in Greenfield	2,000,000	380	
Lane Mile Widen, Urban	3,500,000	660	
Earthwork		350	
Few Utilities	875,000	170	
Many Utilities	2,975,000	560	
Light Demolition, little new earthwork	875,000	170	
Heavy Demolition, new profile	3,500,000	660	
Closed Drainage system	800,000	150	
Retaining Wall (5 foot average height)		700	
Bridge		2,880	
Signalized Intersection Control			300,000
One Lane Roundabout on existing, 200' approaches			900,000
Two Land Roundabout on existing, 200' approaches			1,400,000
Tunnel		28,800	
Signing marking landscaping architecture	875,000	170	

Utilities and Demolition are major cost elements which must be estimated using engineering judgment. Generally, for the roadway widening alternatives, Utilities is the cost to relocate electrical, fiber optic, telephone, fire service or cable service. For the Grid Roadway these same costs are applied, however these costs could be included in the cost of the surrounding development.

Table 7: Major Project Costs

	Length	New Lanes or Rebuilt Lanes	Moderate Utilities	Many Utilities
Duke Street at Grade	2,110	6 and 2	14,800,000	17,600,000
Duke Street at Grade w Bridge	2,110	6, 4 and 2	22,500,000	28,100,000
New High Street	4,500	2	16,500,000	18,400,000
Other New Grid Roadways	4,000	2	15,400,000	17,100,000
Long Term New Grid Roadways	8,375	2	30,100,000	33,600,000
Landmark Local Roadways	5,000	2	16,800,000	18,900,000
Van Dorn Boulevard, North	5,250	6	48,500,000	54,900,000
Van Dorn Boulevard, South	1,750	6	18,600,000	23,000,000
Van Dorn Bridge Widening	335	2	not applicable	2,900,000
Multimodal Bridge	1,950	3	not applicable	22,000,000

[1] *A large number of sources were used to develop these unit costs. The results were checked with similar projects in VDOT's 6 year plan.*

Notes

1. Duke Street at Grade	*6 lanes west of Van Dorn, 2 new lanes through new intersection on east*
2. Duke Street at Grade w Bridge	*Same as "at grade" with bridge and approaches*
3. New High Street	*New spine road*
4. Other New Grid Roadways	*New NS east of Van Dorn, and new EW south of Edsall*
5. Long Term New Grid Roadways	*New grid in existing residential*
6. Landmark Local Roadways	*Road network in Landmark site*
7. Van Dorn Boulevard, North	*From Pickett to north of Duke. Complete rebuild, three new intersections.*
8.Van Dorn Boulevard, South	*From Eisenhower to Pickett.*
9. Van Dorn Bridge Widening	*Additional lane each direction at Duke and CSX RR crossings.*
10. Multimodal Bridge	*Pickett to Eisenhower, 2 lanes with wide multiuse trail*

Moderate Utilities: Overhead and some underground utilities will need to be relocated. Many Utilities: Expensive relocation of gas, cable, telephone, or fiber optic. May be utility related issue. Van Dorn North : Moderate Utilities assumes project will stay within existing roadway limits between Edsall and just north of Stevenson.

Phasing Concept

By 2030 nearly $200 million in new bridge, road, transit, bike and pedestrian infrastructure will be built in the study area. New bus service, bus circulators and Bus Rapid Transit (or Rail Transit) will use this infrastructure.

As previously discussed, the success of the plan depends on a transformation of the area from an auto-dominated realm to a walkable, multimodal realm. The phasing must support the new *maximum* parking requirements and TDM. The phasing must support the creation of a walkable grid of streets.

This section outlines a phasing concept. This concept demonstrates the phasing of projects in a logical manner that meets the ongoing need for transportation service. Although the actual phasing will depend on the timing, location and type of development, this concept can be further refined and adjusted as development occurs.

To avoid congestion and create multimodal choices, transit service must be added with each increment of new development. As shown in the previous section, 18% of current commuter trips are by transit. Future transit traffic is projected to be between 21% and 27% transit. As such, new transit capacity must be created to meet at least 21% of new trips created by development.

Table 8 shows the type of service that corresponds to general levels of development. The new trip demand was developed using the ITE Trip Generation Manual[2] and New Transit Required was developed using Transit Capacity and Quality of Service Manual, TRCP Project A-15.

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[2] *Institute of Transportation Engineers (2003), Trip Generation, 7th Edition, Washington D.C*

Table 8: New Transportation Required for Various Development Examples			
	New Transit Trips Demand (21% of Total)	New Transit Capacity Required	New Roadway Capacity Required
1 Million SF Office, OR 400 K SF shopping OR 3,850 new residential units in mid rise apt	300 PM peak hour	Reduced headways (current service) New local service.	Grid roadway link(s) Intersection improvement(s). New transit lane(s).
800 K SF Retail + 1,600 units Residential + 2.5 Million SF Office + 1,000 room hotel	1,350 PM peak hour	Reduced headways (current service) New local service. Transit Transfer Center Circulator from Metro Express bus service	Connected grid roadway links. Significant portions of Duke and Van Dorn improvements.
90% Full Build Out	2,600 PM peak hour	All improvements above and BRT/LRT with capacity of 1,600 passengers per hour.	All improvements in infrastructure plan.

The major new infrastructure and service can be divided into the following elements:

Table 9: New Infrastructure and Service Elements	
Duke Street Improvements	▪ Upgrade Walker Street Intersection (add missing movements, add through movement to existing EB right turn). ▪ Remove flyover ▪ New intersection between Van Dorn and Walker ▪ Transit lanes ▪ New intersection east of Van Dorn ▪ High Street Bridge over Van Dorn ▪ BRT/LRT stations and features
Van Dorn Multimodal Boulevard	▪ Transit lanes and improve Pickett to Edsall ▪ Transit lanes Edsall to north of Duke Street ▪ Transit lanes south of Pickett Street ▪ BRT/LRT stations and features
Grid Roadway System	▪ West End Town Center ▪ North-south “spine” roadway ▪ East-west main street ▪ Other grid roadways
Transit Service	▪ Expanded Bus Transfer facility at west end ▪ Circulator service, with stop at Metro ▪ Express bus service (predecessor to BRT/LRT) ▪ Van Dorn LRT / BRT ▪ Duke Street LRT / BRT
Multimodal Bridge	▪ Expand Pickett / Edsall (spot improvements and add lanes on selected links). ▪ New intersection on Pickett. This new intersection will serve new grid roadway and termini of the New Bridge. ▪ New Bridge.

Phasing of the BRT/LRT system depends not only on dedicated lanes and stations within the City of Alexandria, but also on improvements in Fairfax and Arlington County. Express bus service will need to be added as an interim solution. Dedicated transit lanes will be complete in Phase 2, however full BRT/LRT is not assumed until Phase 3. The Phasing Concept:

Table 10: New Infrastructure and Service Elements by Phase	
Phase 1: With development along Pickett east of Van Dorn and Phase I of Mall redevelopment.	Duke Street ▪ Upgrade Walker Street Intersection ▪ Remove flyover ▪ New intersection between Van Dorn and Walker Van Dorn ▪ Transit lanes and improve Pickett to Edsall Grid Roadway System ▪ East-west main street ▪ Other grid roadways Transit Service ▪ Expanded Bus Transfer facility at west end ▪ Circulator service, with stop at Metro ▪ Express bus service (predecessor to BRT/LRT) Multimodal Bridge ▪ Expand Pickett /Edsall
Phase 2: Development of either BJ site and adjacent sites or sites south of Stevenson, and Phase II of Mall redevelopment.	Duke Street ▪ Transit lanes New intersection east of Van Dorn Van Dorn Street ▪ Transit lanes Edsall to north of Duke Street ▪ Transit lanes south of Pickett Street Grid Roadway System ▪ Other grid roadways Transit Service ▪ Upgrade express and local service Multimodal Bridge ▪ New intersection on Pickett
Phase 3: 90% Full redevelopment.	Duke Street ▪ BRT/LRT stations and features Van Dorn Street ▪ BRT/LRT stations and features Grid Roadway System ▪ Complete Grid Roadways Transit Service ▪ Full Van Dorn LRT / BRT ▪ Full Duke Street LRT / BRT Multimodal Bridge ▪ New Bridge

IV Future Conditions

Methodology

The process to determine future traffic conditions used an array of data sources and computerized processes. The principal data sources and computerized processes are shown below and discussed in the following pages.

Data Source or Process	Purpose
Metro Washington Council of Governments (MWCOG) travel demand forecasting model	As a data source, provides existing and future travel behavior including number of trips and mode choice.
	As a computerized process the model uses a 4 phase process to assign and distribute trips onto transportation network. Creates sub area Trip Table.
Future Land Use by Zone	Basis for future traffic demand.
Future roadway network and transit network	Future traffic "supply". Traffic is assigned to the network to create the subarea trip table.
Trip Table by Zone	Generated by the travel demand model, this trip table is used to populate a VISUM simulation
VISUM and VISSIM Traffic Simulations	Used to model traffic moving through the network. The results determined the turning movements at each intersection.
SYNCHRO	Used to determine intersection and arterial level of service.

Results of Analysis: Growth in Travel Demand

As shown in the figure, developed space has the potential to increase by 12 million square feet, and increase of nearly 50%. Table 10 shows the growth in trips due with this increase in development by mode of travel.

Table 10: Growth in Person Trips by Mode

	2008	2030 Current Zone	2030 Build
Low Occupancy Vehicles (LOV)	114,782	151,776	206,183
Transit	5,237	8,719	20,173
HOV	721	5,187	9,366
All Person Trips	120,740	165,684	235,722
% Transit and HOV	4.9%	8.4%	12.5%

The growth in trips by auto (LOV) is not as great. Transit and HOV take an increasing share of the total trips as shown in Table 11. The increase from 4.9% for transit and HOV trips to 12.5% is significant. Table 12 below shows that the increase for commuter trips (home based work) for transit and HOV.

Table 11: Home Based Work (Commuter Trips)			
	2008	2030 Current Zone	2030 Build
Low Occupancy Vehicles (LOV)	14,017	16,042	24,989
Transit	3,431	5,167	12,587
High Occupancy Vehicles (HOV)	721	5,187	9,366
All Person Trips	18,169	26,397	46,942
% Transit	18.9%	19.6%	26.8%

Traffic volumes in the study area are greatly influenced by through traffic. Table 12 shows the change in the portion of traffic that has external destinations and origins. The table shows that, despite 22 years of general growth in the surrounding area, through traffic actually decreases in the Plan area.

This is due to local trips using the available capacity of local roadways. With increased local demand, through trips will find alternative routes. The projections show external traffic is reduced, and transit use is increased. Although the overall increase in trips from 2008 to 2030 is 94%, only Duke Street has increases greater than 21%. Several link volumes are unchanged, or even decrease. This is due to a redistribution of traffic onto the new grid roadways and the new multimodal bridge.

Table 12: Change in Through (E-E) trips				
	Internal Trips	Through Trips	Total Trips	Percent change in through trips
2008	99,575	110,731	210,306	0.0%
2030 current zoning	135,651	113,366	249,017	2.4%
2030 Build	191,379	96,726	288,105	-12.6%

Quaker Lane and Seminary Road both have increases between 2008 and 2030, but only modest increases from current zoning (no build) to Plan (build). In the vicinity of Old Town on Route 1 and Washington Street the volumes are relatively unchanged. This is due to a high current volume to capacity ratios and additional capacity elsewhere in the system.

Results of Analysis: Distribution of Traffic

The new grid system works well providing alternatives for Van Dorn Street. It also works well in distributing traffic to and from Duke Street.

Table 13 shows north south trips at selected screen lines. These percentages are for roadways that are generally parallel to Van Dorn Street. Much of this traffic would be on Van Dorn Street if not for the grid roadway system.

Dispersion of traffic to the grid roadway system is important for two reasons. The vehicular capacity of Van Dorn was not increased by the improvements described in the previous sections. Furthermore, the improved circulation makes the entire system more efficient, not only for vehicles but for transit and pedestrians as well.

The new multimodal bridge will provide another access point to the new walkable street grid. The new bridge will carry 16,600 vehicle trips per day and the Van Dorn crossing will decrease from 69,400 trips per day (2030 current zoning and road links) to 52,900 trips per day.

Table 13: Van Dorn vs Grid Roadways Traffic Share, Daily Traffic

	% on Grid Roadways	% on Van Dorn
South of Duke Street	41%	59%
North of Edsall Road, including Pickett	53%	47%
At CSX RR	24% (Multimodal Bridge only)	76%

Results of Analysis: Required Left Turn Lanes on Duke Street

In order to develop Duke Street improvement options, it was determined that four left turn lanes at three intersections would be needed to access the current Landmark Mall site from the east. The analysis to determine a general "number of left turn lanes" was developed using the critical lane method with volumes calculated using ITE trip generation rates.

Total Trips Generated during PM Peak Hour:	6,700
Total Trips with reductions for Pass-by, TDM, and Internal Capture (35% total reduction):	4,300
Total entering:	2,150
Total entering from east:	1,500
Maximum per turn lane:	375
Required Lanes:	No less than 4

Currently, access from Duke Street is through a right turn lane that routes traffic onto Van Dorn Street, and a separated through lane that routes traffic onto a flyover over westbound Duke Street. For analysis purposes there are no left turn lanes on Duke Street into the mall site.

If 50% of these trips will be entering (50% exiting) the site, and 70% entering from the east then there will be approximately 1,500 eastbound left turning trips. Without high through volumes, three separate lanes at two or three intersections could conceivably meet this demand. However, Duke Street does have high through lane volumes. As such four lanes are required at a minimum.

Results of Analysis: Intersection and Arterial Performance

To determine the effects of land use changes, the road network was analyzed to determine how well traffic will move through the network. On signalized arterials, the function of the intersections determines how well the arterial will function.

Seven intersections[3] were analyzed for average delay. These intersections are:

1. Van Dorn and Pickett
2. Van Dorn and Edsall
3. Van Dorn and Stevenson
4. Van Dorn at Mall
5. Duke and Walker
6. Duke and Pickett
7. Edsall and Pickett

Table 14 and Table 15 show Average Control Delay for each of the intersections for the three study periods in the AM and PM.

In the AM (Table 15), three intersections have noteworthy declines in service: Duke and Pickett, Pickett and Edsall and Van Dorn at the Mall. The only intersection with an LOS of F is Duke and Pickett.

The change in LOS for the Pickett Street intersections is due in part to the addition of the multimodal bridge. Pickett Street, in conjunction with the bridge, becomes another arterial in the system. Unlike Van Dorn and Duke Street, Pickett Street does not have additional parallel capacity or additional turn lanes.

Duke and Walker and Van Dorn and Pickett are "gateway" intersections. Traffic entering the study area from the west or south have few options but to use these intersections. Delay is actually less at each intersection; Van Dorn / Pickett as a result of traffic diverting to the multimodal bridge, and Duke / Walker as a result of improved intersection timing and an additional lane.

Table 14: Average Control Delay, AM

Intersection	Existing	2030 Current Zone	2030 Build
Van Dorn and Pickett	65 / E	78 / E	46 / D
Van Dorn and Edsall	29 / C	43 / D	76 / E
Van Dorn and Stevenson	42 / D	35 / C	26 / C
Van Dorn at Mall	11 / B	18 / B	64 / E
Duke and Walker	40 / D	59 / E	29 / C
Duke and Pickett	23 / C	145 / F	152 / F
Edsall and Pickett	31 / C	43 / D	76 / E

In the PM (Table 15) Van Dorn / Edsall also has a decline in service and three intersections have

Table 15: Average Control Delay, PM

Intersection	Existing	2030 Current Zone	2030 Build
Van Dorn and Pickett	40 / D	49 / D	24 /C
Van Dorn and Edsall	66 / E	77 / E	107 / F
Van Dorn and Stevenson	18 / B	77 / E	78 / E
Van Dorn at Mall	11 / B	21 /C	59 / E
Duke and Walker	51 / D	52 / D	42 / D
Duke and Pickett	26 / C	90 / F	115 / F
Edsall and Pickett	24 / C	115 / F	130 / F

[3] *The intersection of Duke eastbound ramp and Van Dorn was analyzed for existing conditions. This ramp does not exist in the future Duke Street concept and is not included in the future analysis.*

LOS F: Duke / Pickett, Edsall / Pickett and Van Dorn / Edsall. However, only for Van Dorn / Edsall is the LOS worse than 2030 Current Zoning.

Table 16 shows the average delay at the worst approaches at each intersection during the PM peak period. With the exception of three approaches, most traffic in the "worst approaches" will be able to clear the intersection in a single cycle. Traffic will arrive at the intersection, wait for a green and then clear the intersection.

The three intersections with excessive delays are Van Dorn/Edsall, Duke/Pickett and Pickett/Edsall. As mentioned earlier, Pickett attracts additional traffic due to the addition of the Multimodal Bridge. With the addition of the bridge, Pickett becomes a complementary minor arterial, connecting Eisenhower Avenue with Duke Street. Improvements to Pickett may become necessary.

Table 16: Intersection Delay with Worst Approach, PM 2030 Plan

Intersection	Average Delay and LOS	Worst Approach and Volume (vph)	Average Delay at Worst Approach
Van Dorn and Pickett	24 /C	WB / 285	69.5
Van Dorn and Edsall	107 / F	SB / 2,020	125.8
Van Dorn and Stevenson	78 / E	EB / 427	144.5
Van Dorn at Mall	59 / E	SB / 1,073	64.5
Duke and Walker	42 / D	NB / 738	88.5
Duke and New Road	25 / C	NB / 424	67.3
Duke and Pickett	115 / F	NB / 2,022	129.6
Edsall and Pickett	130 / F	NB / 1,293	236.0

The Van Dorn and Edsall intersection was analyzed with combined through and right turn lanes. With an additional right turn lane in the northbound and southbound direction each, the LOS of the intersection improves to LOS E.

Based on the analysis, Picket Street may need to be upgraded and Van Dorn Street may need additional right turn lanes. Although neither improvement is part of the Plan, both should be considered again as development progresses and the planned transportation infrastructure is developed.

Arterial analysis was conducted to compare changes in travel times and average speeds. Travel times on Duke Street will increase by an average of 70% (PM peak hour). As shown in Table 17, average speeds on Duke Street are 7 to 14 mph.

Table 17: Duke Street Average Speeds

AM	Existing	2030 Current Zoning	2030 Plan
Average Speed EB	16	10	7
Average Speed WB	21	20	10
PM			
Average Speed EB	15	10	9
Average Speed WB	21	20	14

Although traffic will slow considerably on Duke Street, traffic does continue to move. This is due in part to the two additional intersections. The Highway Capacity Manual considers speeds below 10 mph for this type of roadway as LOS F. However, most traffic will move at what is considered LOS D or E. These average speeds also indicate that traffic is not projected to be gridlocked.

On Van Dorn Street, travel times will increase by an average of 34% (PM peak hour) and average speeds are 9 to 18 mph. (Table 18).

Table 18: Van Dorn Street Average Speeds			
AM	Existing	2030 Current Zoning	2030 Plan
Average Speed NB	11	11	9
Average Speed SB	17	13	18
PM			
Average Speed NB	16	12	15
Average Speed SB	14	12	9

Average speeds on Van Dorn are only slightly slower in the plan year than existing speeds. Speeds for 2030 with the current zoning are comparable to 2030 Plan speeds.

Generally, traffic will move at what is considered LOS D or E. These average speeds indicate that traffic is not projected to be gridlocked.

V Findings and Conclusions

The analysis form the previous sections result in the following findings:

1. Total demand for trips will increase by 92%.
2. Transit share will increase to a maximum 27% of commuter traffic.
3. Through traffic will decrease by 13%.
4. Vehicular traffic will be diverted to the new multimodal bridge. The bridge will carry over 16,000 vehicles per day.
5. Grid roadways will carry up to 53% of vehicular trips.
6. The Van Dorn/Edsall, Duke/Pickett and Pickett/Edsall intersections have excessive average delays (PM peak hour). The delays on Edsall can be mitigated with additional right turn lanes.
7. Travel times on Duke Street through the Plan area increase by about a minute (eastbound) and two minutes (westbound). Average speeds on Duke Street are 7 to 14 mph.
8. Travel times on Van Dorn Street increase by about a minute northbound and by about 3 minutes southbound. Average speeds on Van Dorn Street are 9 to 18 mph.

These findings lead to the following conclusions:

- The increase in total trips is significant, and cannot be achieved without significant mode shift and new roadway choices.

- Improvements to Pickett Street and the Van Dorn/Edsall Road intersection may be necessary to address the current awkward configuration..
- The new multimodal bridge and grid roadway do provide new vehicle choices and change travel patterns.
- These favorable travel patterns, combined with increased transit use and a reduction in through traffic result in manageable increases in Duke Street and Van Dorn Street traffic.