

# **Seminary Road / Beauregard Street Alternatives Report**

**Technical Memorandum - Draft**

**Review of Options for the  
Beauregard Street and Seminary Road Intersection**

**September 2012**

## Executive Summary

**Background.** The City of Alexandria, in coordination with the developers group in Beauregard Corridor Small Area Plan, has studied traffic conditions along the Beauregard corridor leading to the approval of the Beauregard Corridor Small Area Plan (SAP) dated June 16, 2012. A major area of concern along this corridor is the operation of the Beauregard Street and Seminary Road intersection under the 2035 with development conditions (also known as the Market scenario). During the planning process several options were considered to improve operations at this intersection. These alternatives included the following.

- the No-Build option,
- the Parallel Road Extension option,
- the Traffic Circle option,
- two grade-separated options, and,
- the Ellipse.

**Purpose.** This report qualitatively compares previously examined options and documents the process that led to the selection of the preferred option in accordance with the City Council guidance. The evaluation criteria included traffic operations and capacity, driveway and intersection access, pedestrian, bicycle and transit accessibility, right-of-way, utility, visual and sound effects as well as cost.

**Discussion.** The No-Build option would fail to meet the transportation demand projected in 2035 resulting in excessive delays, queues and difficult weaving maneuvers. The Parallel Road Extension option would improve operations; however, it would require significant land acquisition and would displace townhomes on the west side of Beauregard Street. The Traffic Circle option would partially address the weaving issue in westbound Seminary Road. However, because it would require all traffic to go around the circle, it still would cause delays and queues. The grade-separated options, designed as compressed diamond interchanges with the upper roadway being carried by a bridge structure, would reduce traffic delays and queues. But, due to the constrained area in which the structure could be built, it would result in sub-standard weaving, merging, and grade conditions. These compressed diamond options would also have right-of-way impacts and utility conflicts, and were the most expensive.

Ultimately, the Ellipse option was developed as a variation of the Traffic Circle option. It addresses the critical westbound weaving issue on Seminary Road, while allowing for the high volume of through traffic on Seminary Road to proceed straight ahead.

## Study Overview

This study was done in accordance with the City's request to memorialize the various intersection configuration options that were considered and analyzed at the Beauregard Street and Seminary Road intersection as part of the Beauregard Corridor Small Area Plan Transportation Analysis, Volume 1: Technical Report, dated January 18, 2012. As part of this analysis, several intersection options were explored for the Beauregard Street and Seminary Road intersection. The No-Build option included short- and mid-term improvements as proposed by Virginia Department of Transportation (VDOT). The Build options included considerations of grade-separating Beauregard Street and Seminary Road, installing a traditional traffic circle, creating parallel roads to Beauregard Street to provide alternative travel routes, and the Ellipse, which is the preferred option.

## Report Purpose and Structure

The purpose of this report is to summarize the intersection options that led to the selection of the preferred option, qualitatively compare previously examined alternatives and document the process that led to the selection of the preferred option in accordance with the City guidance.

This technical memorandum gives the reader an understanding of the design and impacts associated with each option, provides a pro and con comparison, and explores the grade-separated options in further detail. This memorandum is organized in the following manner:

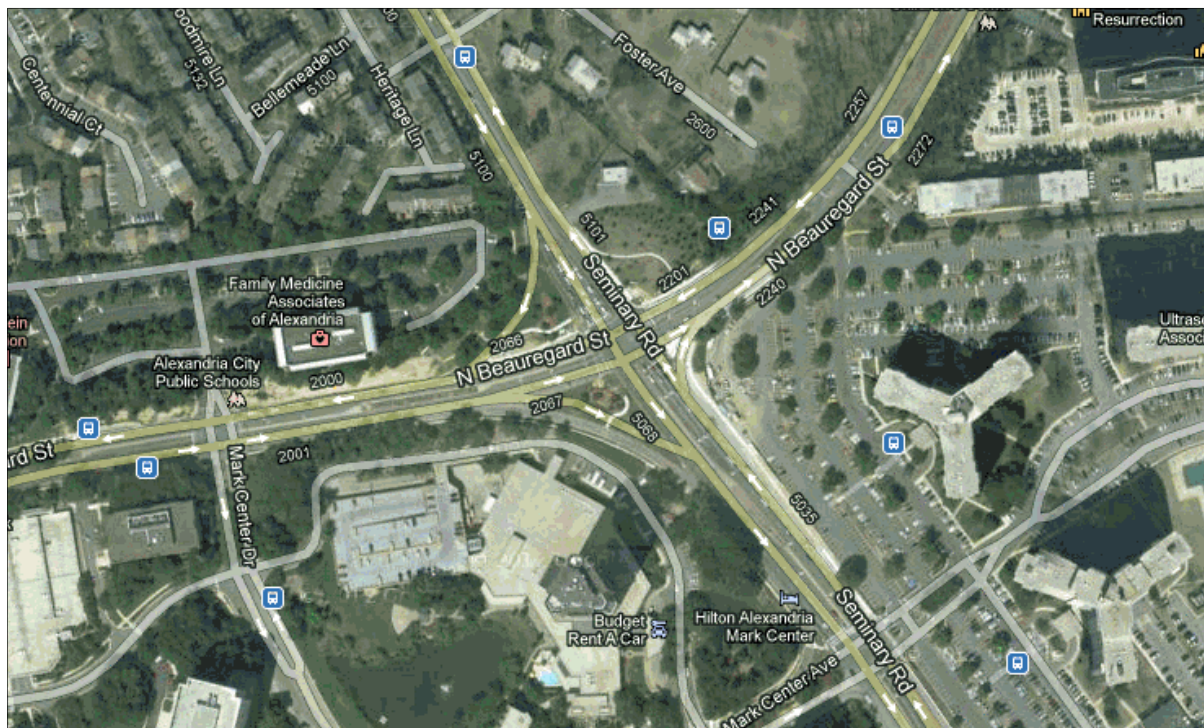
- Site Description
- Intersection Options
- Comparison of Options
- Appendix A – Grade-separated Options

## Site Description

The intersection of Beauregard Street and Seminary Road is located in the City of Alexandria's West End. This at-grade signalized intersection is served by I-395 to the east and is surrounded by office, residential and hotel uses.

Currently, the intersection configuration is comprised of signalized through and left-turn movements and free flow right-turn movements for three of the four legs. Westbound Seminary Road has triple left-turn lanes, dual through lanes and a free flow right movement. Eastbound Seminary Road consists of a single left-turn lane, triple through lanes and a free flow right-turn lane that originates approximately 200-feet west of the intersection. Beauregard Street in the northbound direction has dual left-turn lanes, dual through lanes and a single free flow right-turn lane that originates approximately 200-feet south of the intersection. Southbound Beauregard Street does not have a free flow right movement but consists of a single left-turn lane, a through lane and a combined through and right-turn lane. Separating the two larger free-flow right-turn lanes are landscaped islands. Adjacent to this intersection are several roadways and property entrances, including Mark Center Drive, which is accessible from both Beauregard Street and Seminary Road. Sidewalks and pedestrian paths provide accessibility along these roadways and between developed properties.

Figure 1: Existing Site



## Intersection Options

The options examined for this intersection include:

- No-Build (VDOT short- and mid-term improvements)
- Parallel road extension
- Traditional traffic circle
- Grade-separated options
- Ellipse

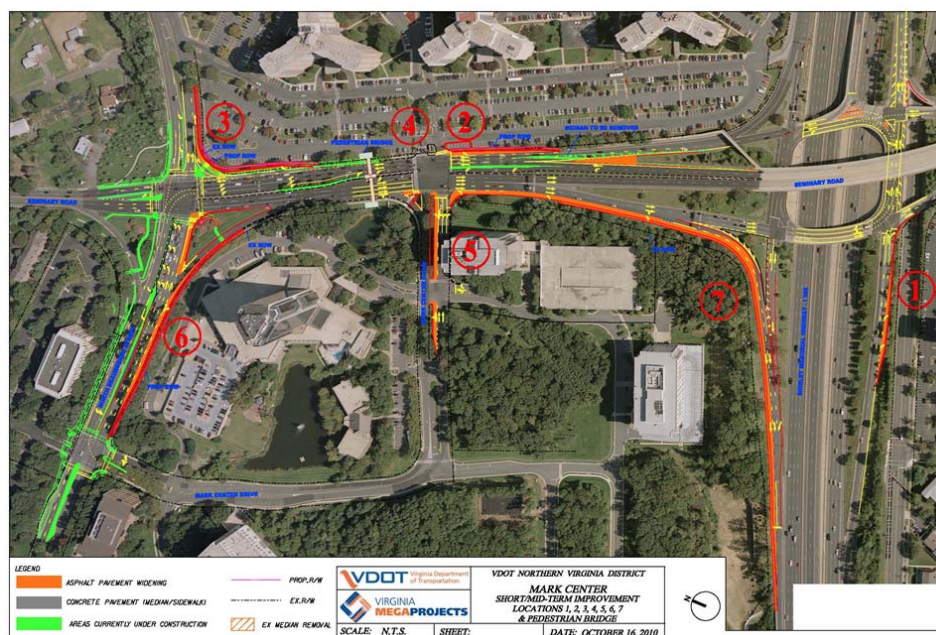
**No-Build.** The No-Build option included short- and mid-term improvements as proposed by Virginia Department of Transportation (VDOT) as explained below. Figure 2 illustrates these improvements.

- Widen northbound Beauregard Street between Mark Center Drive and Seminary Road to provide a dedicated right-turn lane to Seminary Road downstream of the direct ramp connecting northbound Beauregard Street to Eastbound Seminary Road. Reconfigure intersection to allow for two dedicated left-turn lanes and two through-lanes along northbound Beauregard Street. The new dedicated right-turn lane will be signed for Seminary Road eastbound to allow eastbound Seminary Road traffic to avoid the weave condition between the direct ramp exit and Mark Center Drive.
- Widen westbound Seminary Road at Beauregard Street to provide a deceleration lane and widen northbound Beauregard Street at Seminary Road to provide an acceleration lane for the westbound-to-northbound right-turn lane.
- Widen westbound Seminary Road from the rotary back to the Mark Center Drive to two lanes and provide a dedicated right-turn lane into Southern Towers. Restripe the westbound Seminary Road flyover to allow one through lane on Seminary Road and one left-turn lane



- into Mark Center Drive. Provide a physical separation between the two lanes from the rotary and the left-turn lane at Mark Center Drive.
- Widen eastbound Seminary Road from Mark Center Drive to the I-395 southbound ramp meter signal to provide a continuous two-lane ramp. Restripe the southbound ramp connection from the rotary to provide a merge into the two-lane ramp from eastbound Seminary Road.
  - Widen the northbound I-395 off-ramp from two to three lanes, providing two through lanes and one right-turn lane. Restripe the rotary (area encompassing the four intersections of the I-395 on and off ramps at the Seminary Road interchange) to provide dual lefts for the northbound-to- westbound movements and eastbound-to-northbound movements. Restripe the westbound approach at the I-395 southbound off-ramp to provide two through lanes and one left-turn lane.
  - Provide triple right-turn lanes from northbound Mark Center Drive to eastbound Seminary Road.

**Figure 2: VDOT Short- and Mid-Term Improvements**



**Parallel Road Extension.** This option introduces a parallel road west of Beauregard Street connecting the intersections of Heritage Lane and Seminary Road to Sanger Avenue in addition to the no build configuration.

**Figure 3: Parallel Road Extension**



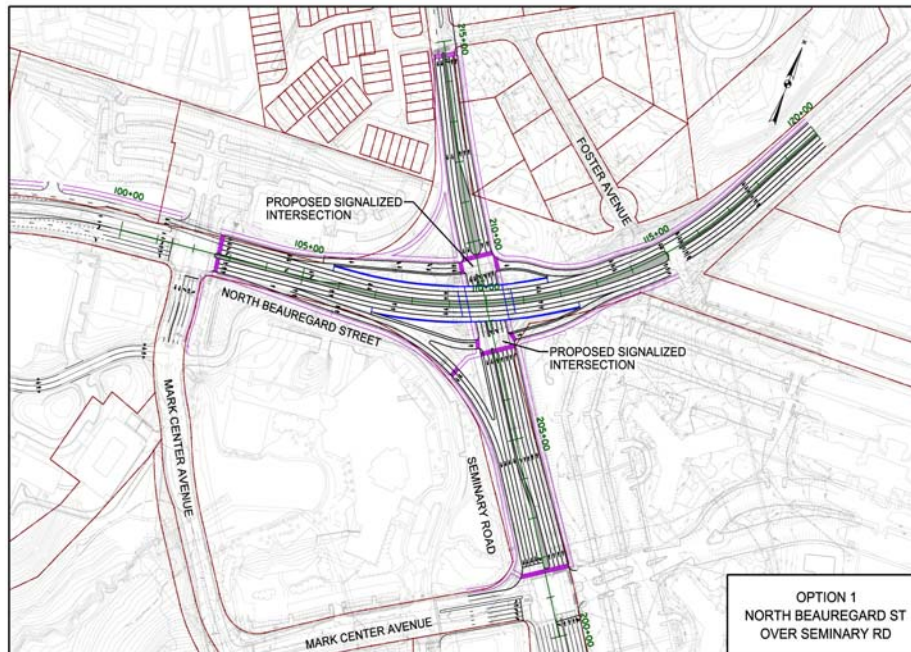
**Traffic Circle.** This option includes a traditional four-legged traffic circle with signals at each approach.

**Figure 4: Traffic Circle**

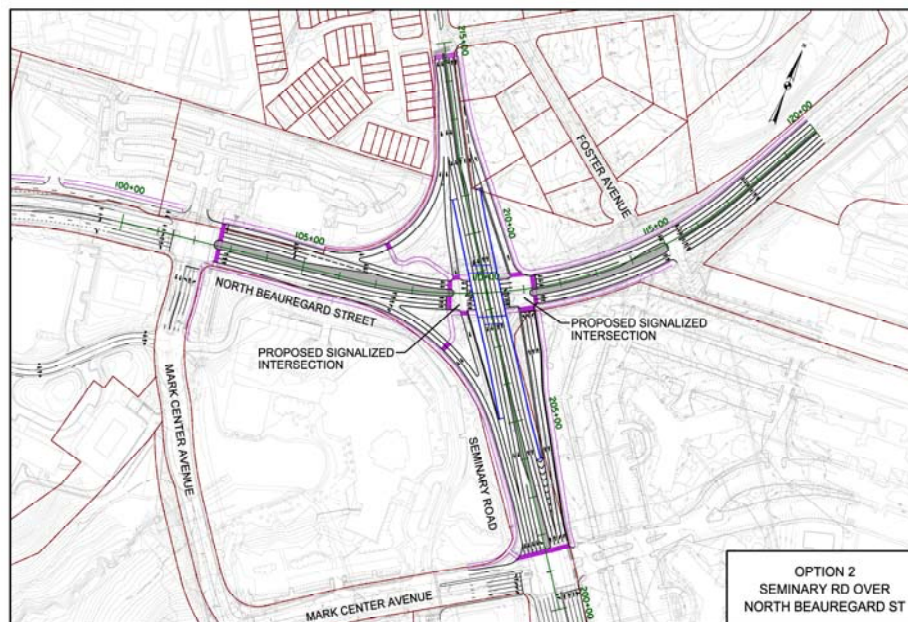


**Grade-separated Options.** Two compressed diamond grade-separated options were considered: Option 1: Beauregard Street over Seminary Road, and Option 2: Seminary Road over Beauregard Street. These schematic options are designed as compressed diamond interchanges in accordance to VDOT and AASHTO design guidance. A compressed diamond interchange is an interchange in which a ramp is provided at each quadrant to facilitate left and right turns. Refer to **Appendix A** for a detailed discussion of these two options.

**Figure 5: Grade Separated Option 1**



**Figure 6: Grade Separated Option 2**





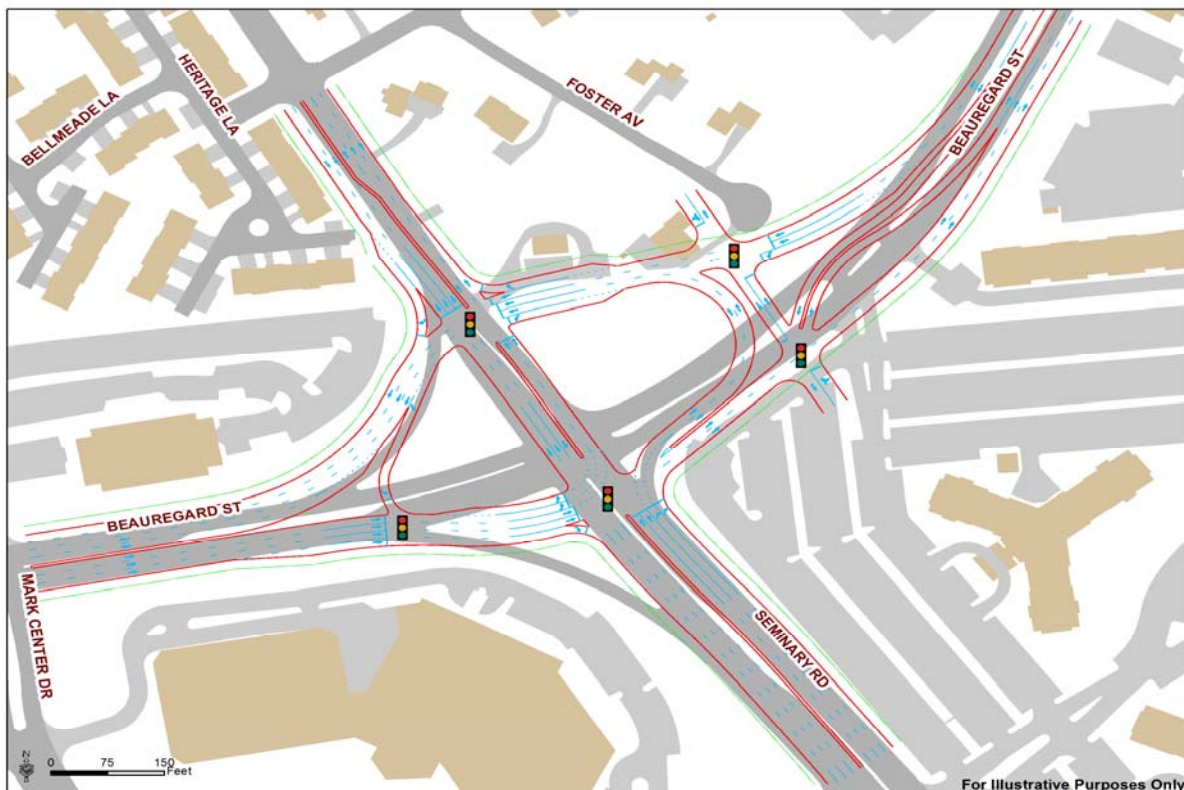
**The Ellipse.** This option includes a modified traffic circle that allows the Seminary Road through movements continue through the circle. For the Ellipse, the existing conventional eight-phase traffic signal would be replaced with a pair of inter connected, coordinated four-phase signals along Seminary Road located about 300 feet apart. Vehicles turning left from eastbound and westbound Seminary Road would loop around the Ellipse to complete the movements. A separate right-turn lane would be added along westbound Seminary Road that extends back to Mark Center Drive.

Signal control at the Ellipse comprises of five nodes which include:

- Northbound Beauregard Street at Seminary Road
- Southbound Beauregard Street at Seminary Road
- Eastbound Main Street at Southbound Beauregard Street
- Northbound Beauregard Street at Ellipse (intersects with eastbound left-turn leg)
- Westbound Main Street at Northbound Beauregard Street (from Southern Towers)

All the signalized intersections within the Ellipse are designed to be coordinated, providing smooth traffic flow on Beauregard Street and Seminary Road.

**Figure 7: Ellipse**





## Comparison of Alternatives

The alternatives described above were assessed based on the following criteria/effects:

- Traffic operations and capacity including intersection/interchange spacing, level-of-service, queuing and weaving
- Geometry
- Driveway and intersection access
- Pedestrian, bicycle and transit access
- Right-of-way
- Utility
- Noise
- Aesthetics
- Cost

Below is a summary of the traffic operations assessment of the various options. Table 1 summarizes the overall pros and cons of each option. Table 2 summarizes the evaluation of these options under the criteria identified above in a graphical manner.

**No-Build.** The Beauregard Corridor Small Area Plan Transportation Analysis, Volume 1: Technical Report, dated January 18, 2012 shows that the intersection would operate at Level-of-Service (LOS) F with an average vehicle delay of 84.5 seconds during the AM peak hour in the 2035 No-Build condition. In particular, vehicles coming from westbound Seminary Road would experience an average delay of 121 seconds (LOS F) and the westbound queues on Seminary Road would spill beyond Mark Center Drive and up to the I-395 HOV ramp during the AM peak hour. This makes this option unacceptable from an operations perspective. For the PM period, the intersection would operate with a LOS E and with an average vehicle delay of 58.3 seconds. It should be noted that the results only reflect the 2035 without development traffic conditions. With 2035 development conditions, the traffic operation is expected to further deteriorate.

This option also creates a two-sided weaving problem. Westbound vehicles on Seminary Road coming from north on I-395 need to change more than one lane to reach the triple left-turn lanes at Beauregard Street conflicting with the traffic coming from the bridge over I-395 on westbound Seminary Road destined to turn right or go through at the Beauregard intersection. In addition, this option creates wide cross-section, which is not pedestrian friendly.

**Parallel Road Extension.** The Parallel Road option introduces a new parallel roadway as an alternative to Beauregard Street at the Seminary Road intersection in addition to the proposed changes under the No-Build configuration. This additional capacity would relieve some of the congestion that would otherwise occur under the No-Build configuration. Delays, queues and weaving issues would be more favorable compared to the No-Build scenario. However, the parallel road requires right-of-way takings in the order of 12 to 17 townhomes west of Beauregard Street, and, therefore, has significant community impacts. This impact rendered this option unacceptable.

**Traffic Circle.** The traffic circle option provides additional queuing storage for the heavily used westbound left-turn movement during the AM peak hour by requiring vehicles to go around the circle. It also addresses some of the weaving problems described under the No Build scenario as all traffic is forced to go around the circle (turning right). However, requiring all westbound and eastbound Seminary Road traffic to go around the circle would result in significant queues and delays at all proposed signalized intersections at the circle.

**Grade-separated Options.** These options are designed as compressed diamond interchanges allowing one roadway to be grade-separated from the other. Ramps are provided at each quadrant to facilitate left and right turns. High delays for vehicles and pedestrians are caused by ramps feeding into the two new signalized intersections. Weaving impacts are also associated with these options, especially on westbound Seminary Road approaching Beauregard Street, and the ramp connecting Seminary Road to southbound Beauregard under Option 1, where two lanes merge into

one lane which will cause significant impacts on westbound left-turning traffic, which carries high demand with Option 1. Short storage distances may not handle high demands, which may cause traffic queues to spill back on westbound Seminary Road. Additional aspects of these options are discussed in Table 2.

**Ellipse.** As proposed in the SAP, the Ellipse provides the most favorable traffic operations. According to the SAP, the Seminary Road and Beauregard Street intersection would operate at LOS D with an average vehicle delay of 54.3 second during the AM peak hour in the 2035 Build condition. The westbound approaches experience an average delay of 69.2 seconds (LOS E), and the queues do not reach the upstream intersection at Mark Center Drive. As compared to the No Build conditions, the Ellipse reduces average vehicle delays and queues, provides more storage spaces for westbound left-turning vehicles, and provides higher capacity to handle future traffic growth in the 2035 with development condition.

Unlike the No-Build option, the vehicles coming from I-395 on westbound Seminary Road do not need to change lanes to make left turns at Beauregard Street. This partially alleviates some of the weaving issues between I-395 and Beauregard Street on westbound Seminary Road.

Table 2 qualitatively compares the pros and cons of each option. Criteria used for comparison include: traffic operations, geometry, accessibility, pedestrian/transit access, right-of-way, utilities, noise, aesthetics, and cost. Major impacts, which are associated with fatal flaws, are highlighted in bold.

**Table 1: Pros and Cons Comparison of Options**

Option	Pros	Cons
<b>No-Build</b>	<ul style="list-style-type: none"> <li>User familiarity.</li> <li>Cost effective.</li> <li>Minimal additional utility and ROW impacts.</li> <li>At-grade construction.</li> <li>Keeps access to existing driveways and intersections.</li> <li>Compatible with proposed Bus Rapid Transit (BRT) Transitway operations.</li> </ul>	<ul style="list-style-type: none"> <li><b>Future westbound queues on Seminary Road would spill beyond Mark Center Drive and up to the I-395 HOV ramp during the AM peak hour with and without future development.</b></li> <li>Wide cross-section is not pedestrian friendly.</li> <li>Weaving problems on westbound Seminary Road.</li> <li>Lack of capacity for handling traffic growth in the future years.</li> </ul>
<b>Parallel Road Extension</b>	<ul style="list-style-type: none"> <li>Divert traffic demand along Beauregard Street and provide additional capacity.</li> <li>Improved weaving condition compared to No Build.</li> <li>At-grade construction.</li> <li>Keeps access to existing driveways and intersections.</li> <li>Compatible with proposed Bus Rapid Transit (BRT) Transitway operations.</li> </ul>	<ul style="list-style-type: none"> <li><b>Residential units in path of proposed roadway creating significant right-of-way (taking 12 to 17 townhomes) and community impacts.</b></li> <li>Places more traffic on local/residential roadways.</li> <li>Significant cost due to taking 12-17 townhomes.</li> <li>Potentially increased noise through residential areas.</li> </ul>
<b>Traffic Circle</b>	<ul style="list-style-type: none"> <li>At-grade construction.</li> <li>Allows for landscaping/ green space in center creating an opportunity for a gateway feature.</li> <li>Improved weaving condition compared to No-Build.</li> <li>Keeps access to existing driveways and intersections.</li> <li>Compatible with proposed Bus Rapid Transit (BRT) Transitway operations.</li> </ul>	<ul style="list-style-type: none"> <li><b>Significant delays and queuing expected to impact adjacent intersections as well as I-395 operations.</b></li> <li>Lack of capacity for handling traffic growth in the future years.</li> <li>Moderate right-of-way impacts.</li> </ul>

Option	Pros	Cons
<b>Grade Separated</b>	<ul style="list-style-type: none"> <li>Separated movements for through traffic on Beauregard Street and Seminary Road.</li> <li>Opportunity for installation of public art and gateway features on bridge elements.</li> <li>Allows for landscaping in medians</li> <li>Pedestrian movements/ access remain at-grade and ADA accessible.</li> <li>Compatible with proposed Bus Rapid Transit (BRT) Transitway operations.</li> </ul>	<ul style="list-style-type: none"> <li><b>Significant weaving and merging issues at certain ramp entrances and exits as well as possibly high traffic delays for turning vehicles and pedestrians.</b></li> <li><b>Significant right-of-way impacts particularly related to the elimination of parking spaces in Southern Towers.</b></li> <li>1 acre of construction beyond existing ROW limits.</li> <li>Turn movements accessible only off of ramps.</li> <li>Greater potential for traffic accidents due to increased number of conflict points.</li> <li>To achieve min. under clearance for Option 1, Beauregard St. will have steep approach grades (7.2% and 10%).</li> <li>Utility impacts/ relocations due to bridge and retaining wall elements.</li> <li>Visual disruption due to bridge structure.</li> <li>Potential for increased noise and light pollution due to elevated structure</li> <li>Extensive signal timing coordination need among closely spaced intersections.</li> <li>Not compatible with the character of the planned development.</li> <li>High initial cost and required future maintenance costs.</li> </ul>
<b>Ellipse</b>	<ul style="list-style-type: none"> <li>At-grade construction.</li> <li>Allows for landscaping/green space in center.</li> <li>More storage space for westbound left turns.</li> <li>Better intersection traffic operation.</li> <li>Reduced vehicle weaving impacts on westbound Seminary Road approaching Beauregard Street.</li> <li>Capable of handling future traffic growth associated with future development.</li> <li>Environmental impacts/noise similar to existing conditions.</li> <li>Compatible with proposed Bus Rapid Transit (BRT) Transitway operations.</li> <li>Compatible with pedestrian and bike circulation as envisioned in the SAP.</li> </ul>	<ul style="list-style-type: none"> <li>Unconventional compared to a standard intersection and requires special design.</li> <li>Moderate ROW impacts.</li> </ul>

\***Bold indicates major impacts associated with fatal flaws**

**Table 2: Qualitative Comparison of Options**

Options	No-Build	Parallel Road Extension	Traditional traffic circle	Grade-separated Options	Ellipse
Traffic Operations					
Geometry					
Driveway Access					
Pedestrian and Bicycle Accessibility					
ROW Impacts					
Utility Impacts					
Noise					
Aesthetics and Compatibility with Urban Environment					
Cost					

Good
 Fair
 Poor
 Fatal Flaw



## APPENDIX A – Grade-separated Options

For this study, two grade-separated options were developed at a schematic level; Option 1: Beauregard Street over Seminary Road, and Option 2: Seminary Road over Beauregard Street. During the preparation of the Beauregard Corridor Small Area Plan, grade separated options were discussed and ruled out based on professional judgment; this report provides a more thorough investigation based on development of schematic designs and analysis of impacts.

### Grade Separated Options

These schematic options are designed as compressed diamond interchanges in accordance with the VDOT Road Design Manual, Volume 1, and AAHSTO Geometric Design of Highways and Streets, 2004. A compressed diamond interchange is an interchange in which a ramp is provided at each quadrant to facilitate left and right turns. This allows for minimal interference for traffic approaching the intersection from either direction. Although this requires signalization at the end of the ramps, typically, the right movement can be free-flowing, but otherwise the end of the ramp functions as a T intersection at grade. This requires four-phase signal phasing with overlapping for both intersections along the at-grade roadway.

Both options are schematically designed to maintain the existing elevation for the lower roadway and utilize bridge/structural elements to provide grade separation. Designing the grade separated options in this manner may result in steeper roadway grades. A proposed centerline was created along both roadways that tie into the existing roadways beyond the intersection limits, which in both options are the nearest upstream/downstream intersections; all proposed geometry is offset from these centerline locations except where the pavement is transitioned in order to match existing lane width. Lane configuration is based on available traffic data, travel demand forecasts presented in the Beauregard Corridor Small Area Plan Transportation Analysis, Volume 1: Technical Report, dated January 18, 2012, and geometry of existing and proposed receiving roadways and driveways. The typical lane widths used are 11-feet and 12-feet.

Due to the elevated upper roadway, retaining walls are required to separate the ramps from the upper roadway; walls are only necessary along the inner side of the ramps. The height of the wall will vary and increase as it approaches the bridge abutment.

To analyze construction impacts and costs, these options include roadway and bridge elements, retaining walls, medians, sidewalks and ADA facilities, potential traffic signals, and utilities. The attached sketches show a proposed design and identify right-of-way impact locations and key constraints.

**Option 1: Beauregard Street over Seminary Road.** This grade-separated option provides unrestricted through access along Beauregard Street by means of a bridge structure to span over Seminary Road; Seminary Road will generally maintain its existing elevation. Access between Beauregard Street and Seminary Road is obtained by on/off ramps located at the four corners of the intersection; see attached plan and profile.

The north side of the Beauregard Street and Mark Center Drive intersection represents the starting point for this option. On Beauregard Street, three travel lanes are provided in the northbound direction; two of these lanes are for northbound through traffic, which continues over the bridge, and the right lane is to access Seminary Road. This ramp, at the southeast quadrant, begins as a single lane but splits in to two. Two lanes continue as a free-flow right movement onto eastbound Seminary Road. To access westbound Seminary Road from this ramp, a short exit lane is provided off of the left lane and terminates at a new traffic signal on Seminary Road to facilitate left-turn movements. At this signal, westbound Seminary Road will be able to access northbound Beauregard Street through a dedicated right-turn lane and the new single lane ramp at the northeast quadrant.

Traveling southbound on Beauregard Street there are two through lanes. To exit onto Seminary Road, a single lane exit ramp is provided. A traffic signal is introduced at the end of this ramp to allow right and left-turns onto Seminary Road. From this signalized intersection, eastbound Seminary Road will make a right-turn onto a new two lane ramp to access southbound Beauregard Street. Likewise, westbound Seminary Road will have dual left-turn lanes to access the ramp. Due to ROW constraints, this ramp merges from two lanes into one lane that serves as a dedicated through lane on Beauregard Street; this movement accommodates future configuration of the intersection of Mark Center Drive.

In this option, Seminary Road generally maintains its horizontal and vertical alignment. However, through and turning lanes are added to accommodate movements associated with a compressed diamond interchange. Beginning at the intersection of Mark Center Drive, westbound Seminary Road will begin with four through lanes and eastbound will have four through lanes (two lanes from northbound Beauregard and two lanes from Seminary Road) plus a dedicated left-turn lane into Southern Towers. At the new signalized intersection associated with the ramps for northbound Beauregard Street, Seminary Road will have four through lanes and a dedicated right turn lane; eastbound Seminary Road will have two lanes with the left lane being a through and left movement. At the second new signalized intersection, westbound Seminary will have two through lanes and two left-turn lanes to access southbound Beauregard; eastbound will have two through lanes.

The bridge has a span length of approximately 100 feet with an out-to-out width of approximately 88 feet. Two through lanes, as well as 12-foot wide shoulders and a 16-foot median, will be carried by the bridge; sidewalks are not carried by the bridge as pedestrian movements will remain at existing grade. At this time, the structure is envisioned to have a steel superstructure designed in accordance with VDOT bridge standards and will provide a minimum 16'-6" clearance over Seminary Road. Retaining walls are necessary and will either be mechanically stabilized earth (MSE) or traditional cast in place concrete walls. The bridge abutments have a wide setback to accommodate the pedestrian realm and to improve visibility.

Medians are used to separate opposing traffic and vary in width from a minimum of four-feet to a maximum of 28-feet. At locations where median widths exceed six feet, median composition is assumed to be turf or landscaped, possibly including Low Impact Development (LID) treatments such as bioretention; a landscape plan has not been prepared as part of this report. A minimum ten-foot wide sidewalk/trail, with a four-foot setback from the roadway, is used throughout except under the bridge or if existing sidewalk is wider. Pedestrian facilities generally follow existing circulation patterns.

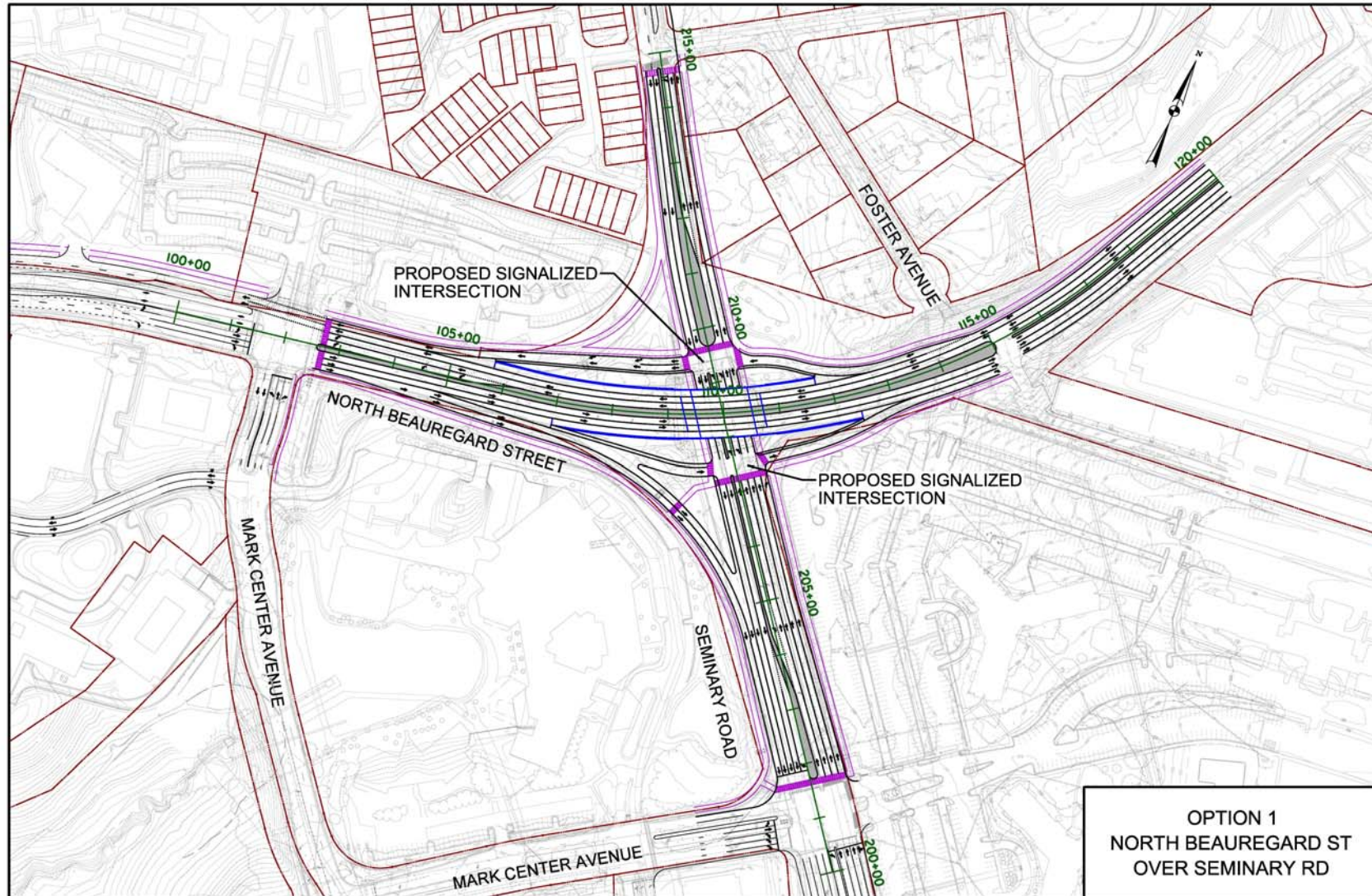
Pros and cons for Option 1 can be found in Appendix A – Table 1 on the next page:

## Appendix A -Table 1: Pros and Cons of Option 1: Beauregard Street over Seminary Road

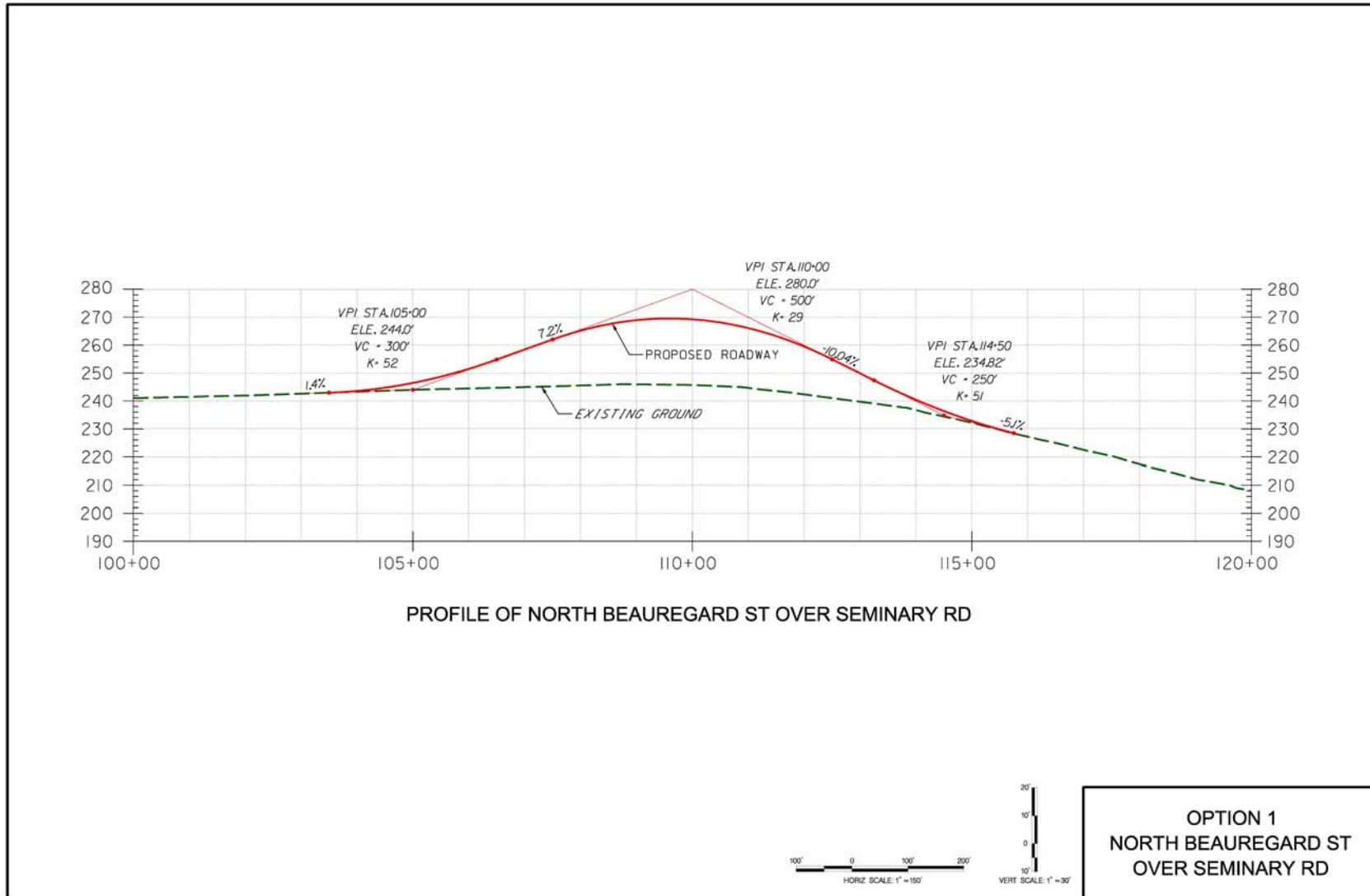
Pros	Cons
<ul style="list-style-type: none"> <li>Minimizes delays for through traffic on Beauregard Street.</li> <li>Pedestrian circulation similar to existing.</li> <li>Opportunity for installation of public art and gateway features on bridge elements</li> <li>Allows for landscaping in medians</li> <li>The option is compatible with proposed Bus Rapid Transit (BRT) operation along the Beauregard Street.</li> </ul>	<ul style="list-style-type: none"> <li><b>High cost to construct (\$41.9 M) coupled with future maintenance costs.</b></li> <li><b>Weaving impacts on westbound Seminary Road approaching Beauregard Street – vehicles coming from I-395 to change more than one lane to reach the left-turn lane at Beauregard Street.</b></li> <li>To achieve the min. 16.5' clearance over Seminary Road, Beauregard Street will have steep approach grades (7.2% and 10.0%) which exceed AASHTO requirements.</li> <li>Loss of parking spaces within the Southern Tower complex.</li> <li>Potential light pollution effects.</li> <li>Approximately 1 acre of construction beyond existing ROW limits.</li> <li>Four approaches (ramps) feeding into the two new signalized intersections on Seminary Road need to operate under split phases, which will cause high delays for vehicles and pedestrians.</li> <li>Relocation of aerial and underground utilities.</li> <li>The ramp connecting Seminary Road to southbound Beauregard merges two lanes into one lane, which will cause significant impacts on westbound left-turning traffic which carries high demand.</li> <li>Increased levels of light pollution due to height of bridge.</li> <li>The lane changing distance is too short for vehicles coming from Seminary Road to get into southbound left-turn lanes on Beauregard Street for Mark Center Drive.</li> </ul>

\***Bold indicates major impacts associated with fatal flaws**









**Option 2: Seminary Road over Beauregard Street.** Beginning just west of the intersection of Mark Center Drive and Seminary Road, this option ramps Seminary Road up to span over Beauregard Street which remains at its current elevation; see attached plan and profile. Two through lanes in each direction, as well as 12-foot wide shoulders, will be carried by the bridge; sidewalks are not carried by the bridge as pedestrian movements will remain at existing grade. Beauregard Street will generally remain on its current horizontal and vertical alignment. Seminary Road will maintain its horizontal alignment but the vertical profile will change dramatically due to the introduction of the bridge needed to provide a minimum 16'-6" clearance over Beauregard Street. Two new traffic signals will be introduced along Beauregard Street where the new ramps serve to exit and access Seminary Road.

The bridge has a span length of approximately 113 feet with an out-to-out width of approximately 76 feet. At this time, the structure is envisioned to have a steel superstructure designed in accordance with VDOT bridge standards. Retaining walls will either be mechanically stabilized earth (MSE) or traditional cast in place concrete walls. The bridge abutments have a wide setback from Beauregard Street to accommodate the pedestrian realm and to improve sight distances and visibility.

Ramps at each quadrant facilitate turns to and from Beauregard Street. Traffic traveling westbound on Seminary will utilize a two lane ramp to access Beauregard Street. Prior to the intersection, the ramp will gain a lane so as to provide dual left-turn lanes and a single right-turn lane; the construction of this ramp impacts existing parking for Southern Towers. To access westbound Seminary Road from southbound Beauregard Street, a single lane ramp is provided. Traveling eastbound on Seminary Road, a split ramp provides access to northbound and southbound Beauregard Street. Shortly after exiting Seminary Road, vehicles can continue straight on the ramp to the signalized intersection to make a left on to northbound Beauregard, or use the free-flow right-turn lane to travel south in a manner similar to the existing condition. To exit northbound Beauregard Street towards eastbound Seminary Road, a two lane free-flow ramp is provided. Vehicles heading south on Beauregard Street will make a left turn at the new traffic signal to utilize the ramp to access eastbound Seminary Road. The existing free-flow right-turn lane from eastbound Seminary Road on to Mark Center Drive has been eliminated; vehicles will now make a right turn at the intersection. A new driveway into Southern Towers off of Beauregard Street has been shown as per the Ellipse design.

Medians vary from a minimum of four-feet to a maximum of 33-feet. Concrete medians are used to provide permanent separation of traffic. At locations where median widths exceed six feet, median composition is assumed to be turf or landscaped, possibly including LID treatments such as bioretention; a landscape plan has not been prepared as part of this report. Pedestrian access has been shown and generally mimics existing configuration. A minimum ten-foot wide sidewalk with a four-foot setback from the roadway is used throughout except under the bridge or if existing sidewalks is wider.

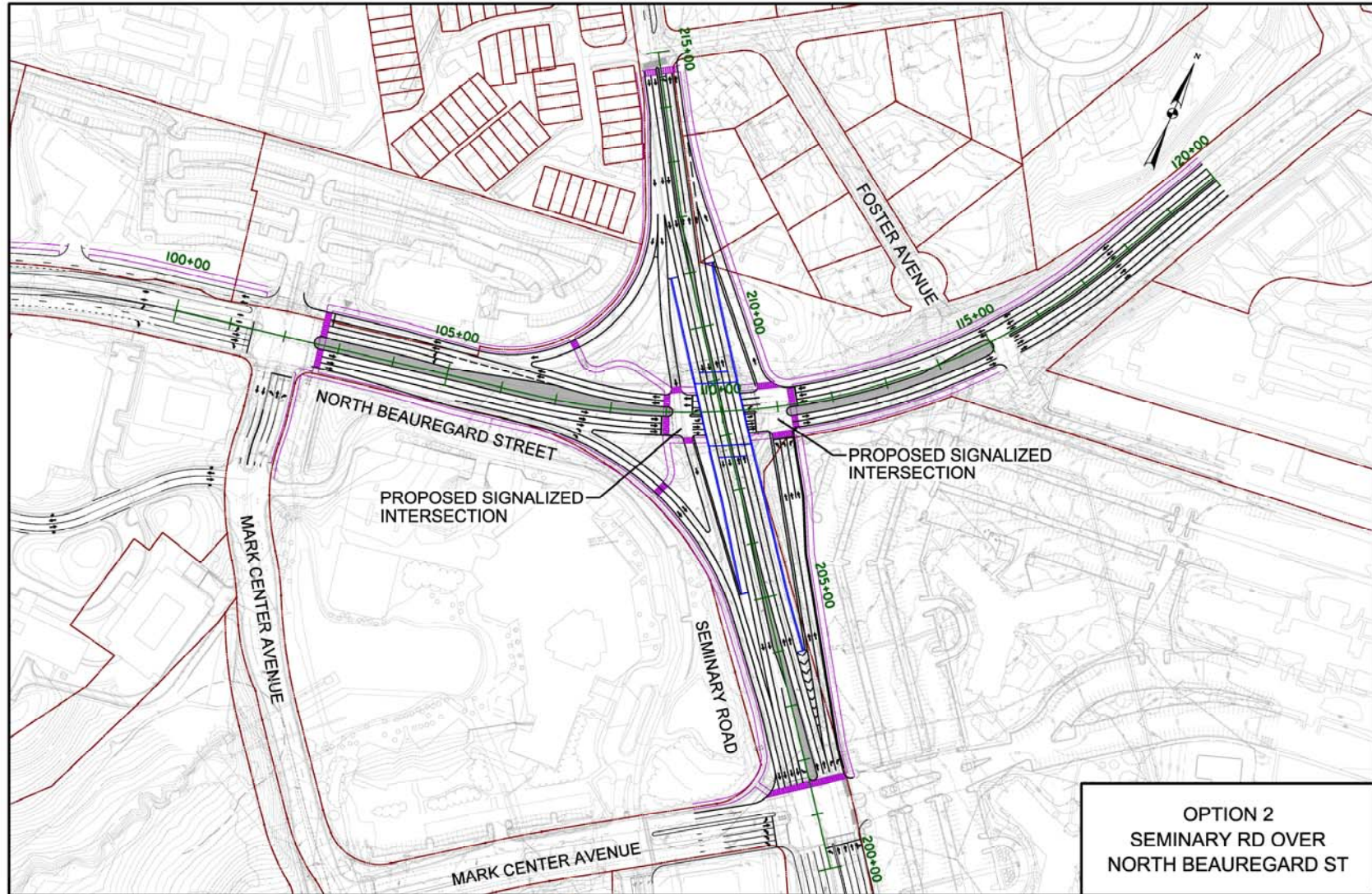
Pros and cons for Option 2 can be found in Appendix A – Table 2 on the next page:

## Appendix A -Table 2: Pros and Cons of Option 2: Seminary Road over Beauregard Street

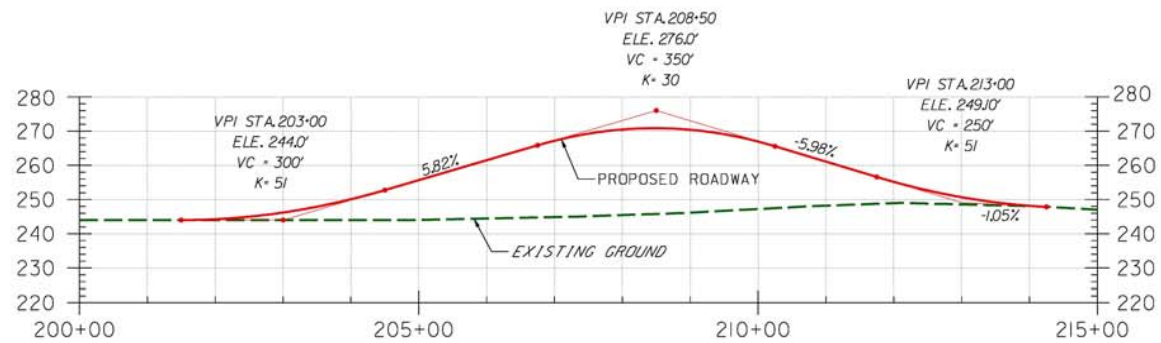
Pros	Cons
<ul style="list-style-type: none"> <li>Minimizes traffic delays for through traffic on Seminary Road.</li> <li>Pedestrian circulation similar to existing.</li> <li>Opportunity for installation of public art and gateway features on bridge elements</li> <li>Allows for landscaping in medians</li> <li>Dual right-turn lanes are provided for northbound approach on Beauregard Street at Seminary Road. This lane configuration would improve the traffic operation for this heavy movement during the AM and PM peak hours.</li> <li>The option is compatible with proposed Bus Rapid Transit (BRT) operation along the Beauregard Street.</li> </ul>	<ul style="list-style-type: none"> <li><b>High cost to construct (\$42.3 M) coupled with future maintenance costs.</b></li> <li><b>Weaving issues for Seminary Road through traffic exiting for Beauregard Street and for eastbound Seminary Road traffic merging onto southbound Beauregard to access Mark Center Drive.</b></li> <li>To achieve the min. 16.5' clearance over Beauregard Street, Seminary Road will have steep approach grades (5.82% and 5.98%).</li> <li>Close proximity to adjacent intersections limits bridge touchdown location creating a steeper structure.</li> <li>Loss of parking spaces within the Southern Tower complex.</li> <li>Approximately 1 acre of construction beyond existing ROW limits.</li> <li>Relocation of aerial and underground utilities.</li> <li>Four approaches (ramps) feeding into the two new signalized intersections on Beauregard Street need to operate under split phases, which will cause high delays for vehicles and pedestrians.</li> <li>Two left-turning lanes, combined with short storage distance, may not handle high left-turning demand from westbound Seminary to Beauregard Street and may cause traffic queues to spill back on westbound Seminary Road.</li> </ul>

\***Bold indicates major impacts associated with fatal flaws**

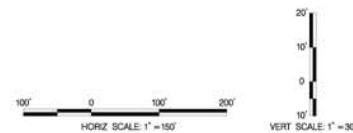
As part of the analysis of grade separated options, an order of magnitude construction cost estimate has been prepared as shown below. This estimate is based on the schematic designs presented. Contingency percentages used are in line with previous studies. Please note that this estimate does not reflect cost for right-of-way acquisition.







PROFILE OF SEMINARY RD OVER NORTH BEAUREGARD ST



**OPTION 2**  
**SEMINARY RD OVER**  
**NORTH BEAUREGARD ST**

**Appendix A - Table 3: Order of Magnitude Cost Estimate for grade-separated Options**

Option	Item	Unit	Quantity	Unit Price	Cost
1	Site Clearing	AC	9.0	\$2,500	\$22,431
	Bridge (Superstructure and substructure)	SF	8782	\$235	\$2,063,770
	Retaining Walls	SF	7244	\$110	\$796,785
	Sidewalks/Multi-use trail (concrete)	SY	6418	\$65	\$417,192
	Curb and Gutter	LF	7629	\$20	\$152,580
	Pavement	SY	28451	\$140	\$3,983,202
	Earthwork	CY	116244	\$30	\$3,487,322
	Signalized Intersection	EA	5	\$225,000	\$1,125,000
	Lighting	LS	1	\$914,840	\$914,840
	Landscaping	LS	1	\$100,000	\$100,000
	Subtotal				\$13,063,122
	SWM				\$3,265,780
	E&SC				\$914,419
	Utilities				\$1,959,468
	Marking and Signage				\$261,262
	MOT				\$1,959,468
	Mobilization and Survey				\$1,306,312
	Construction Management				\$3,265,780
	Subtotal				\$12,932,491
	Total				\$25,995,612
	Design				\$2,599,561
	1% Bond				\$259,956
	Contingency (50%)				\$12,997,806
	Total				\$41,852,936
2	Site Clearing	AC	8.6	\$2,500	\$21,475
	Bridge (Superstructure and substructure)	SF	8486	\$235	\$1,994,210
	Retaining Walls	SF	8828	\$110	\$971,025
	Sidewalks/Multi-use trail (concrete)	SY	6412	\$65	\$416,780
	Curb and Gutter	LF	7834	\$20	\$156,680
	Pavement	SY	28473	\$140	\$3,986,282
	Earthwork	CY	113555	\$30	\$3,406,638
	Signalized Intersection	EA	5	\$225,000	\$1,125,000
	Lighting	LS	1	\$1,147,930	\$1,147,930
	Landscaping	LS	1	\$100,000	\$100,000
	Subtotal				\$13,326,021
	SWM				\$3,265,780
	E&SC				\$914,419
	Utilities				\$1,959,468
	Marking and Signage				\$261,262
	MOT				\$1,959,468
	Mobilization and Survey				\$1,306,312
	Construction Management				\$3,265,780
	Subtotal				\$12,932,491
	Total				\$26,258,511
	Design				\$2,625,851
	1% Bond				\$262,585
	Contingency (50%)				\$13,129,256
	Total				\$42,276,203