BUILD

Build Traffic Volumes

The No-Build traffic volumes shown in *Figure 44* and *Figure 45* were used for the Build Package 1, except for at the I-64 interchange with US 250 where the volumes on the eastbound US 250 ramp to westbound I-64 were converted to left-turn movements.

New traffic volumes for the two Build alternative packages that contain the new interchange at N Gayton Road (Build Packages 2 and 3) were developed for the study area by applying the projected percent change in traffic volumes on all freeways, ramps, and US 250 segments from the subarea travel demand model to the forecasted No-Build traffic volumes and balancing the resulting traffic volumes. The projected percent (2040 peak period) and value (2040 peak hour) changes from the subarea travel demand model are illustrated in *Figure 63* and *Figure 64*, while the resulting changes in 2046 peak hour traffic volumes from the No-Build scenario to the Build scenario for Build Packages 2 and 3 on freeways, ramps, and some segments of US 250 are illustrated in *Figure 65* and *Figure 66*.

A select link analysis was conducted to determine the approximate origins and destinations of the vehicles using the proposed interchange ramps to access I-64. This analysis was used to derive the turning movements onto and off of the proposed ramps as well as the changes to the turning movements at the intersection of US 250 and N Gayton Road.

Turning movement counts were modified as follows at several intersections within the modeling area to balance traffic volumes and reflect the projected percent changes in traffic volumes on US 250 in the subarea travel demand model.

- Reroute a percentage of side street turning movements in one or both peak hours at the following intersections for vehicles accessing I-64 at the new interchange instead of the Route 288 interchange:
  - N Gayton Road (northbound left turns to through movements)
  - Haydenpark Lane (northbound left turns to right turns)
  - Cabela Drive (southbound right turns to left turns)
  - Bon Secours Parkway (southbound right turns to left turns)
  - Wilkes Ridge Parkway (northbound left turns to right turns)
- Reroute a percentage of side street turning movements in one or both peak hours at the following intersections for vehicles accessing I-64 at the new interchange instead of the US 250 interchange:
  - N Gayton Road (northbound right turns to through movements)
  - Towne Center West Boulevard (southbound left turns to right turns)
  - Short Pump Town Center West (southbound left turns to right turns)
  - Lauderdale Drive (northbound right turns to left turns and southbound left turns to right turns)
  - Spring Oak Drive/Hagen Drive (northbound right turns to left turns and southbound left turns to right turns)
  - Pump Road/Pouncey Tract Road (northbound right turns to left turns and southbound left turns to right turns)
    - A percentage of northbound right turns were rerouted to northbound left turns at Lauderdale Drive
    - A percentage of southbound left-turn vehicles at Pouncey Tract Road were removed and assumed to be rerouted to the new interchange via southbound N Gayton Road
    - A percentage of westbound right-turn vehicles at Pouncey Tract Road were removed and assumed to be rerouted to northbound N Gayton Road via I-64
  - John Rolfe Parkway (northbound right turns to left turns at Lauderdale Drive)

Additionally, turning movement volumes were modified at the intersections on N Gayton Road as follows to account for the proposed changes in access described in the *Build Package 2* section.

- Reroute westbound left turns at Bacova Drive to right turns out of Marshal Run Circle and U-turns at Liesfeld Farm Drive
- Reroute southbound left turns and U-turns at Bacova Drive to left turns and U-turns at Liesfeld Farm Drive
- Reroute westbound left turns at Blue Ocean Lane to the intersection of US 250 and Towne Center West Boulevard
- Reroute westbound right turns at Blue Ocean Lane to right turns at the intersection of N Gayton Road and Dominion Chevy Access Road
- Reroute southbound left turns at Blue Ocean Lane to eastbound left turns at the intersection of US 250 and Towne Center West Boulevard

The projected 2026 and 2046 AM and PM peak hour traffic volumes for Build Packages 2 and 3 are summarized in *Figure 67* and *Figure 68*.

Figure 63: AM Traffic Volume Rerouting (2040) in Subarea Model for N Gayton Interchange Scenario

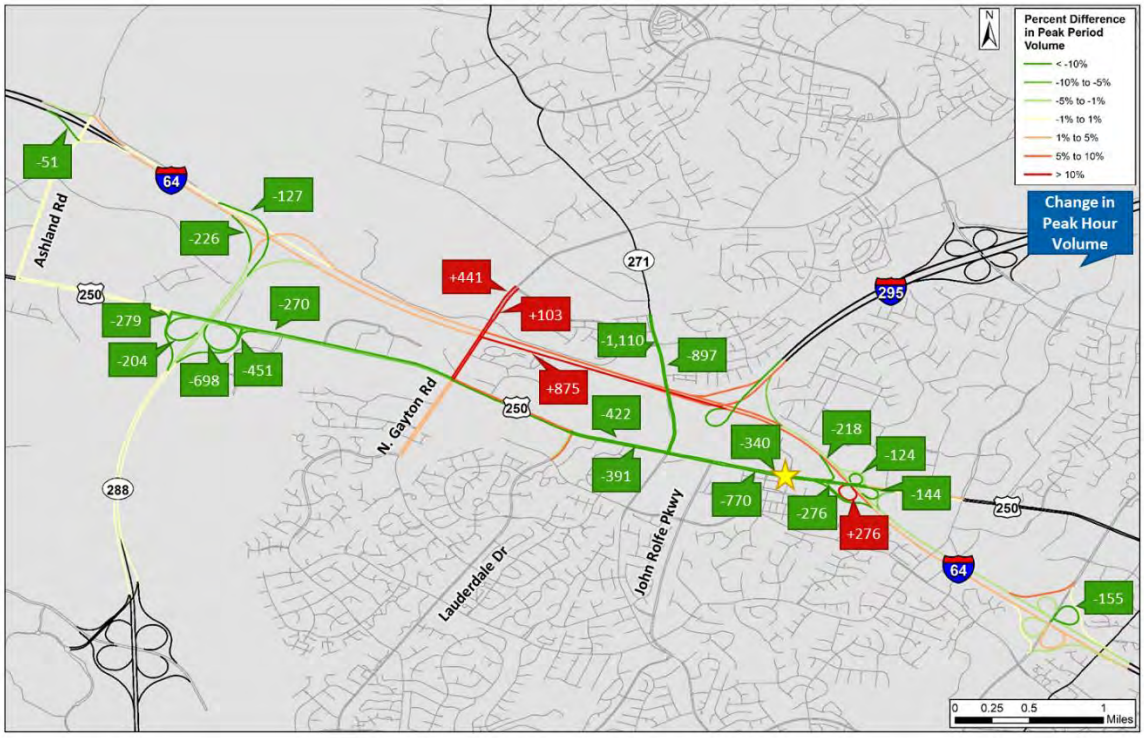


Figure 64: PM Traffic Volume Rerouting (2040) in Subarea Model for N Gayton Interchange Scenario

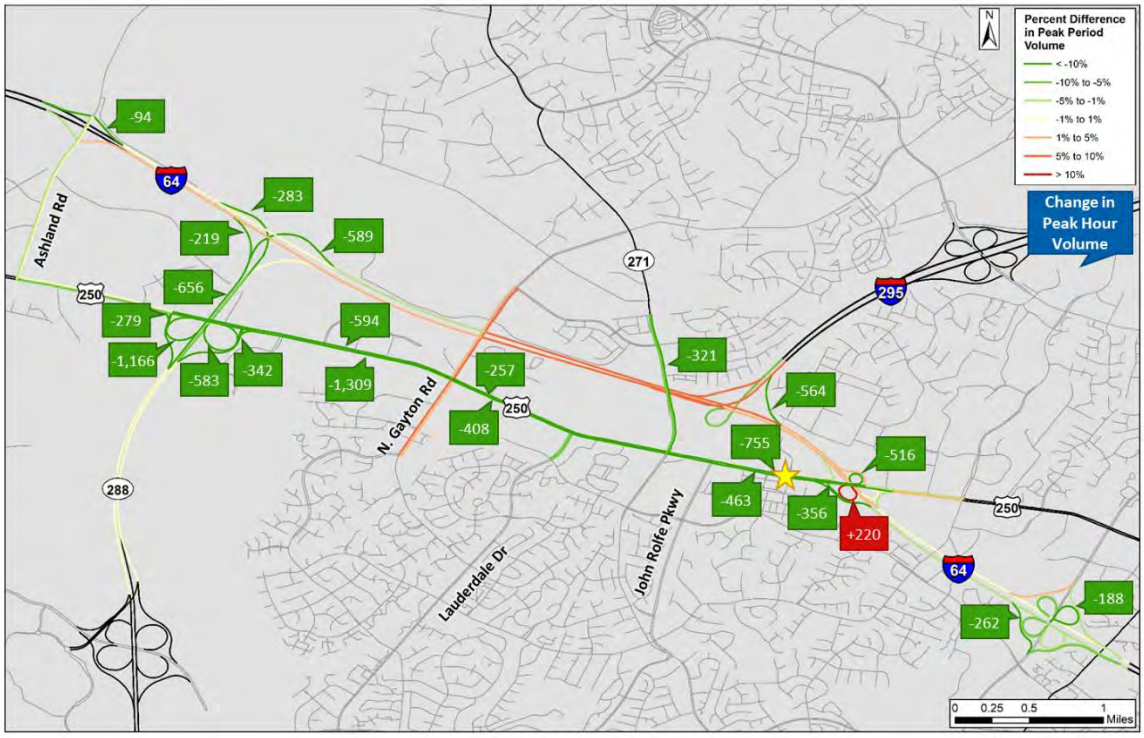


Figure 65: Changes in 2046 AM Peak Hour Traffic Volumes from No-Build for Build Packages 2 and 3

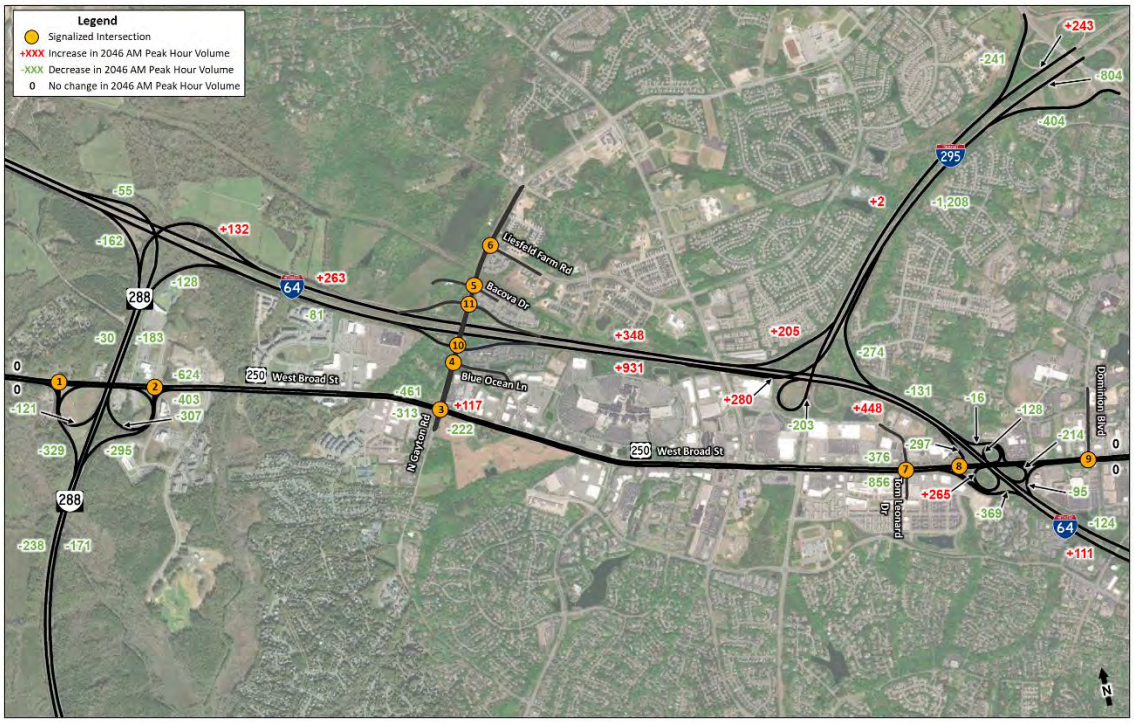


Figure 66: Changes in 2046 PM Peak Hour Traffic Volumes from No-Build for Build Packages 2 and 3

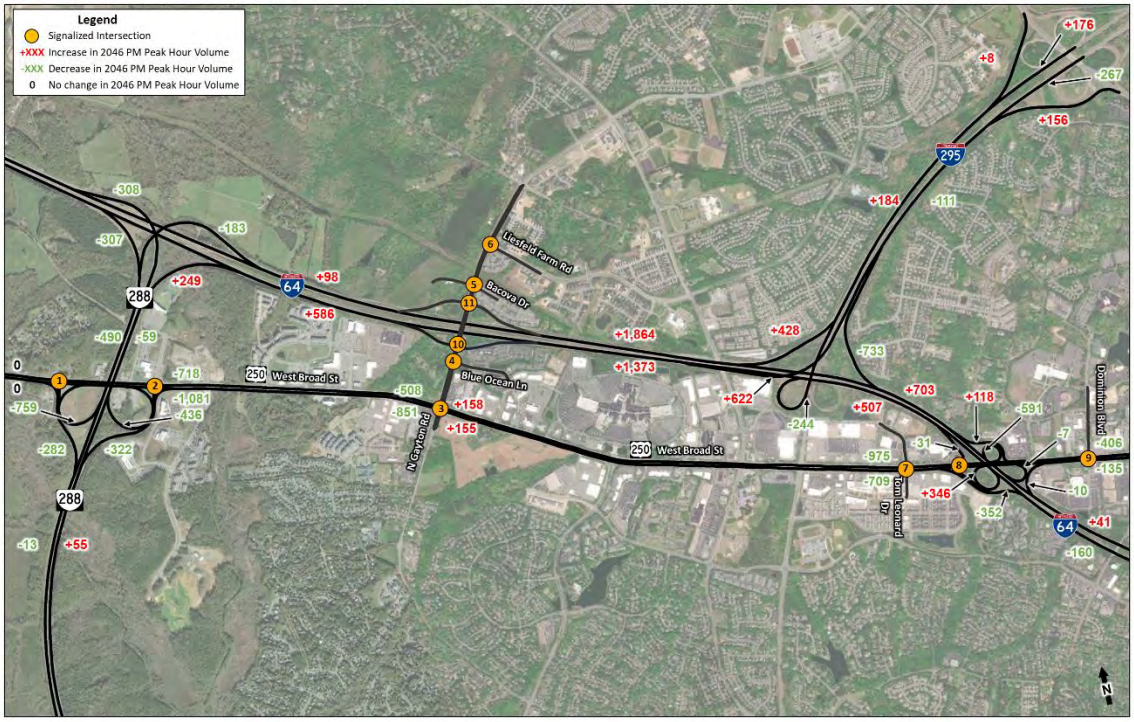


Figure 67: Build (2026) Peak Hour Traffic Volumes for Build Packages 2 and 3

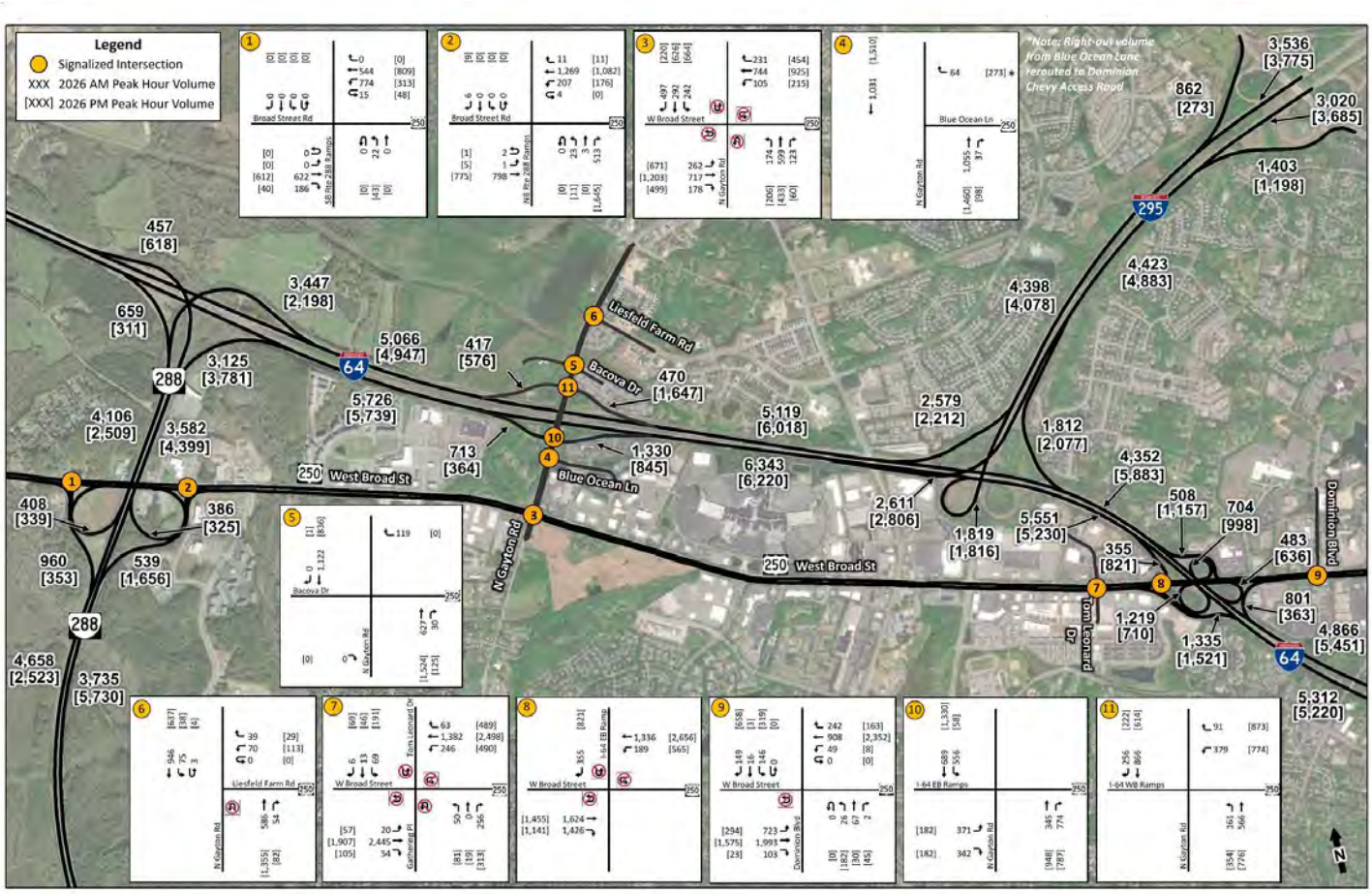
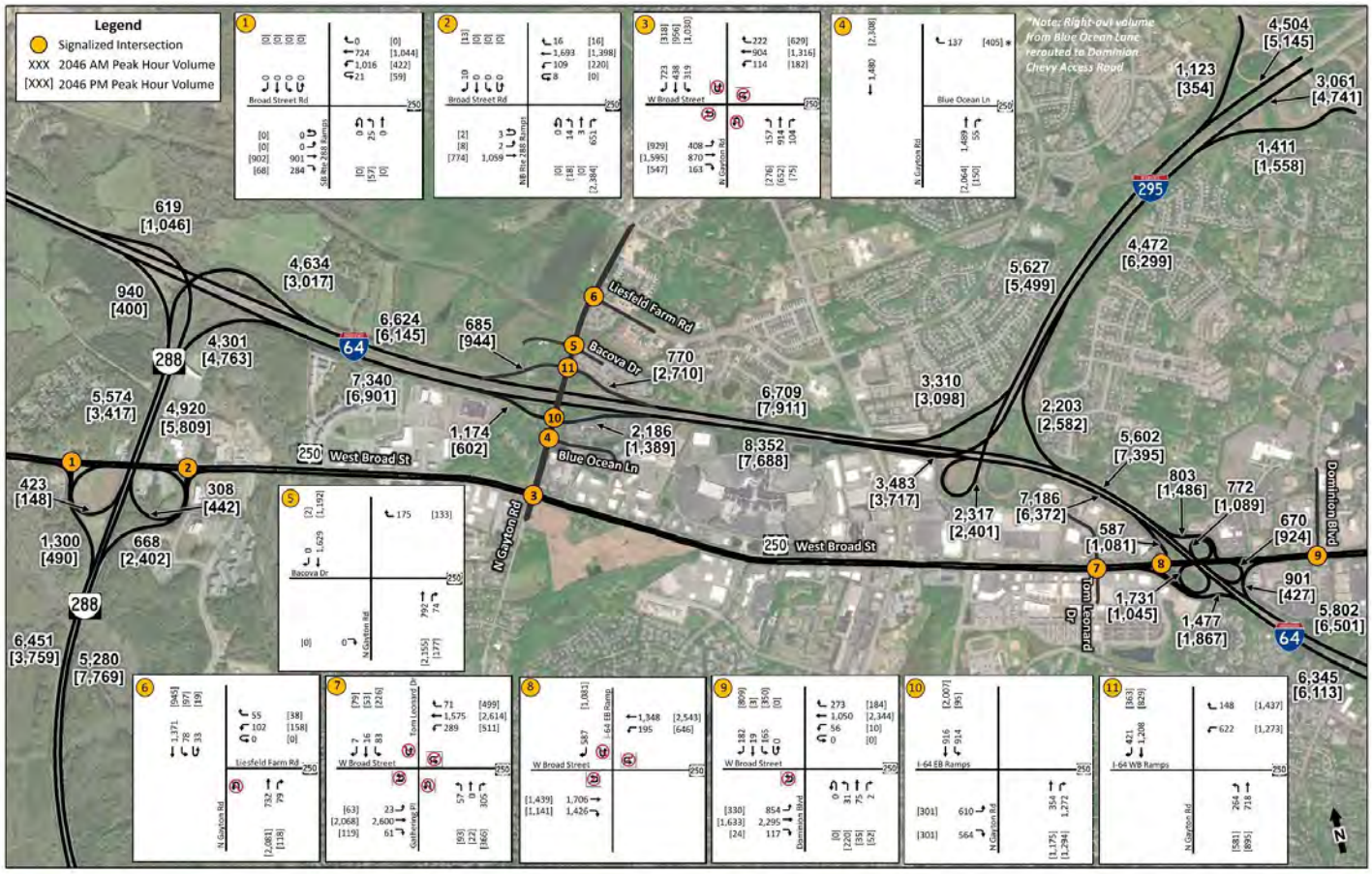


Figure 68: Build (2046) Peak Hour Traffic Volumes for Build Packages 2 and 3



Build Package 1

Heavy vehicle, traffic volume, peak hour factor, and traffic signal timing assumptions remained consistent with the No-Build analyses. A detailed summary of the Build Package 1 inputs is provided in *Appendix G.*

The VDOT Sample Size Determination Tool, Version 2.0 was used to determine the number of traffic simulation runs required to provide the acceptable 95th percentile confidence level for the 2026 and 2046 Build Package 1 models. Ten simulation runs were conducted for the Build Package 1 2026 AM and PM peak hour and 2046 AM peak hour models using different random seeds and the average of these runs was reported. The VDOT Sample Size Determination Tool showed 11 runs were required for the Build Package 1 2046 PM peak hour model. The VDOT Sample Size Determination Tool summary sheets are provided in *Appendix G.*

Build Package 1 Freeway Analysis Results

The AM and PM peak hour average freeway segment density and speed for the 2026 and 2046 Build Package 1 conditions are illustrated in *Figure 69* through *Figure 76*. Graphical representation of the freeway results by lane is included in *Appendix G*.

AM Peak Hour

In the 2026 AM peak hour, all segments of I-64 in both directions in the study area are projected to operate with speeds of 59 mph or greater. The restriping improvement at the eastbound I-64 off-ramp to I-295 that creates one exit only lane and one choice lane is projected to improve speeds on eastbound I-64 between I-295 and Route 288 by allowing vehicles to better pre-position to take the eastbound I-64 off-ramp to northeastbound I-295. The restriping improvement results in more balanced vehicle lane distribution in the Vissim model since exiting vehicles pre-position in the two rightmost lanes on I-64 instead of one lane in the No-Build scenario. Densities are projected to improve to 21 veh/ln/mi or better along the segment of eastbound I-64.

In 2046, all segments of I-64 in both directions in the study area are projected to operate at 54 mph or greater. The restriping improvement on eastbound I-64 is similarly projected to relieve much of the congestion on eastbound I-64 approaching the I-295 interchange that was identified in the No-Build conditions analysis. Although the rightmost lane on eastbound I-64 is still projected to operate with increased densities between 37 and 42 veh/ln/mi due to vehicles pre-positioning to take the ramp to northeastbound I-295, the increased densities are not projected to impact vehicle speeds along this segment.

The partial cloverleaf ramp reconfiguration and the turning restriction from the westbound I-64 off-ramp to eastbound US 250 to Dominion Boulevard are projected to improve the operations on eastbound I-64 approaching the US 250 interchange to speeds of 54 mph or greater and densities of 30 veh/ln/mi or less. The partial cloverleaf reconfiguration removes the arterial weave on eastbound US 250 and the turning restriction reduces the congestion caused by vehicles weaving from the westbound I-64 off-ramp to eastbound US 250 to make a left-turn onto Dominion Boulevard. Both improvements together are projected to reduce queuing and congestion on US 250 and prevent the queuing from eastbound US 250 from backing up to eastbound I-64. *Figure 77* shows the reduction in queuing on eastbound US 250 and the ramps at the I-64 interchange. Intersection queues are still projected to extend on eastbound US 250 to the westbound I-64 off-ramp to eastbound US 250 and impact westbound I-64 operations; however, this queuing is projected to be comparable to the No-Build scenario.

The southbound Route 288 auxiliary lane between the US 250 and Tuckahoe Creek Parkway interchanges is projected to provide relief to the congestion on southbound Route 288 that was identified in the No-Build conditions analysis. The additional capacity from the auxiliary lane allows southbound Route 288 to serve the projected 6,000 vehicles per hour south of the US 250 interchange while still operating at speeds of 52 mph or greater.

The southwestbound I-295 bottleneck identified in the No-Build conditions analysis is still present in Build Package 1 since the study team agreed not to include further improvements on southwestbound I-295 as documented in the *I-64 at US 250 and I-295 Interchanges* screening section. However, the southwestbound I-295 loop ramp to eastbound I-64 is projected to operate with slightly improved speeds between 25 and 35 mph due to the improved conditions on eastbound I-64, but the congestion on southwestbound I-295 approaching the I-64 ramps is still projected to prevent all the demand on I-295 from being served. Speeds on southwestbound I-295 were projected to remain below 20 mph upstream of the interchange.

PM Peak Hour

In the 2026 PM peak hour, all segments of I-64 in both directions in the study area are projected to operate with speeds of 52 mph or greater. The partial cloverleaf reconfiguration at the I-64 at US 250 interchange is projected to improve the speeds on westbound I-64 within the interchange from 20 mph in the No-Build conditions analysis to 53 mph.

The improvements at the intersection of US 250 and the northbound Route 288 ramps are projected to improve speeds on the off-ramp and prevent queuing from impacting the operations of northbound Route 288. These improvements are

projected to decrease the congestion and densities on northbound Route 288 approaching the interchange to 25 veh/ln/mi or less. The intersection improvements and improvements on US 250 between Route 288 and Bon Secours Parkway are projected to allow the ramp terminal intersection to serve 97 percent of the demand at the intersection.

In 2046, all segments of I-64 in both directions within the study area are projected to operate with speeds of 52 mph or greater. Three of the four bottlenecks identified in the No-Build conditions analysis were addressed with improvements included in Build Package 1. The bottleneck on southwestbound I-295 is still present in Build Package 1 since the study team agreed not to include further improvements on southwestbound I-295 as documented in the *I-64 at US 250 and I-295 Interchanges* screening section. Queuing on the over-capacity loop ramp from southwestbound I-295 to eastbound I-64 is projected to back up onto mainline I-295 causing speeds of 20 mph or less and densities over 80 veh/ln/mi.

The improvements to the intersection of US 250 and the northbound Route 288 ramps are projected to relieve congestion on the off-ramp and prevent queuing from impacting northbound Route 288. The additional auxiliary lane on northbound Route 288 from Tuckahoe Creek Parkway to the US 250 interchange increases capacity and allows northbound Route 288 to serve 95 percent of the demand into the study area network. However, northbound Route 288 is still projected to operate with slow speeds between 18 and 44 mph. The proposed improvements are projected to release the ramp bottleneck, but the additional traffic reaching the interchange is projected to slow at the section of northbound Route 288 between the ramps at the US 250 interchange. This two-lane section is over capacity with a projected demand of 5,000 vehicles in the PM peak hour.

Three different improvements are projected to contribute to the improved operations on westbound I-64 at the US 250 interchange: the partial cloverleaf configuration, the northeastbound I-295 ramp improvements, and the Tom Leonard Drive intersection improvements. The Tom Leonard Drive intersection improvements are projected to reduce congestion on westbound I-64 and prevent queues from backing up to the westbound I-64 off-ramp to westbound US 250. The northeastbound I-295 ramp improvements and the auxiliary lane on northeastbound I-295 to Nuckols Road are projected to reduce the density on the ramp to 29 veh/ln/mi and improve speeds up to 52 mph or greater. These improvements prevent the queuing on the ramp that was identified in the No-Build conditions analysis from backing up to westbound I-64.

The partial cloverleaf reconfiguration removes the weave on the freeway and is projected to improve speeds to 58 mph or greater on westbound I-64 within the interchange. The improvements at the I-64 at US 250 interchange are projected to greatly reduce queuing on westbound I-64. Some queuing is still present on the freeway due to the over-capacity westbound I-64 to westbound US 250 loop ramp that is projected to serve 1,630 vehicles in the peak hour. *Figure 78* shows the residual queuing projected on westbound I-64. The queue on westbound I-64 contributes to slower speeds and congestion upstream on westbound I-64 through adjacent interchanges. The speeds for the upstream interchanges with Gaskins Road and Parham Road are shown in *Figure 79*. Although the improvements in Build Package 1 are projected to improve operations on westbound I-64 at the interchange, speeds as low as 20 mph upstream of the interchange are still present.

Figure 69: Build Package 1 (2026) AM Peak Hour Average Density

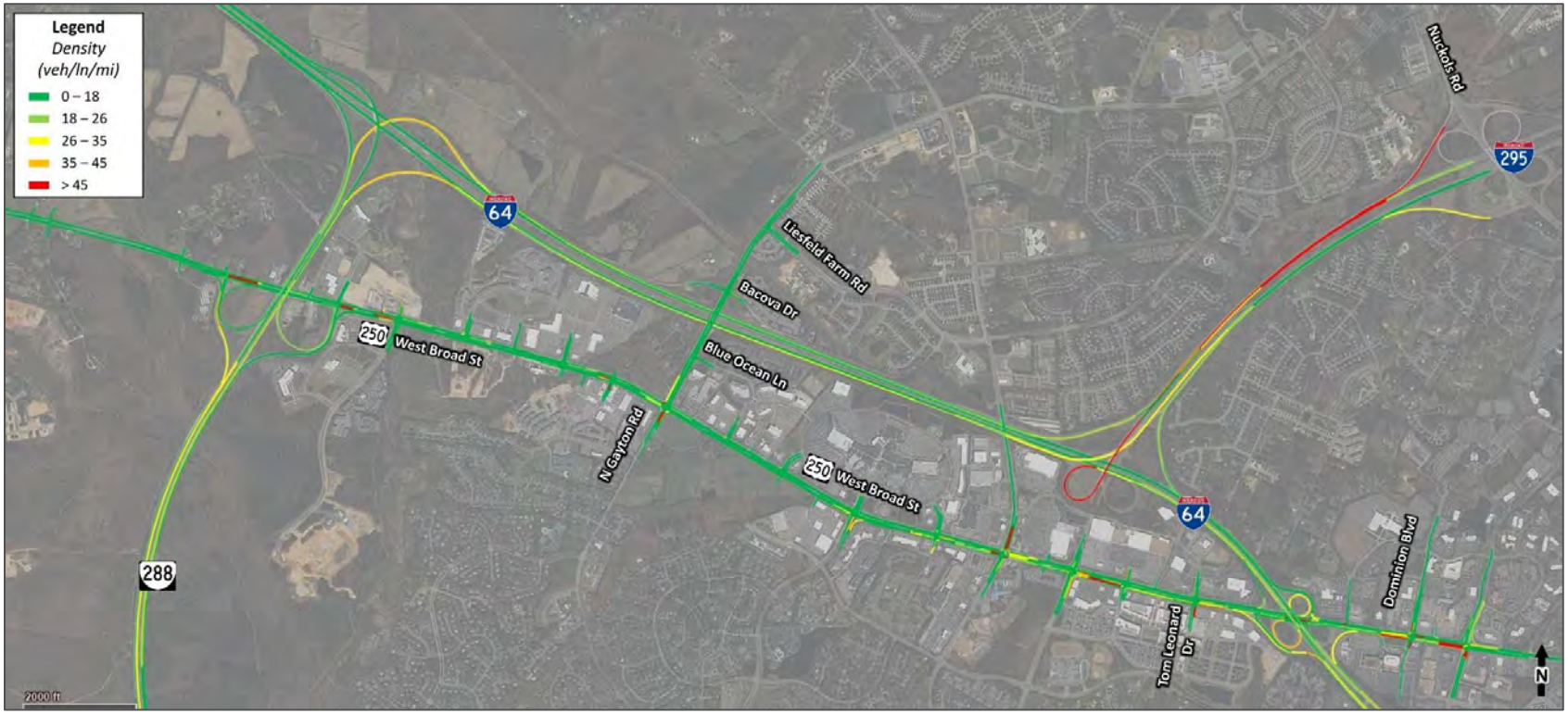


Figure 70: Build Package 1 (2026) AM Peak Hour Average Speed

Figure 71: Build Package 1 (2046) AM Peak Hour Average Density

Figure 72: Build Package 1 (2046) AM Peak Hour Average Speed

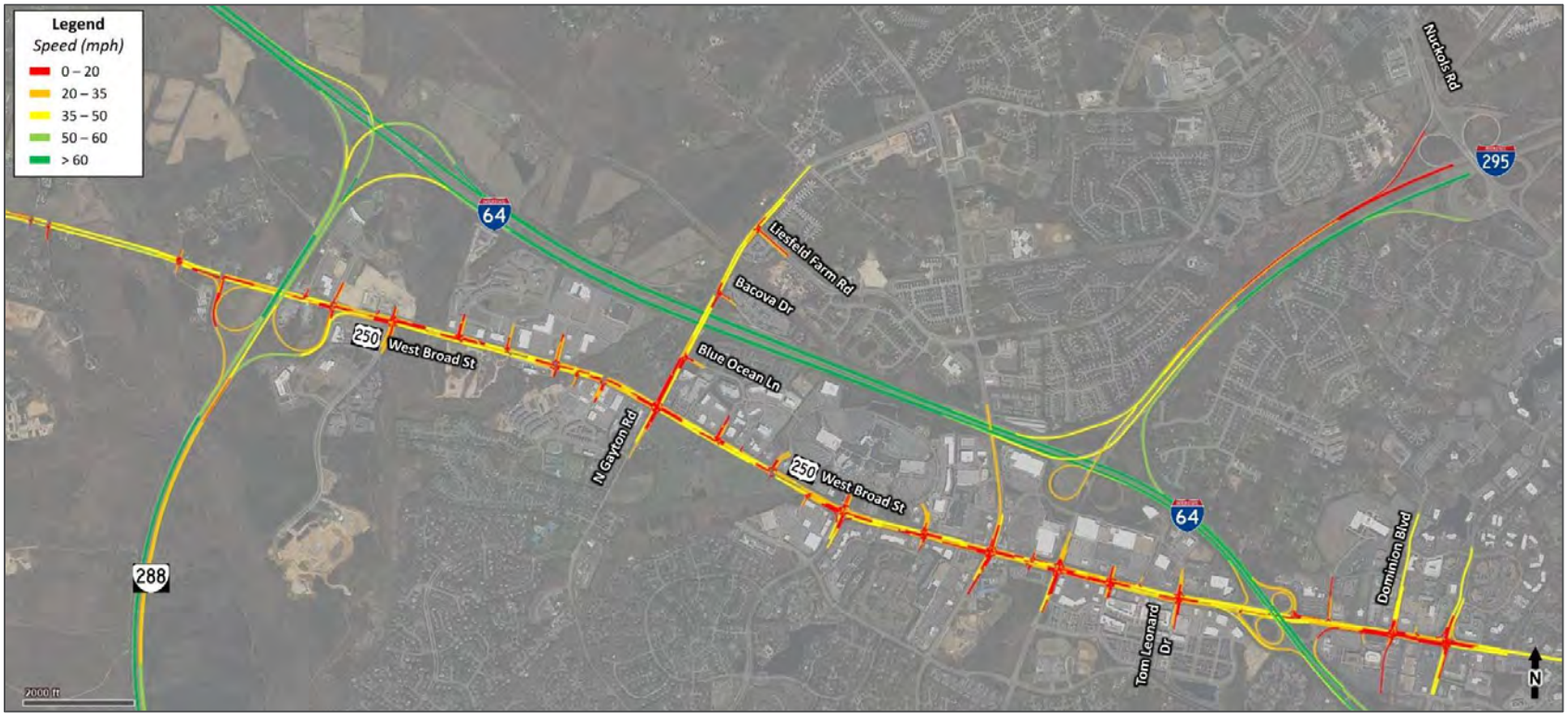


Figure 73: Build Package 1 (2026) PM Peak Hour Average Density

Figure 74: Build Package 1 (2026) PM Peak Hour Average Speed

Figure 75: Build Package 1 (2046) PM Peak Hour Average Density

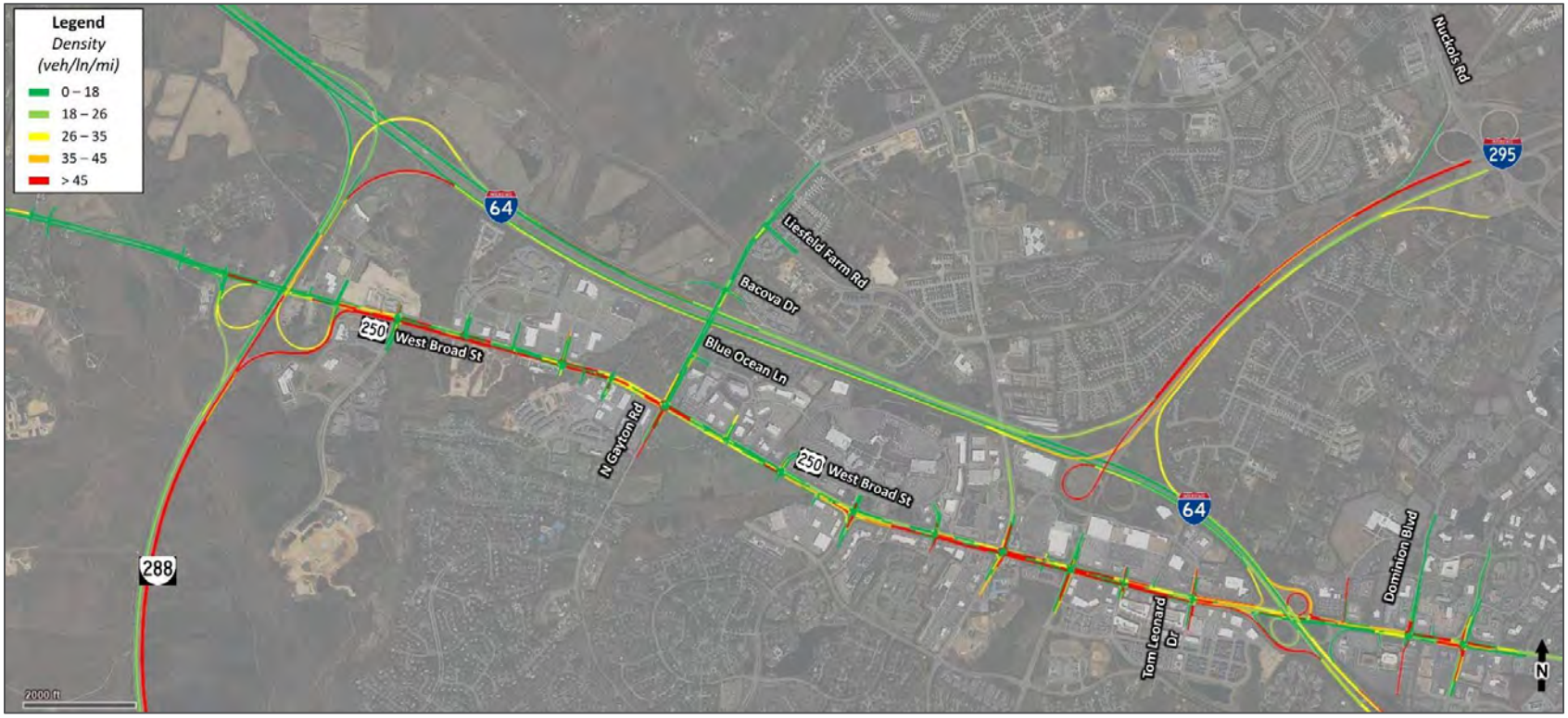


Figure 76: Build Package 1 (2046) PM Peak Hour Average Speed

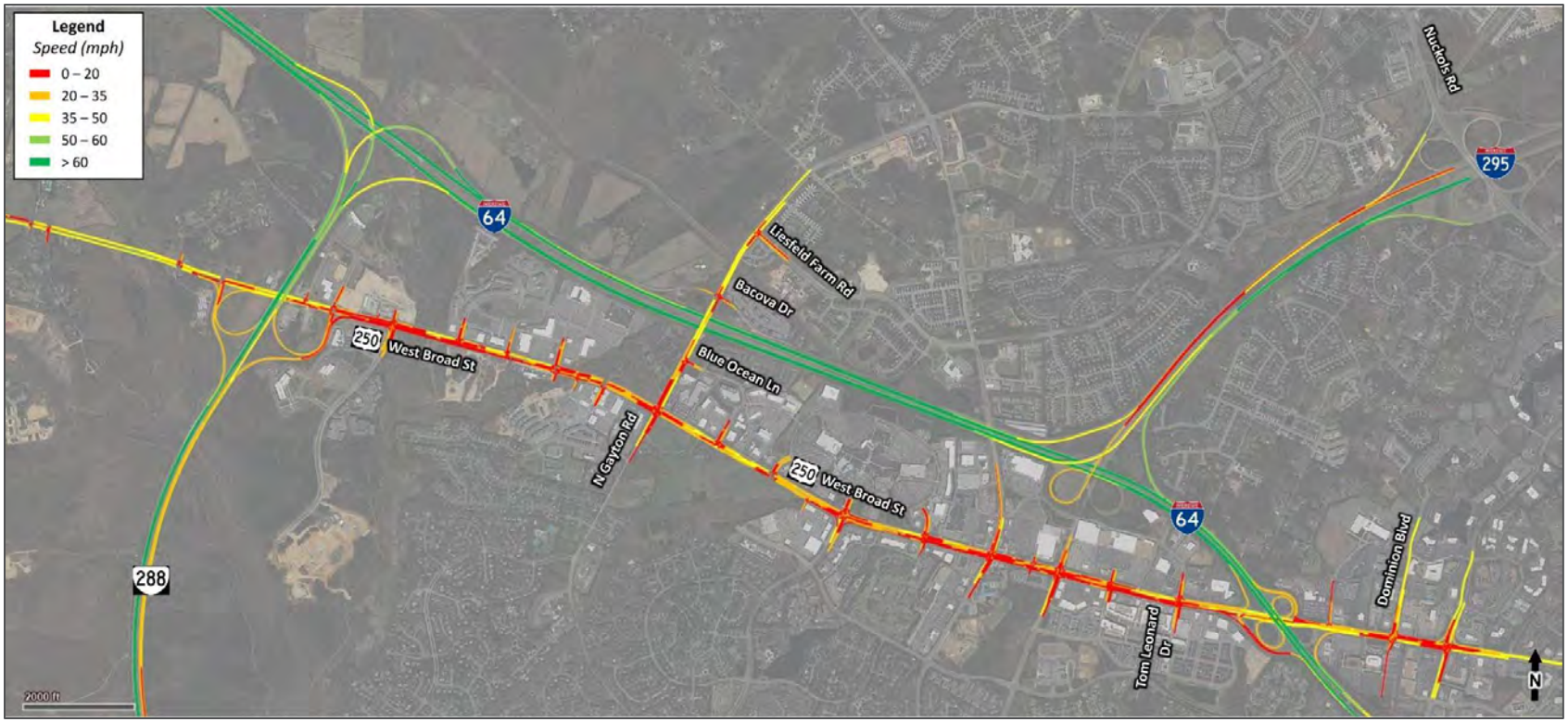


Figure 77: Build Package 1 (2046) AM Peak Hour Maximum Queue Length (Depictive)

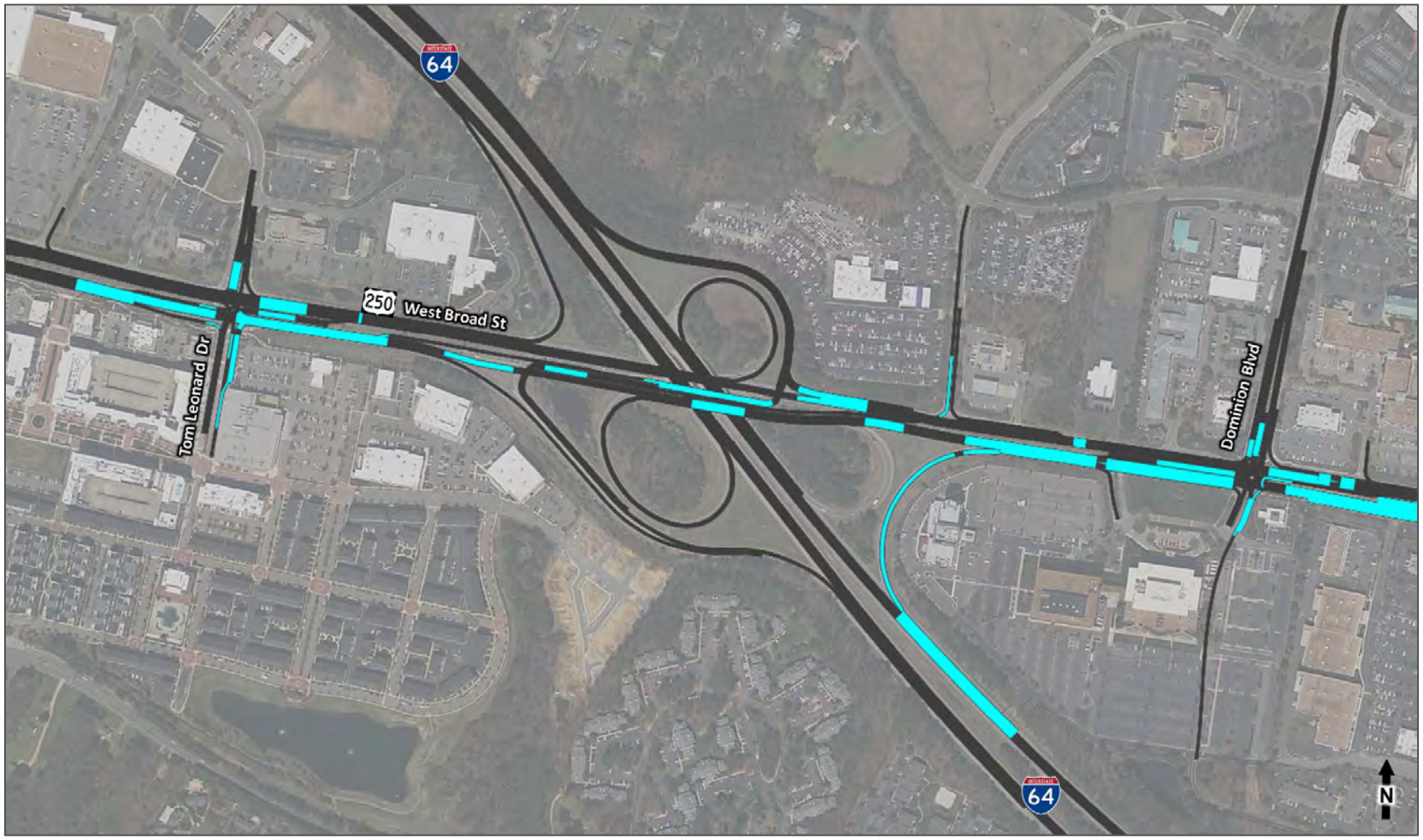


Figure 78: Build Package 1 (2046) PM Peak Hour Maximum Queue Length (Depictive)

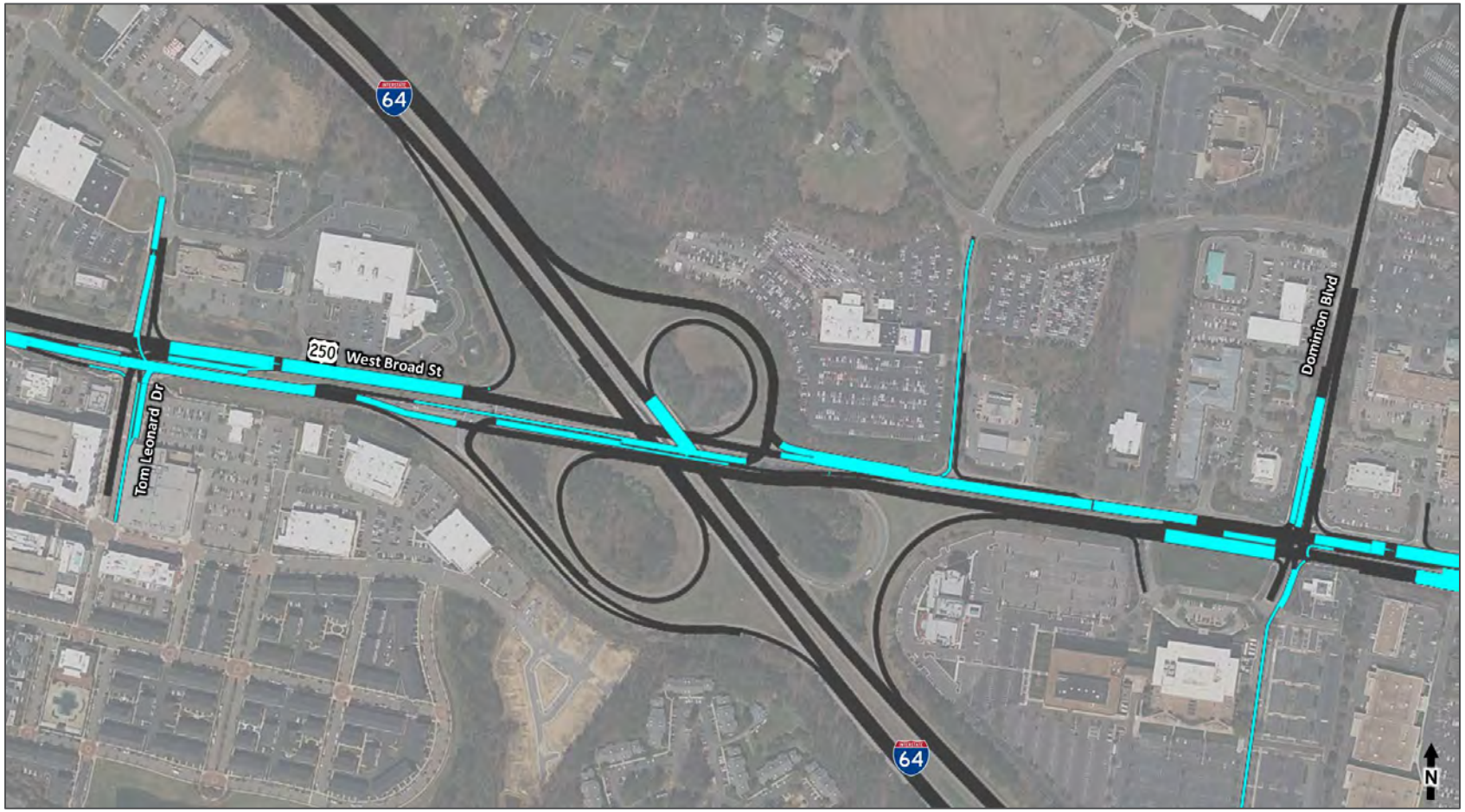


Figure 79: Build Package 1 (2046) PM Peak Hour Average Speeds

Build Package 1 Intersection Analysis Results

Graphical representation of the average intersection delay (seconds per vehicle) by movement and maximum queue length (feet) are shown in *Figure 80* through *Figure 87*.

AM Peak Hour

In 2026, the intersection of US 250 and N Gayton Road is projected to operate with the most overall intersection delay of 31.9 seconds per vehicle. All left-turn movements at the intersection are projected to operate with delays of 62.9 seconds per vehicle or greater. The southbound right-turn movement is projected to operate with the longest maximum queue at 515 feet but is contained in the right-turn storage bay.

All other study area intersections are projected to operate with an overall intersection delay of 24.4 seconds per vehicle or better. The proposed intersection on US 250 at the westbound I-64 ramps is projected to operate with an overall intersection delay of 10.6 seconds per vehicle.

The longest maximum queue in the 2026 AM peak hour is projected to occur at the southbound Route 288 ramp terminal intersection for the westbound left-turn onto southbound Route 288 (935 feet).

By 2046, the intersection of US 250 and N Gayton Road is projected to operate with an overall intersection delay of 49.9 seconds of delay per vehicle. All movements on the southbound approach and all left-turn movements at the intersection are projected to operate with a delay of 56.6 seconds per vehicle or greater. The projected southbound right-turn maximum queue is 1,130 feet which extends out of the 575-feet storage bay, which is comparable to No-Build conditions.

The intersection of US 250 and Dominion Boulevard is projected to operate with an overall intersection delay of 47.4 seconds per vehicle. The southbound, northbound, and westbound left-turn movements at the intersection are projected to operate with 59.2 seconds per vehicle of delay or greater. The eastbound left-turn delay is projected to decrease to 39.5 seconds per vehicle and the eastbound through delay is projected to increase to 64.8 seconds per vehicle in Build conditions due to the improvement that restricts vehicles from the westbound I-64 off-ramp from weaving across US 250 to turn left at Dominion Boulevard. These vehicles are rerouted to travel through the Dominion Boulevard intersection and turn left at the adjacent intersection with Cox Road.

The proposed intersection on US 250 at the westbound I-64 ramps is projected to operate with an overall intersection delay of 13.9 seconds per vehicle. All other study area intersections are projected to operate with overall intersection delays of 30.5 seconds per vehicle or better.

All study area intersections are projected to operate better than or comparable to No-Build conditions. The overall travel time on US 250 between Route 288 and Cox Road is projected to decrease by 2 minutes and 4 seconds in the eastbound direction and increase by 13 seconds in the westbound direction. The section of westbound US 250 between Cox Road and I-64 is projected to experience an increase in travel time from the addition of the new signalized intersection at the westbound I-64 ramps. All other segments of westbound US 250 are projected to experience travel times comparable to No-Build conditions.

PM Peak Hour

In the 2026 PM peak hour, the intersection of US 250 and Dominion Boulevard is projected to operate with the most overall intersection delay of 36.6 seconds per vehicle. The maximum queue on the northbound approach is projected to be 1,050 feet. All movements on the northbound approach are projected to operate with over 300 seconds of delay per vehicle, which is similar to the No-Build conditions analysis results.

All other study area intersections are projected to operate with overall intersection delays of 34.0 seconds per vehicle or better and similar to No-Build conditions analysis results. The proposed intersection on US 250 and the westbound I-64 ramps is projected to operate with an overall intersection delay of 12.8 seconds per vehicle.

All left-turn movements at the intersection of US 250 and Tom Leonard Drive are projected to operate with a delay of 70.9 seconds per vehicle or greater. The westbound and eastbound through movements at this intersection are projected to extend 1,025 feet and 900 feet, respectively.

In 2046, the intersection of US 250 and N Gayton Road is projected to operate with the most overall intersection delay of 56.1 seconds per vehicle. All left-turn movements at the intersection are projected to operate with delays of 61.5 seconds per vehicle or greater. The maximum queue in the eastbound left-turn lane is projected to extend 790 feet, which is longer than the 550-foot storage bay. This queue spills back onto eastbound US 250 and is projected to cause additional queuing and congestion on US 250.

The intersection of US 250 and Dominion Boulevard is projected to operate with an overall intersection delay of 44.2 seconds per vehicle. The northbound approach is projected to operate with severe delays between 356.1 and 424.0 seconds per vehicle, which is similar to the No-Build conditions analysis results.

All other study area intersections are projected to operate with overall intersection delays of 48.2 seconds per vehicle or better. The proposed intersection of US 250 and the westbound I-64 ramps is projected to operate with an overall intersection delay of 16.2 seconds per vehicle. The eastbound left-turn movement is projected to operate with a delay of 60.2 seconds per vehicle and a maximum queue of 1,135 feet. Due to the contraflow left-turn interchange configuration proposed at the US 250 interchange, the maximum eastbound left-turn queue is projected to bel contained to its storage bay without impacting eastbound US 250 operations.

The intersection of US 250 and the northbound Route 288 ramps is projected to operate with an overall intersection delay of 50.5 seconds per vehicle. The northbound right-turn movement is projected to operate with a delay of 83.1 seconds per vehicle despite the improvements at the ramp terminal. This delay results from the congested operations on eastbound US 250 that impact this intersection. The proposed improvements are projected to release the bottleneck on northbound Route 288 so that 95 percent of the demand is served. Releasing this bottleneck allows additional vehicles to reach eastbound US 250, causing increased queuing and congestion that contributes to a 2 minute and 4 second increase in travel time from No-Build conditions between Route 288 and N Gayton Road. While the partial cloverleaf interchange improvement at US 250, which is the major improvement unique to Build Package 1, does not contribute to the increased travel time on eastbound US 250 in this area, it is not projected to mitigate the increase. The signalized intersections along this segment of US 250 are projected to process an average of 94 percent of the overall intersection demand, which is an increase from the average of 82 percent served in No-Build conditions. The overall travel time on US 250 between Route 288 and Cox Road is projected to increase by 5 minutes and 18 seconds in the eastbound direction over the No-Build conditions.

In the westbound direction, travel time on US 250 between Cox Road and Route 288 is projected to increase by 32 seconds over the No-Build conditions. This projected increase in travel time can be attributed to the new signalized intersection at the westbound I-64 ramps and to increased congestion between N Gayton Road and the southbound Route 288 ramps. The increased congestion on this segment can be attributed to the additional throughput on eastbound US 250, which affects the signal operations at all intersections.

Figure 80: Build Package 1 (2026) AM Peak Hour Intersection Delay

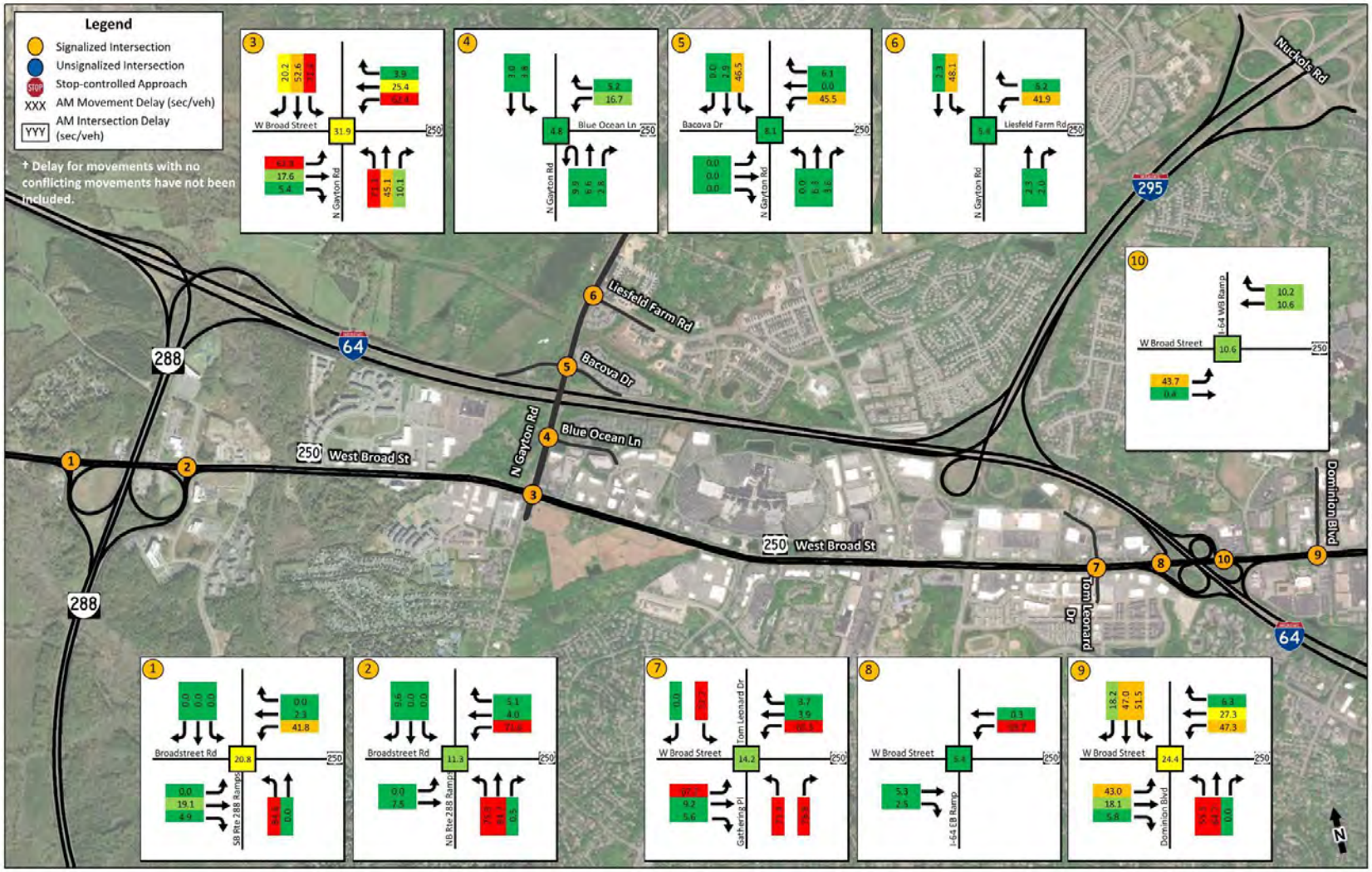


Figure 81: Build Package 1 (2026) AM Peak Hour Maximum Queue Length

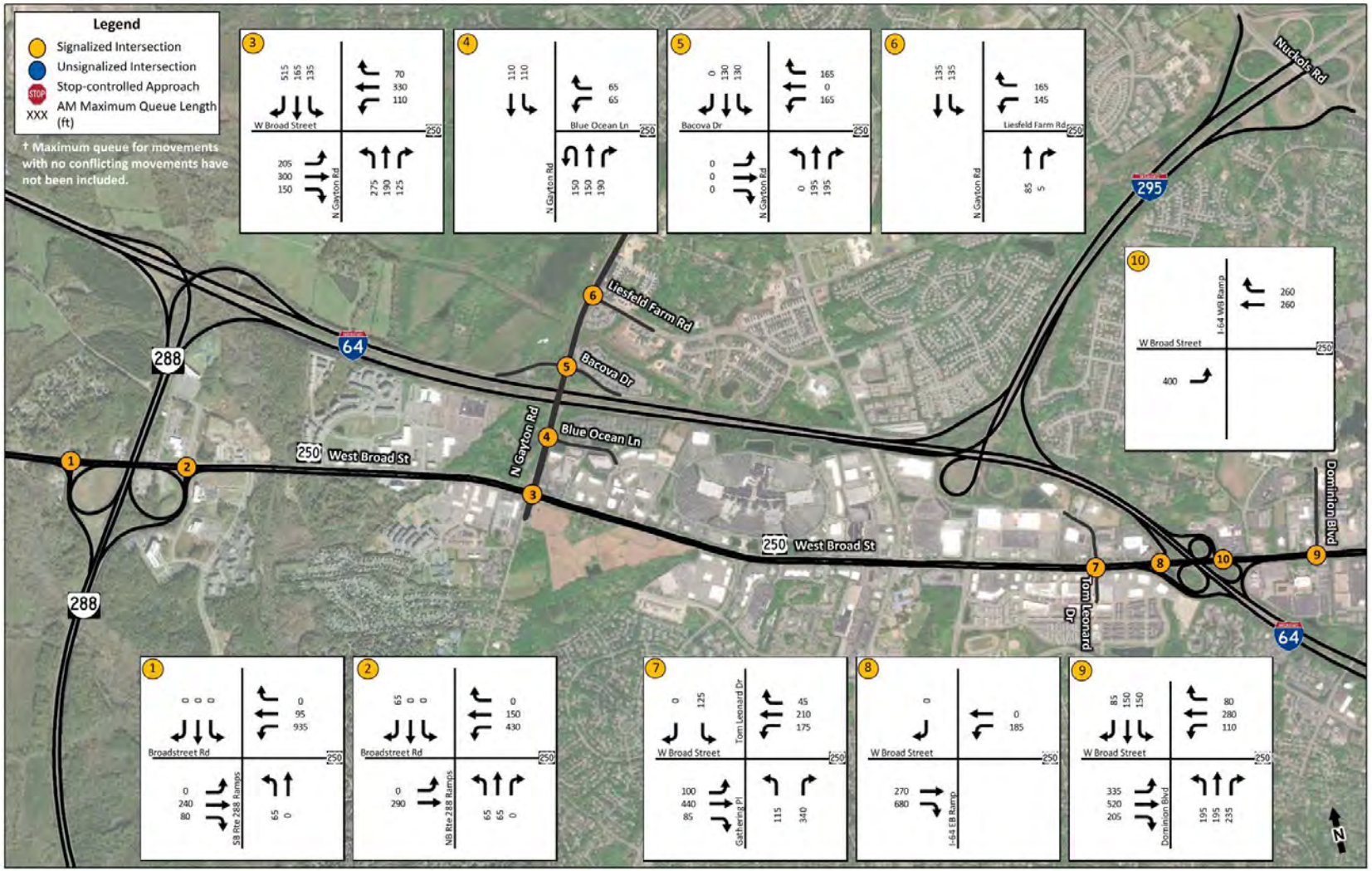


Figure 82: Build Package 1 (2046) AM Peak Hour Intersection Delay

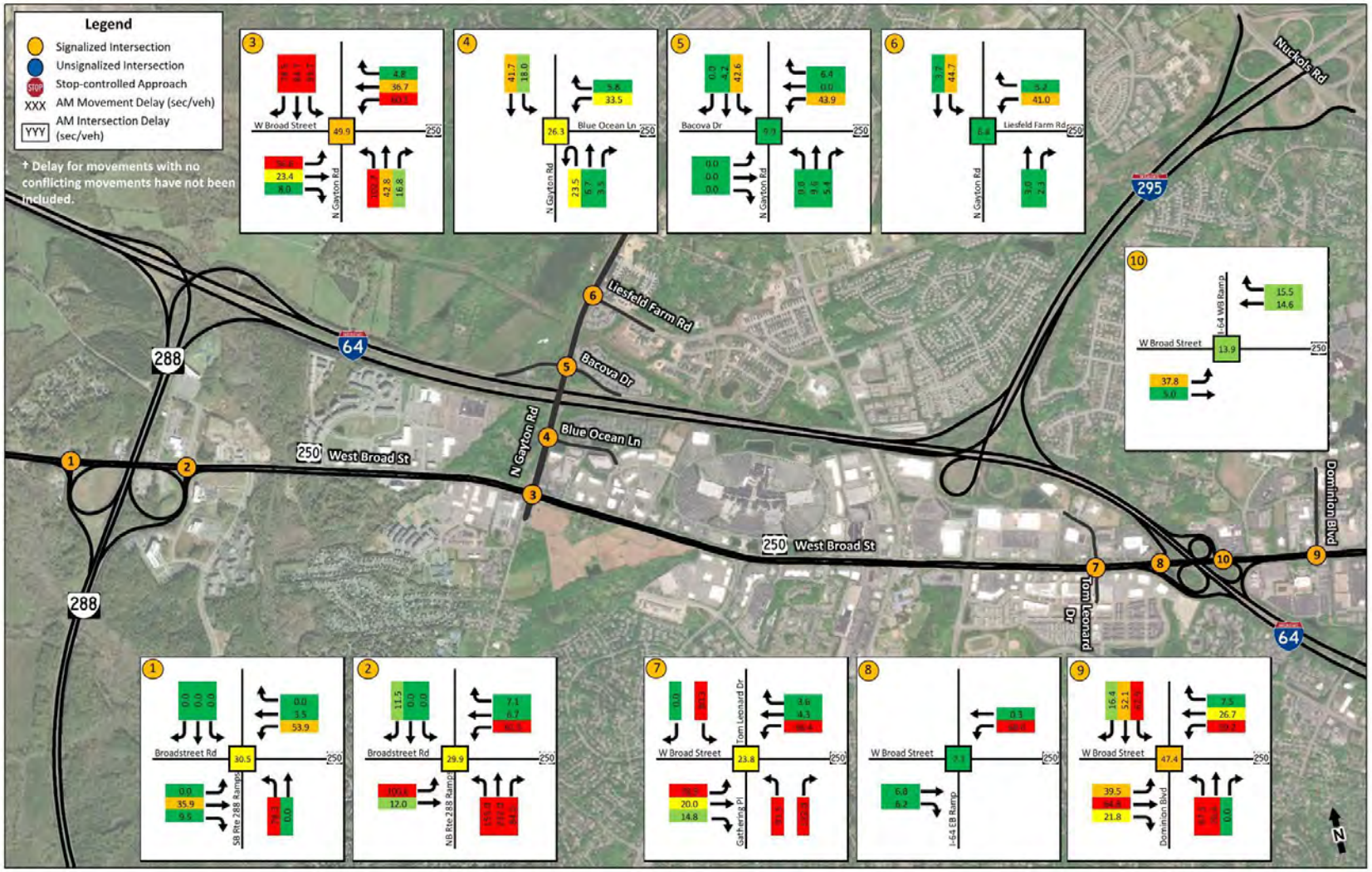


Figure 83: Build Package 1 (2046) AM Peak Hour Maximum Queue Length

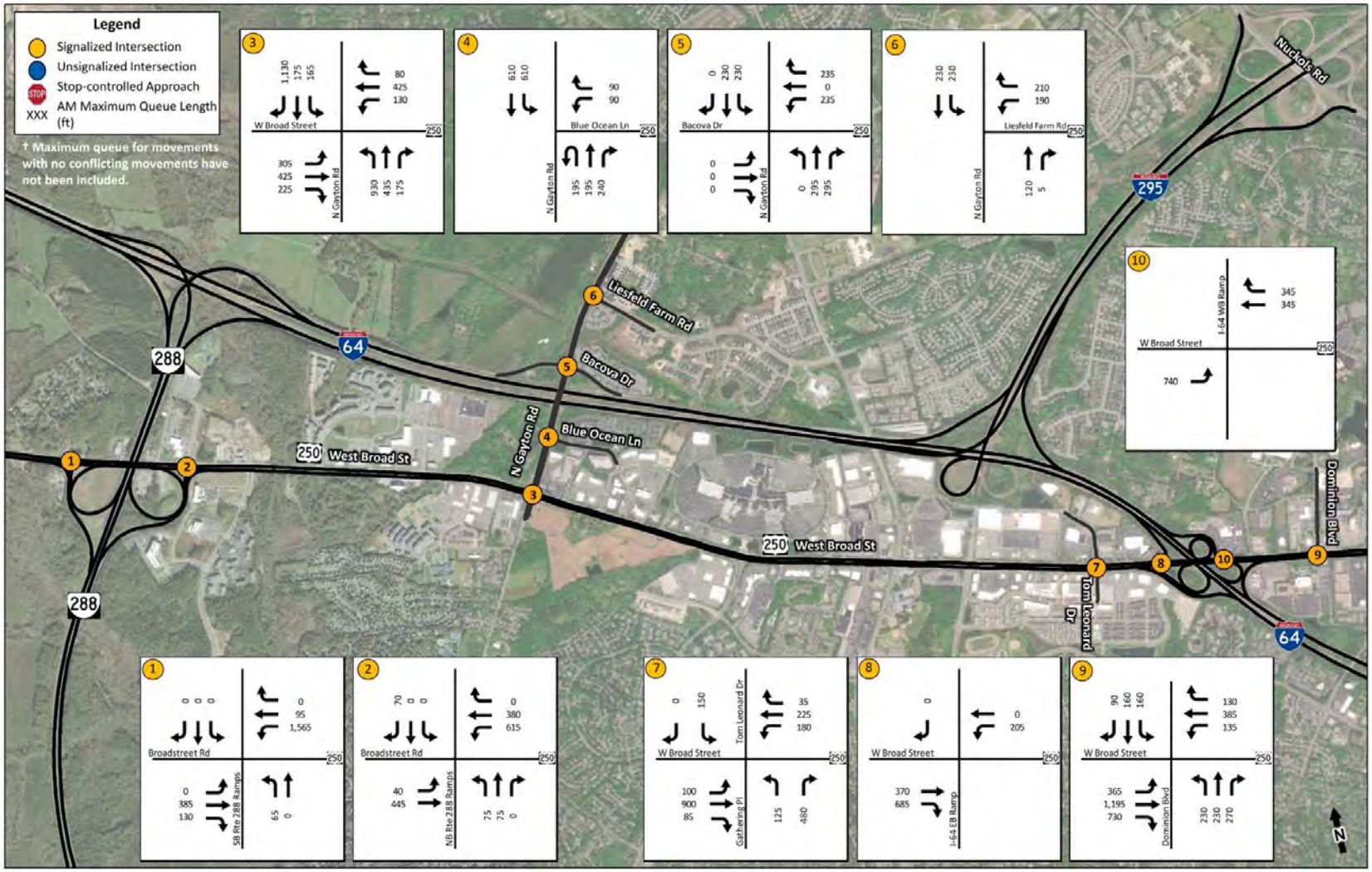


Figure 84: Build Package 1 (2026) PM Peak Hour Intersection Delay

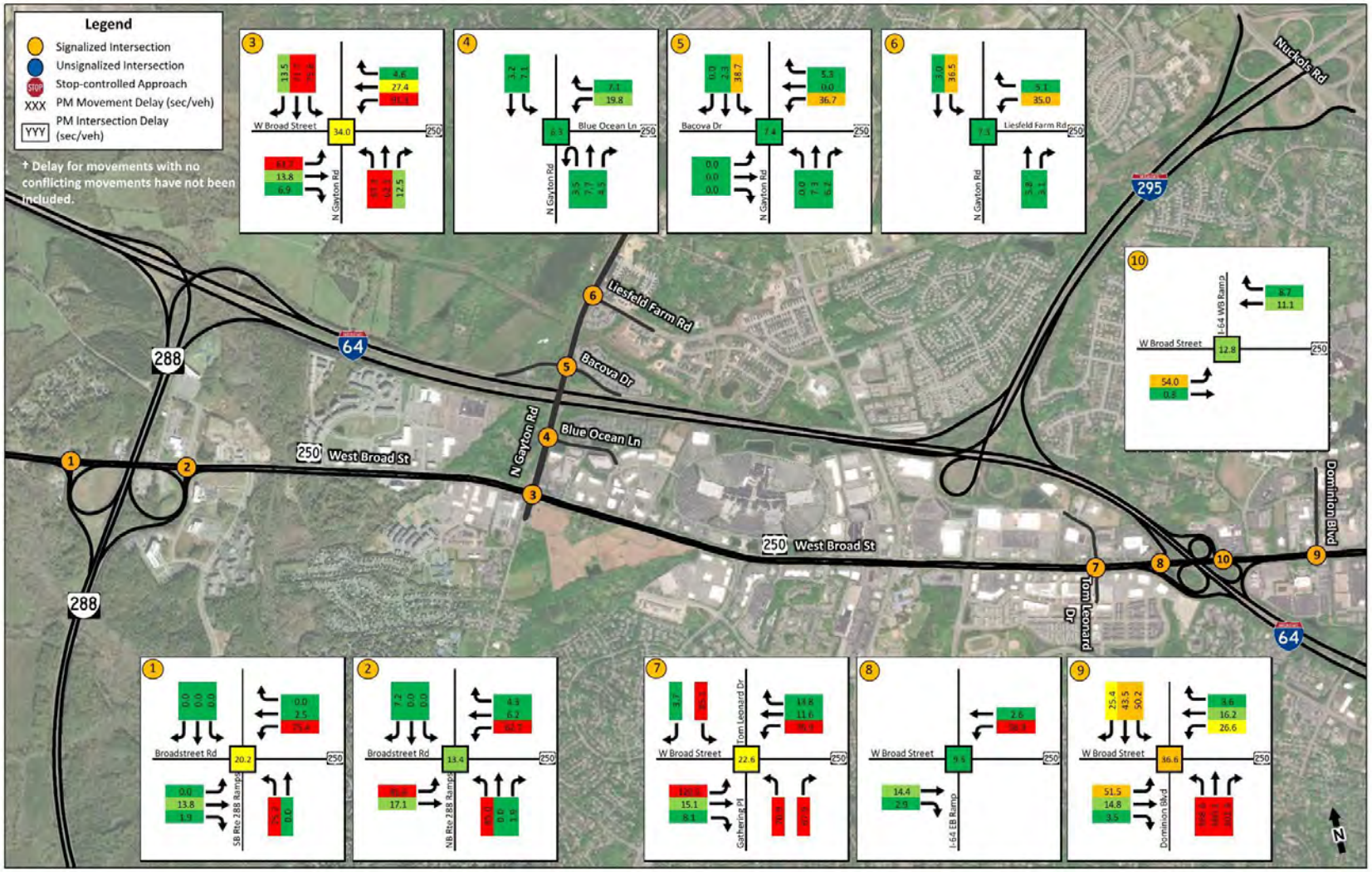


Figure 85: Build Package 1 (2026) PM Peak Hour Maximum Queue Length

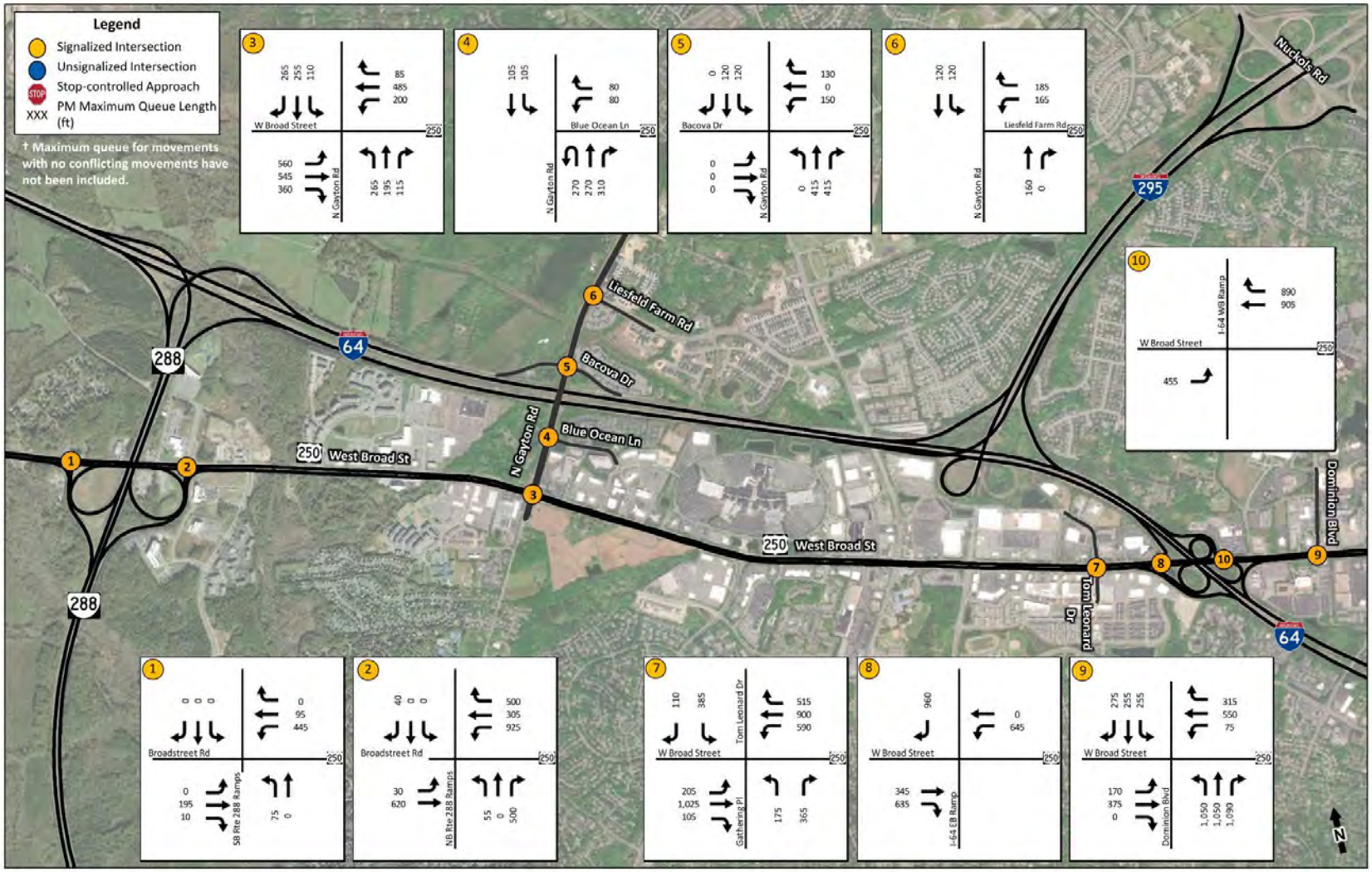


Figure 86: Build Package 1 (2046) PM Peak Hour Intersection Delay

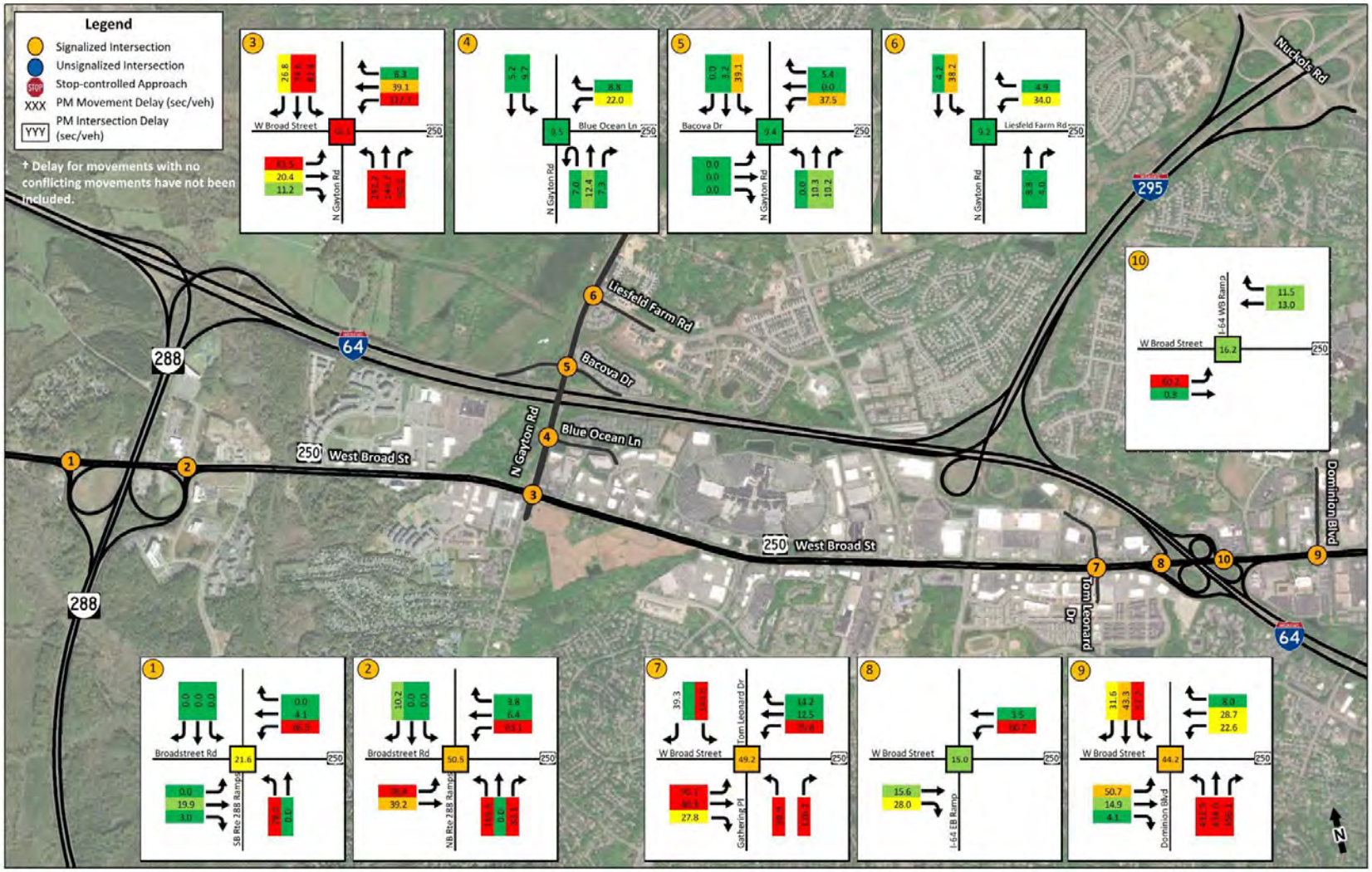
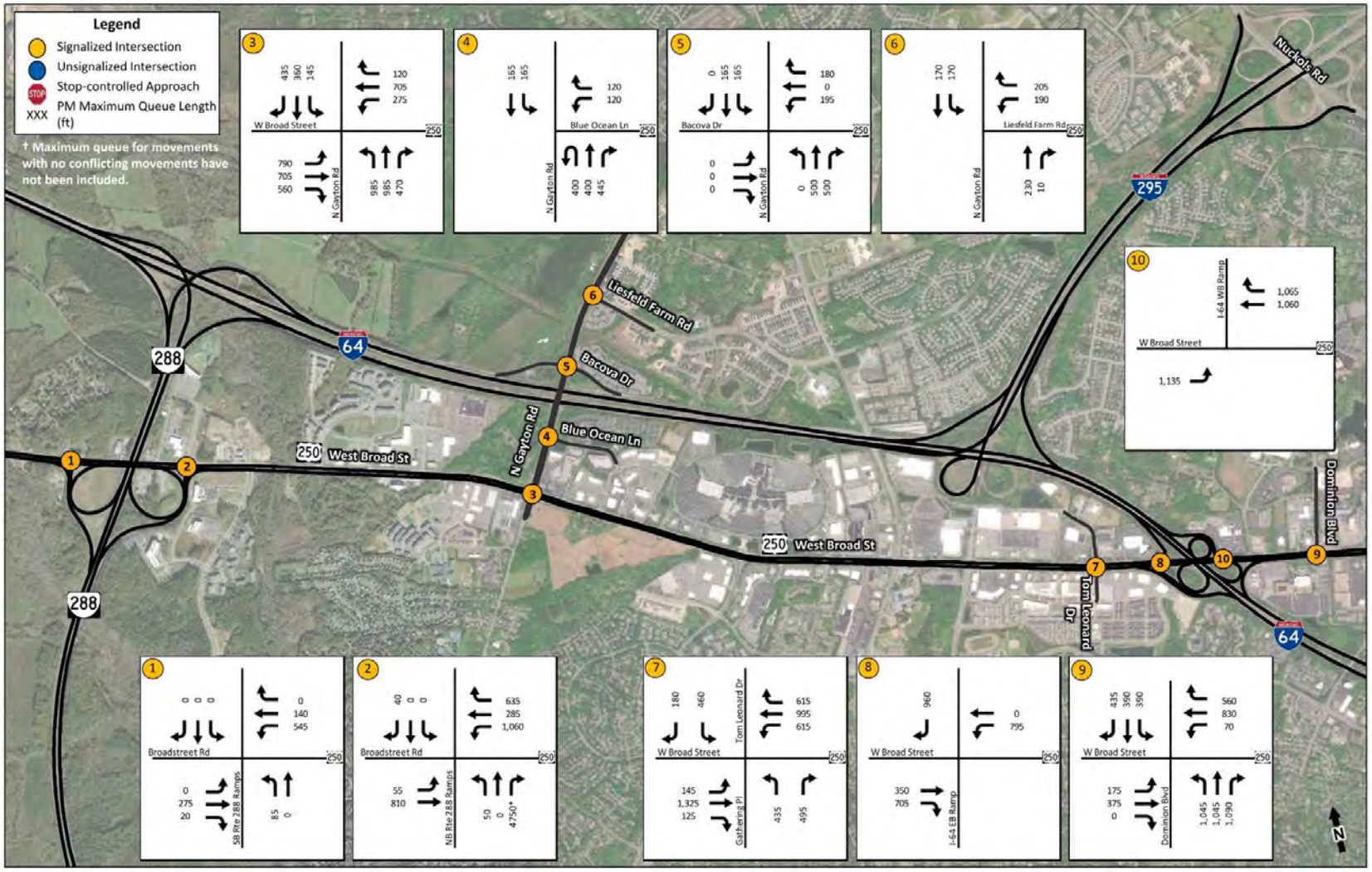


Figure 87: Build Package 1 (2046) PM Peak Hour Maximum Queue Length



Build Package 2

Heavy vehicle, peak hour factor, and traffic signal timing assumptions remained consistent with the No-Build analyses. The input traffic volumes used for Build Package 2 are described and provided in the *Build Traffic Volumes* section of the report. A detailed summary of the Build Package 2 inputs is provided in *Appendix G*.

The VDOT Sample Size Determination Tool, Version 2.0 was used to determine the number of traffic simulation runs required to provide the acceptable 95th percentile confidence level for the 2026 and 2046 Build Package 2 models. Ten simulation runs were conducted for the Build Package 2 2026 AM and PM peak hour and 2046 PM peak hour models using different random seeds and the average of these runs was reported. The VDOT Sample Size Determination Tool showed 30 runs were required for the Build Package 2 2046 AM peak hour model. The VDOT Sample Size Determination Tool summary sheets are provided in *Appendix G.*

Build Package 2 Freeway Analysis Results

The AM and PM peak hour average freeway segment density and speed for the 2026 and 2046 Build Package 2 conditions are illustrated in *Figure 88* through *Figure 95*. Graphical representation of the freeway results by lane is included in *Appendix G*.

AM Peak Hour

In the 2026 AM peak hour, all segments of I-64 in both directions in the study area are projected to operate with speeds of 57 mph or greater. The segment of westbound I-64 between the ramps at the US 250 interchange is projected to experience improved speeds of 56 mph or greater.

In 2046, all segments of I-64 in both directions in the study area are projected to operate with speeds of 53 mph or greater. The segment of westbound I-64 approaching the US 250 interchange is projected to experience improved speeds of 53 mph or greater. The rightmost lane between the westbound I-64 on-ramp from eastbound US 250 and the westbound I-64 off-ramp to westbound US 250 is still projected to operate with speeds of approximately 40 mph due to the vehicles changing lanes in the weaving section. However, due to the change in volume patterns attributed to the new interchange, fewer vehicles are projected to use these two ramps and the speed is projected to increase from No-Build conditions due to fewer weaving movements.

The turning restriction from the westbound I-64 off-ramp to eastbound US 250 to Dominion Boulevard combined with the reduced demand on US 250 is projected to reduce congestion on eastbound US 250 in the vicinity of the I-64 interchange and reduce the queuing on the eastbound I-64 off-ramp to eastbound US 250. *Figure 96* shows the reduced queuing on eastbound US 250 and the ramps at the interchange. Queuing on the eastbound I-64 off-ramp to eastbound US 250 is projected to extend 640 feet from the ramp terminal due to friction caused by vehicles weaving on eastbound US 250, but the queue is not projected to reach the freeway as in the No-Build conditions. Additionally, the queuing on eastbound US 250 is not projected to extend to the westbound I-64 off-ramp to eastbound US 250 since the lower demand on eastbound US 250 combined with the turning restriction that prevents vehicles on this ramp from turning left at Dominion Boulevard are projected to improve operations on US 250. In the case that the volumes on US 250 do not decrease as projected, this queue would be projected to operate similarly to the AM peak hour projections for Build Package 1 and be comparable to the No-Build scenario.

The southbound Route 288 auxiliary lane between the US 250 and Tuckahoe Creek Parkway interchanges is projected to provide relief to the congestion on southbound Route 288 that was identified in the No-Build conditions analysis. The additional capacity from the auxiliary lane allows southbound Route 288 to serve the projected 6,500 vehicles per hour south of the US 250 interchange while operating at speeds of 54 mph or greater.

The southwestbound I-295 bottleneck identified in the No-Build conditions analysis is still present in Build Package 2 since the study team agreed not to include further improvements on southwestbound I-295 as documented in the *I-64 at US 250 and I-295 Interchanges* screening section. However, the southwestbound I-295 loop ramp to eastbound I-64 is projected to operate with slightly improved speeds from the No-Build conditions (between 27 and 35 mph) due to reduced demand on the loop ramp that is attributed to the change in volume patterns attributed to the new interchange. The congestion on southwestbound I-295 approaching the I-64 ramps is still projected to prevent all the demand on I-295 from being served, but the demand served is projected to increase 8 percent from No-Build conditions.

PM Peak Hour

In the 2026 PM peak hour, all segments of I-64 in the study area are projected to operate with speeds of 53 mph or greater. The segment of westbound I-64 between I-295 and Route 288 is projected to serve 100 percent of the demand, which is an increase of 4 percent from No-Build conditions, even though the demand has increased by 1,100 vehicles due to changing volume patterns attributed to the new interchange.

The segment of westbound I-64 between the ramps at the US 250 interchange is projected to have a link speed of 43 mph, which is an increase from 20 mph in No-Build conditions. Due to the change in volume patterns attributed to the new interchange, fewer vehicles are projected to use both the westbound I-64 on-ramp from eastbound US 250 and the westbound I-64 off-ramp to westbound US 250 and the speed is projected to increase from No-Build conditions due to fewer weaving movements. The rightmost lane between the ramps is projected to operate with at 36 mph from the friction of weaving vehicles, which is an increase of 3 mph from No-Build conditions.

The improvements at the intersection of US 250 and the northbound Route 288 ramps are projected to improve speeds on the off-ramp and prevent queuing from impacting the operations of northbound Route 288. Additionally, approximately 200 vehicles are rerouted to continue on northbound Route 288 and access US 250 via the N Gayton Road interchange. This reduction in demand on the northbound Route 288 off-ramp to eastbound US 250 is projected to further reduce congestion on the ramp.

By 2046, all segments of I-64 in both directions in the study area are projected to operate with speeds of 53 mph or greater except the section of westbound I-64 between ramps at the US 250 interchange. The projected average link speed on westbound I-64 between the on-ramp from eastbound US 250 and the off-ramp to westbound US 250 is 37 mph. The projected reduction in demand on the ramps at the interchange due to the new access at N Gayton Road improves speeds and significantly reduces queuing on westbound I-64 when compared to the No-Build conditions, but friction from weaving vehicles is still projected to produce a maximum queue of approximately 1,000 feet on westbound I-64. *Figure 97* shows the residual queuing on westbound I-64 at the interchange. This queue is projected to stay contained mostly in the rightmost lane on the freeway. This section of westbound I-64 through the US 250 interchange is projected to serve 94 percent of the demand, which is an increase of 29 percent from No-Build conditions.

The changing traffic patterns on the ramps at the US 250 interchange are projected to increase speeds on westbound I-64 upstream of the interchange as well. The vehicles that are rerouted to continue westbound on I-64 to use the N Gayton Road interchange to access the Short Pump area instead of the US 250 interchange are projected to result in a more balanced lane distribution on westbound I-64 upstream of the US 250 interchange. The more balanced lane distribution is projected to result in increased speeds on westbound I-64 through the Gaskins Road and Parham Road interchanges as shown in *Figure 98.* The travel time on westbound I-64 between the Parham Road and US 250 interchanges is projected to decrease by 9 minutes and 31 seconds in Build Package 2 compared to the No-Build conditions.

Three of the four bottlenecks identified in the *No-Build Conditions Freeway Analysis Results* were addressed with improvements included in Build Package 2. The bottleneck on southwestbound I-295 is still present in Build conditions due to the over-capacity loop ramp from southwestbound I-295 to eastbound I-64, which has a projected demand of 2,400 vehicles in the PM peak hour. The study team agreed not to include further improvements on southwestbound I-295 as documented in the *I-64 at US 250 and I-295 Interchanges* screening section.

The intersection improvements at Tom Leonard Drive are projected to improve operations on westbound US 250 and prevent queuing from impacting the interchange ramps. The eastbound I-64 off-ramp to westbound US 250 is projected to operate with improved speeds of 26 mph resulting from the reduced queuing on westbound US 250.

The improvements to the intersection of US 250 and the northbound Route 288 ramps are projected to relieve congestion on the ramp and prevent queuing from impacting mainline northbound Route 288. Additionally, over 500 vehicles are projected to be rerouted to continue northbound on Route 288 to access the Short Pump area via the N Gayton Road interchange. The proposed improvements are projected to release the ramp bottleneck, but the additional traffic continuing northbound through the interchange is projected to slow on northbound Route 288 between the ramps at the US 250 interchange. This 2-lane section is over capacity with a projected demand of 4,694 vehicles in the PM peak hour and is projected to operate with speeds of 35 mph or less and densities of 63 veh/ln/mi or greater, which is similar to No-Build conditions. Despite the congestion on northbound Route 288, the Build improvements are projected to allow northbound Route 288 to serve an additional 1,200 vehicles in the PM peak hour.

The northeastbound I-295 ramp improvements and the auxiliary lane on northeastbound I-295 to Nuckols Road are projected to reduce the density on the ramp to 23 veh/ln/mi or better and improve speeds up to 53 mph or greater. These improvements prevent the queuing on the ramp that was identified in the No-Build conditions analysis from backing up to westbound I-64.

Figure 88: Build Package 2 (2026) AM Peak Hour Average Density

Figure 89: Build Package 2 (2026) AM Peak Hour Average Speed

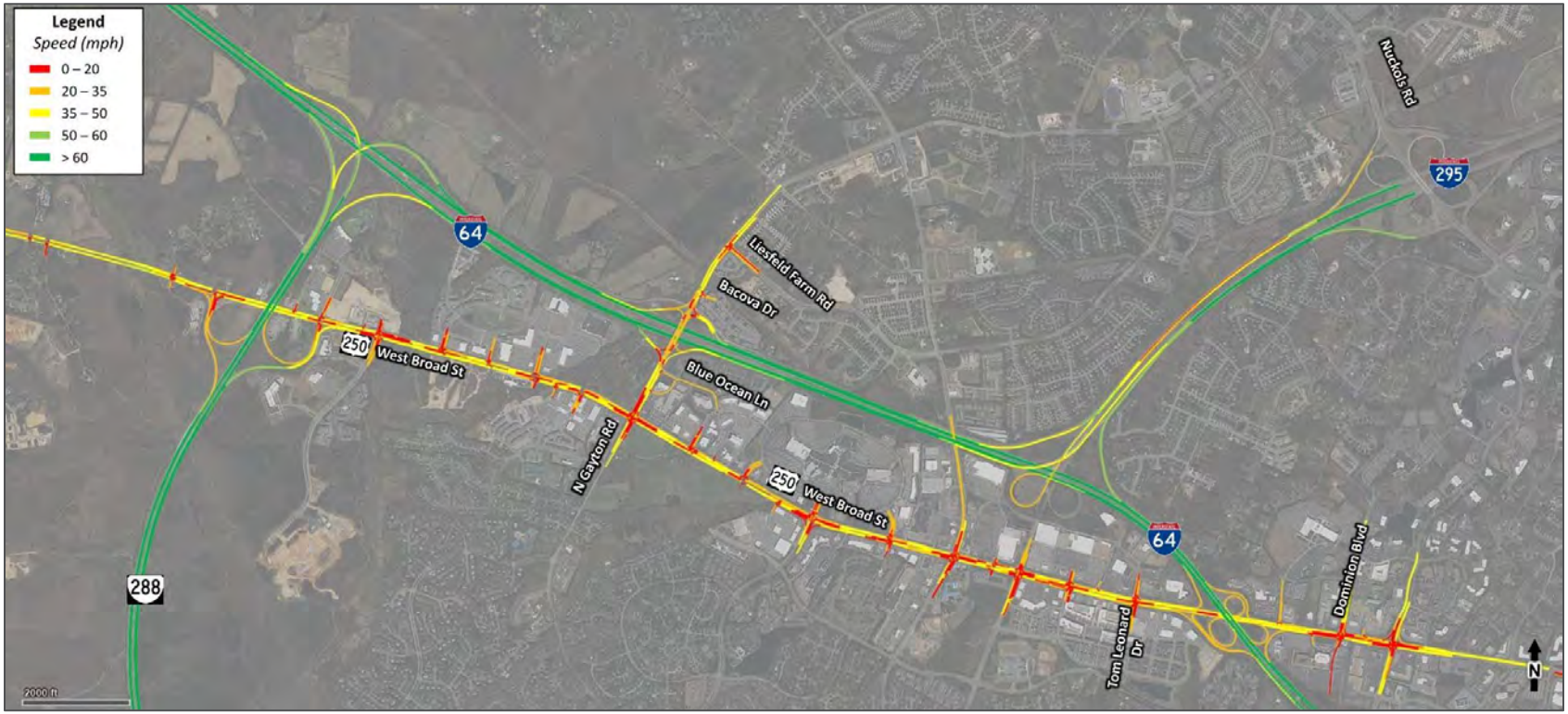


Figure 90: Build Package 2 (2046) AM Peak Hour Average Density

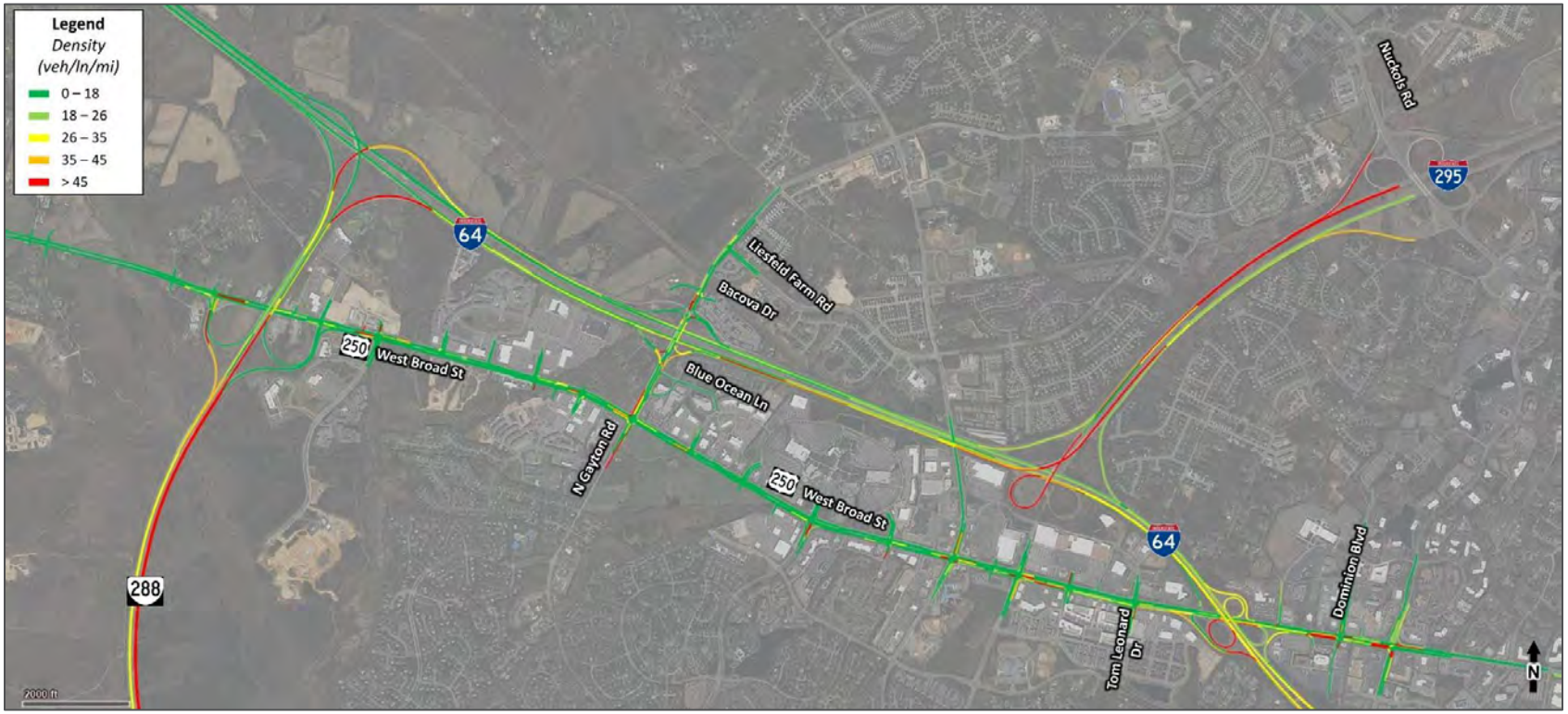


Figure 91: Build Package 2 (2046) AM Peak Hour Average Speeds

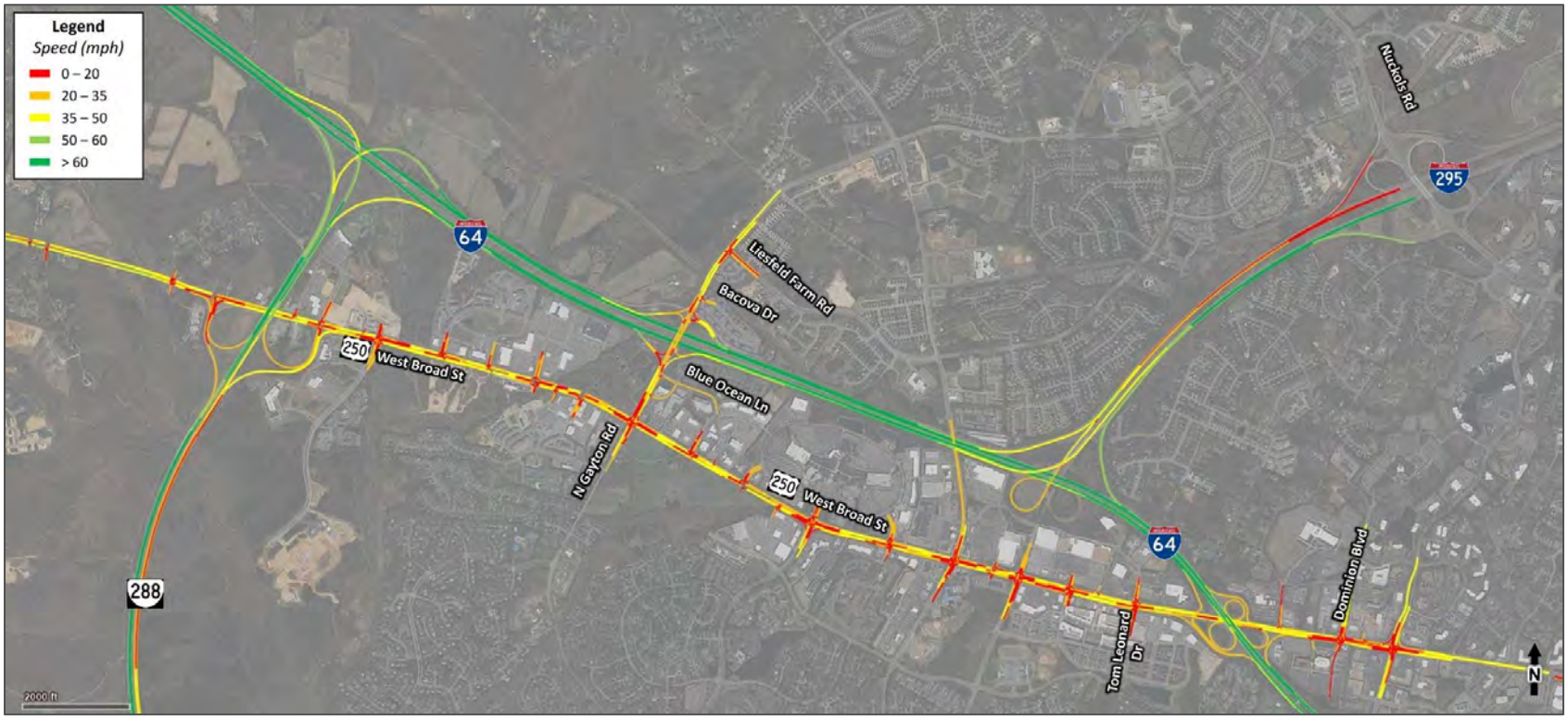


Figure 92: Build Package 2 (2026) PM Peak Hour Average Density

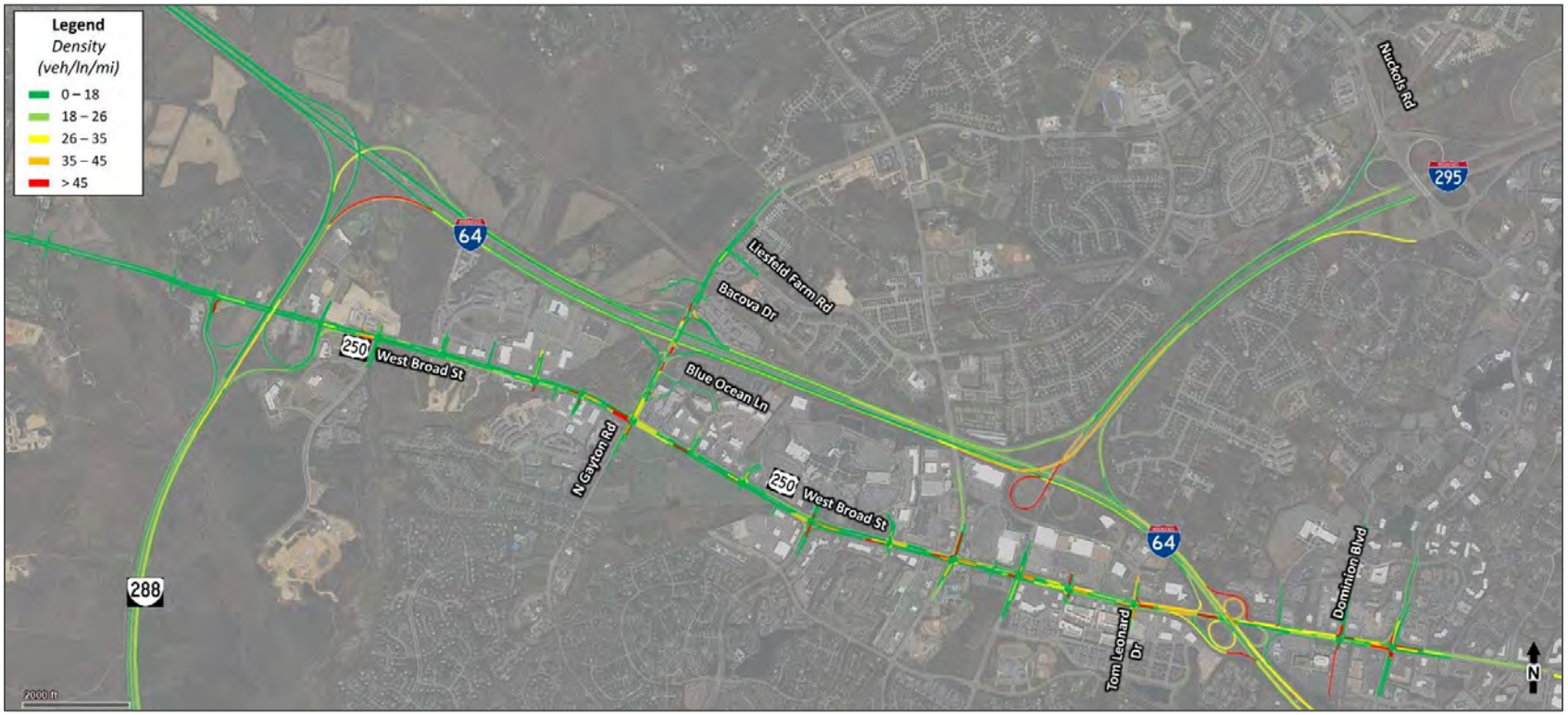


Figure 93: Build Package 2 (2026) PM Peak Hour Average Speed

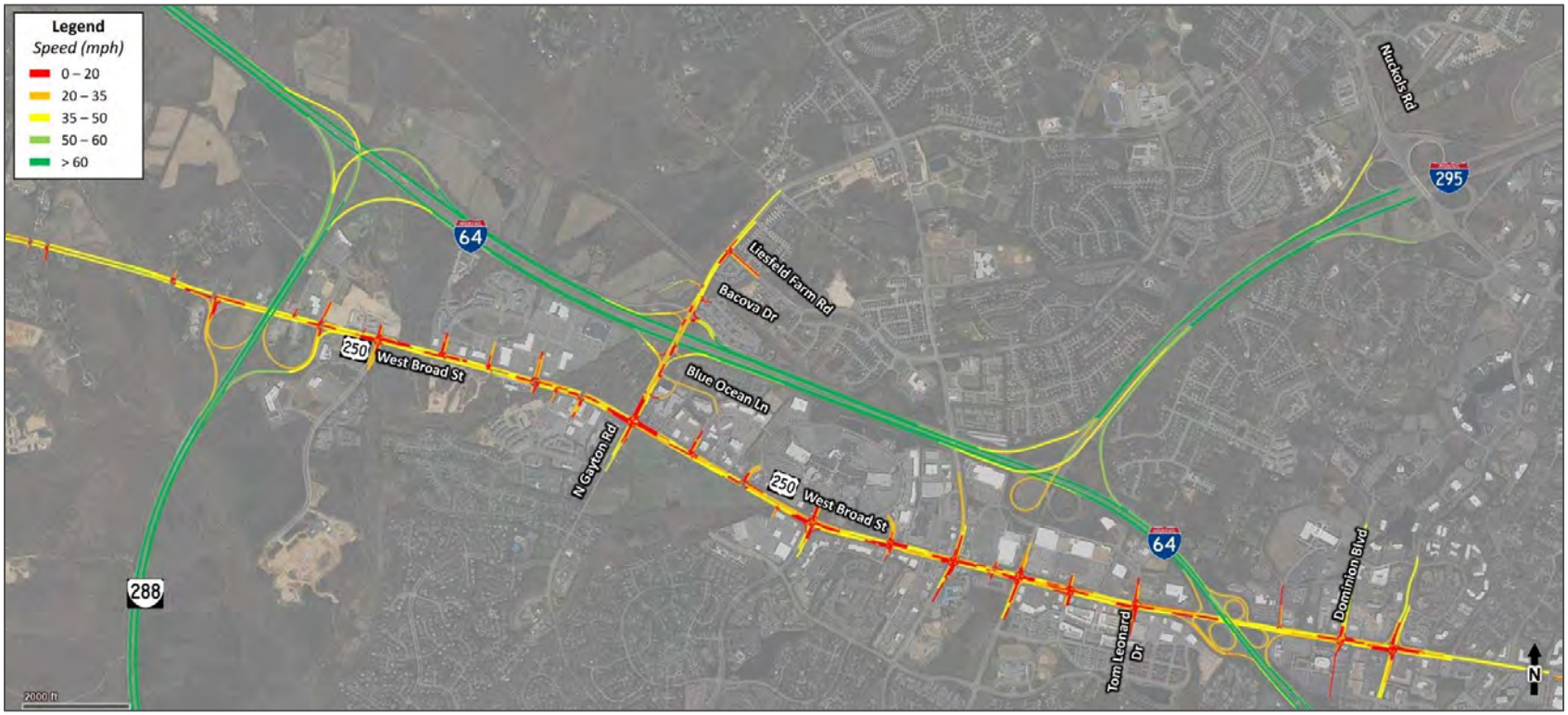


Figure 94: Build Package 2 (2046) PM Peak Hour Average Density

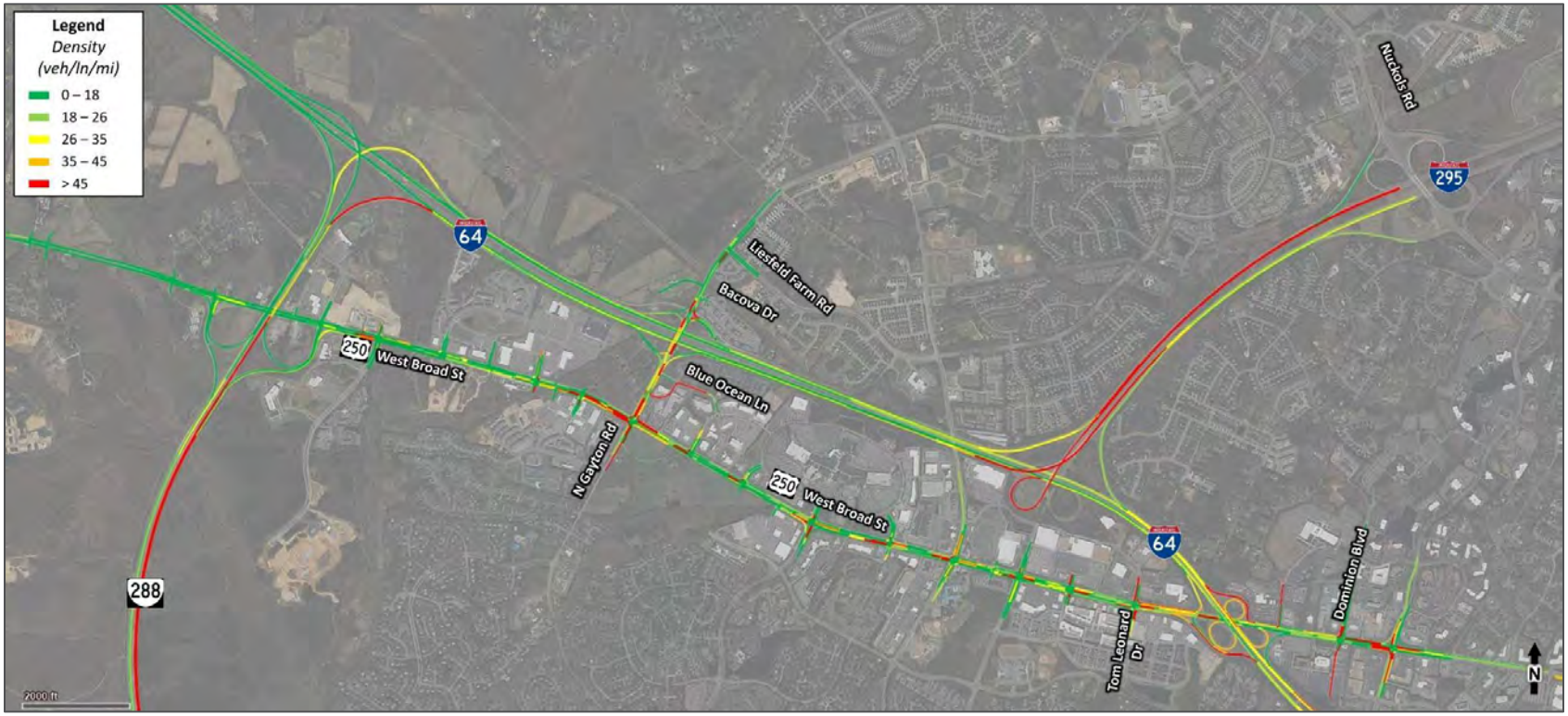


Figure 95: Build Package 2 (2046) PM Peak Hour Average Speed

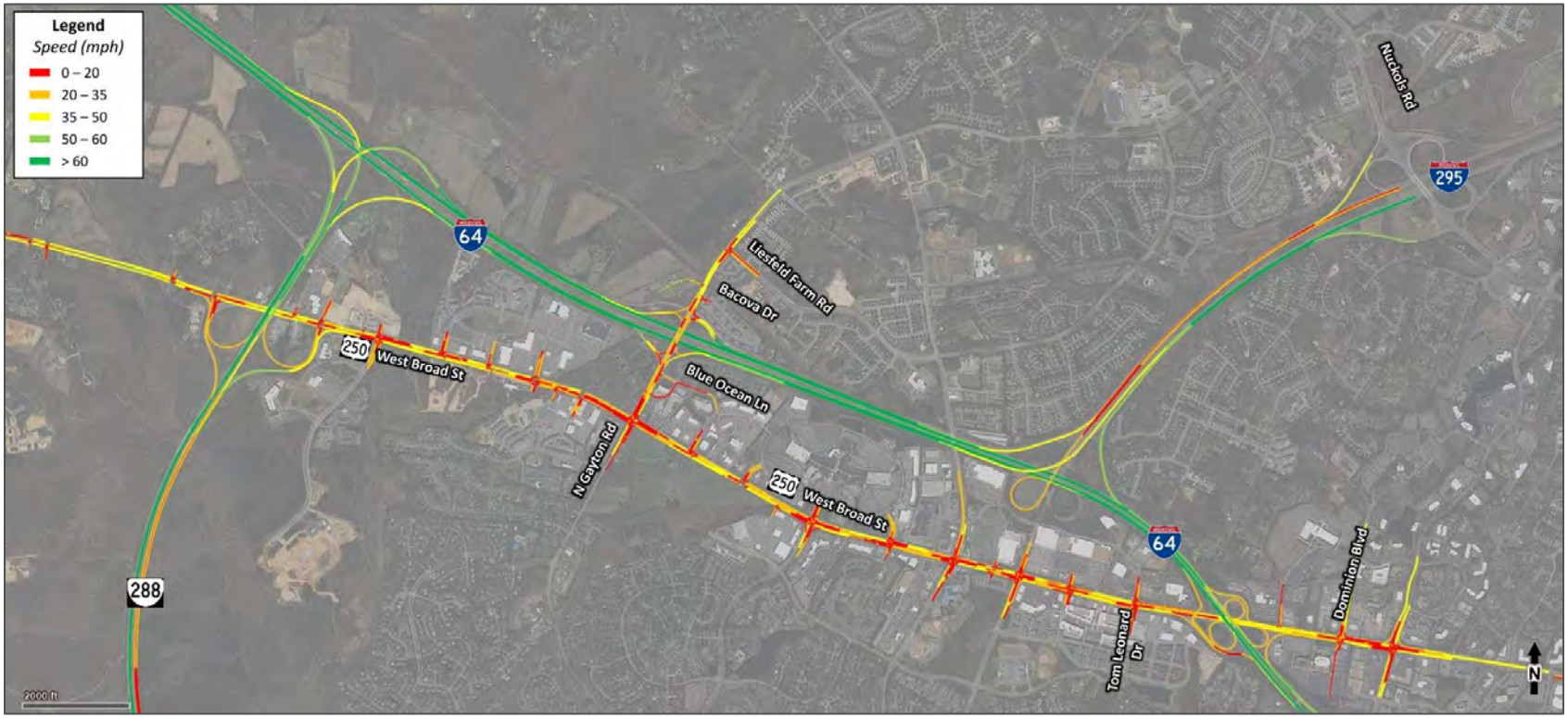


Figure 96: Build Package 2 (2046) AM Peak Hour Maximum Queue Length (Depictive)

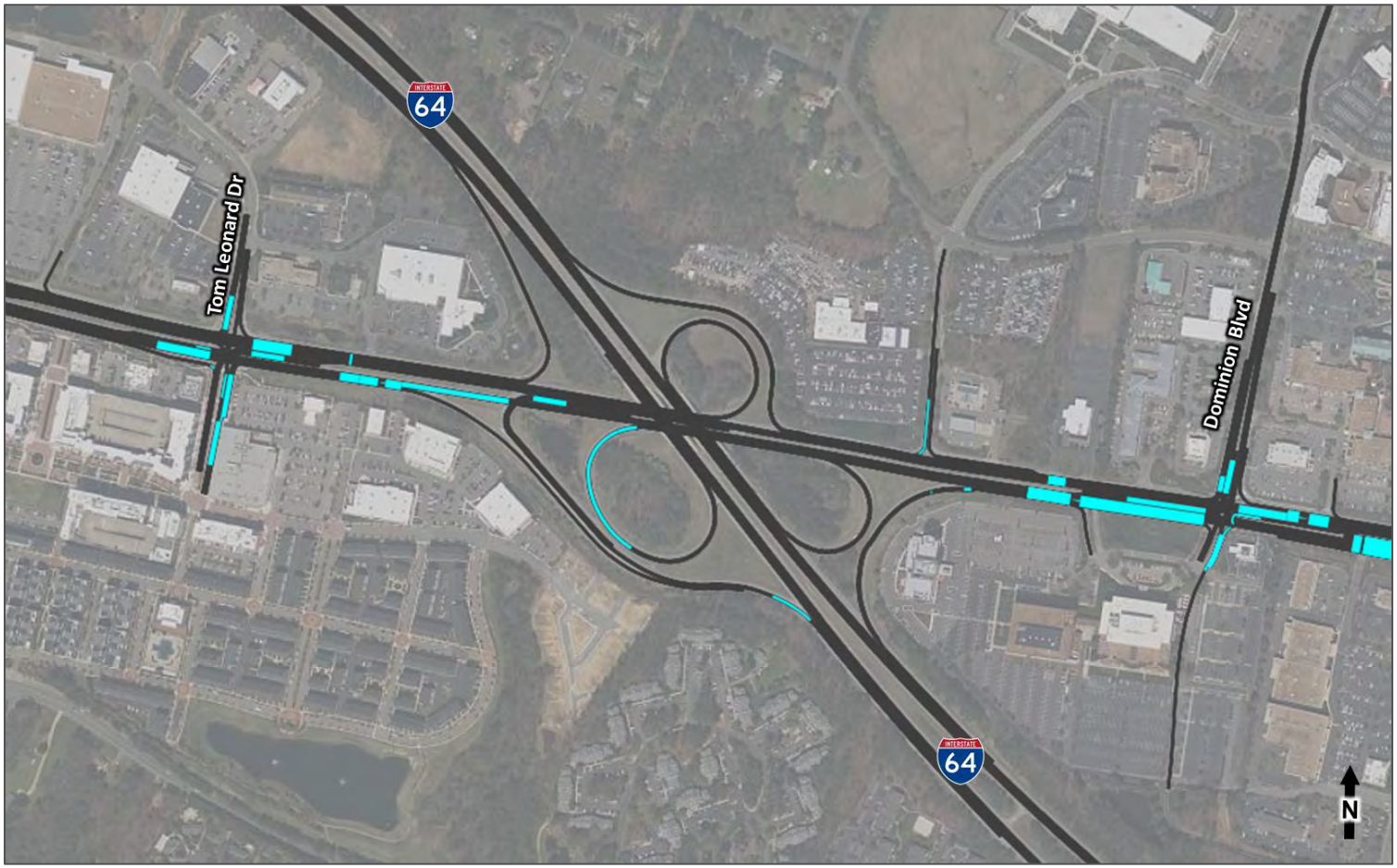


Figure 97: Build Package 2 (2046) PM Peak Hour Maximum Queue Length (Depictive)

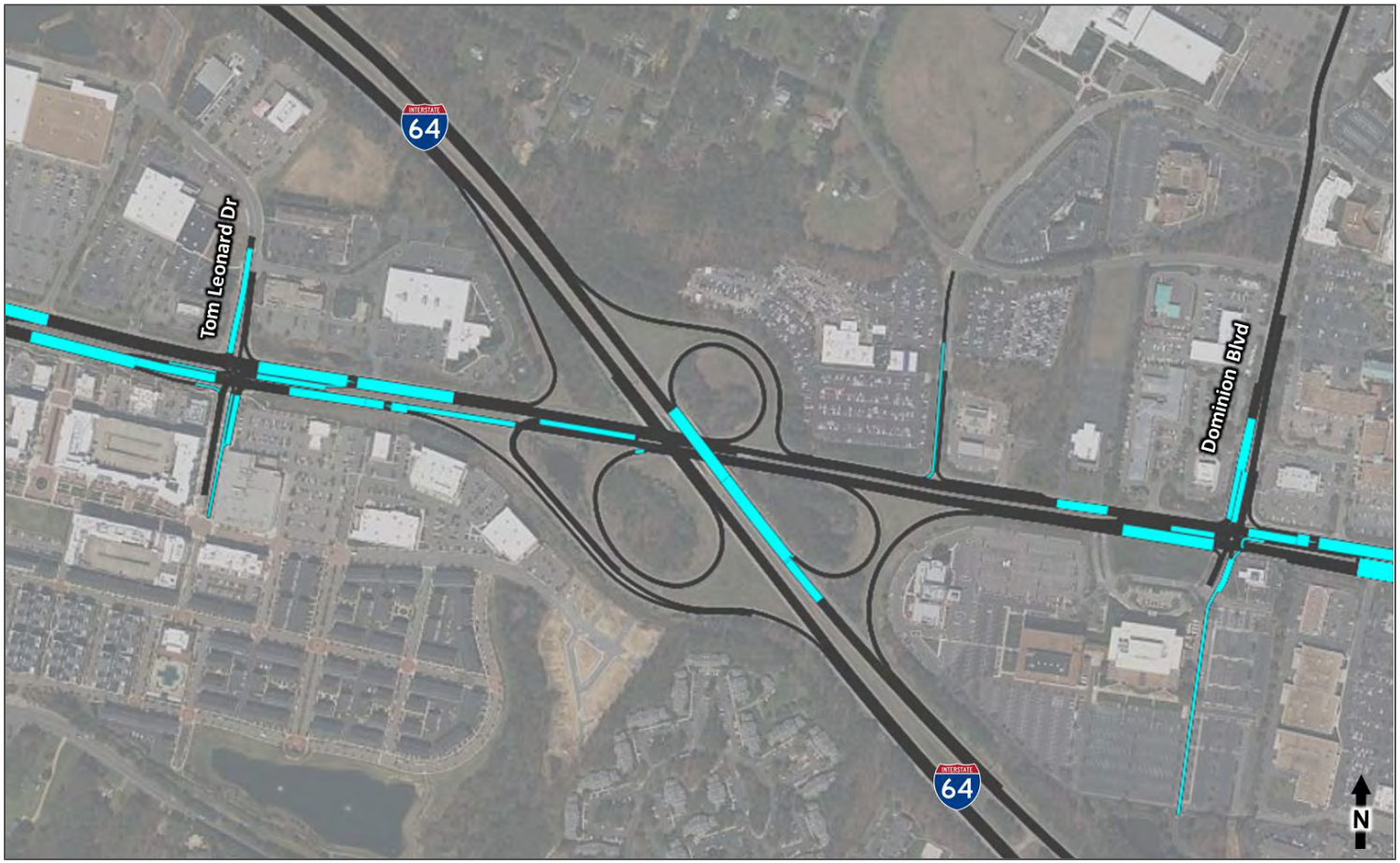
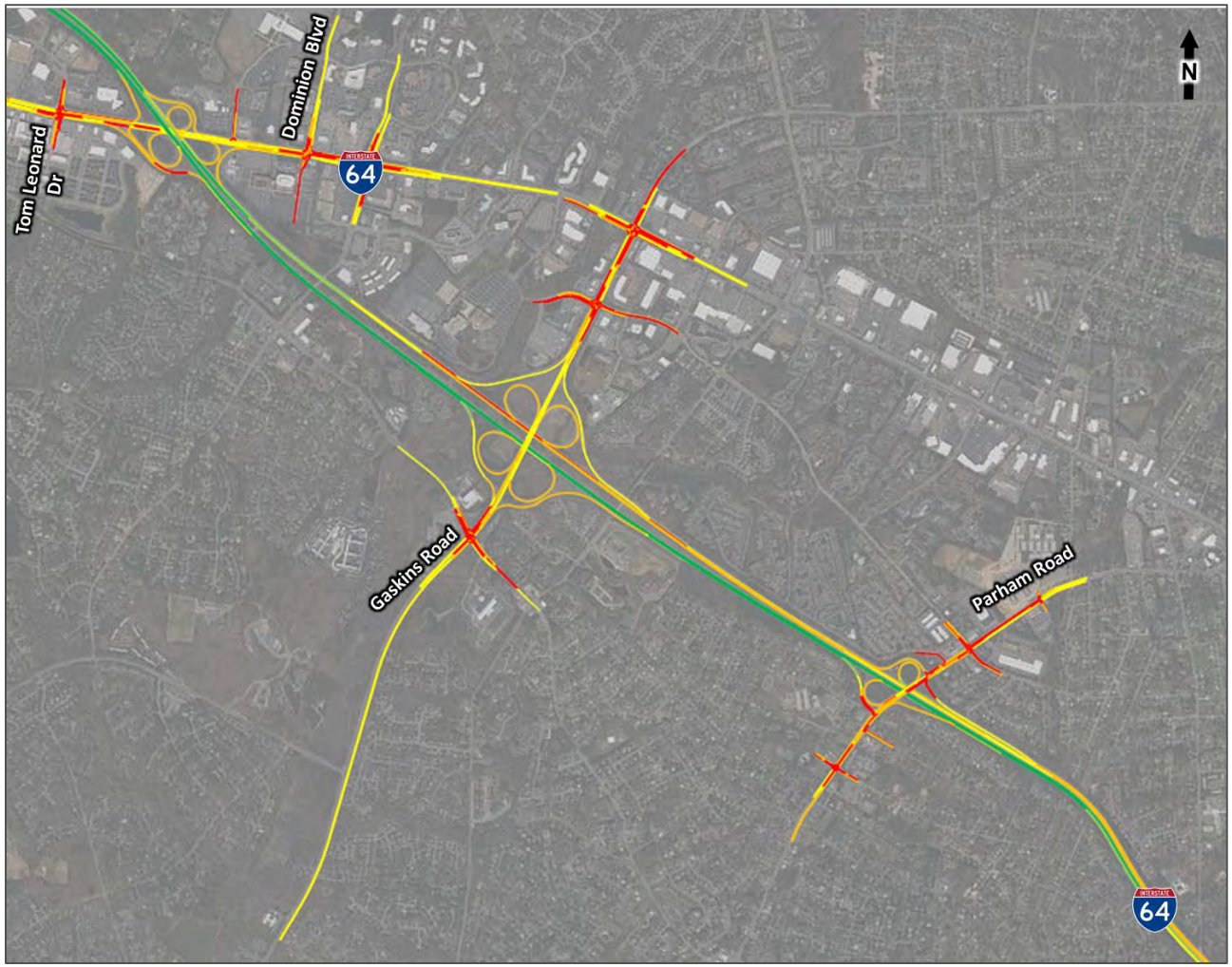


Figure 98: Build Package 2 (2046) PM Peak Hour Average Speed



Build Package 2 Intersection Analysis Results

Graphical representation of the average intersection delay (seconds per vehicle) by movement and maximum queue length (feet) are shown in *Figure 99* through *Figure 106*.

AM Peak Hour

In the 2026 AM peak hour, the intersection of US 250 and N Gayton Road is projected to operate with the most overall intersection delay of 31.0 seconds per vehicle. All left-turn movements at the intersection are projected to operate with 60.2 seconds per vehicle or greater. All left-turn maximum queue lengths are projected to stay contained to their respective storage bays.

All other study area intersections are projected to operate with an overall intersection delay of 25.2 seconds per vehicle or better. The intersections of N Gayton Road and the I-64 ramps are projected to operate with overall intersection delays of 14.4 seconds per vehicle or better.

The longest AM peak hour maximum queue is projected to occur at the westbound left-turn movement at the intersection with the southbound Route 288 ramps, but the 445-foot queue is projected to stay contained in the storage bay.

In the 2046 AM peak hour, the intersection of US 250 and N Gayton Road is projected to operate with the most overall intersection delay of 38.1 seconds per vehicle. The longest AM peak hour maximum queue is projected to occur at the southbound right-turn movement at the intersection of US 250 and N Gayton Road. The projected 825-foot queue extends beyond the right-turn storage bay, which is 305 feet less than No-Build conditions.

All other study area intersections are projected to operate with overall intersection delays of 28.0 seconds per vehicle or better. The intersections of N Gayton Road and the I-64 ramps are projected to operate with overall intersection delay of 14.9 seconds per vehicle or better.

All study area intersections are projected to operate at or better than the No-Build conditions analysis results. The overall travel time on US 250 between Route 288 and Cox Road is projected to decrease by 4 minutes and 29 seconds in the eastbound direction and 4 seconds in the westbound direction from No-Build conditions.

PM Peak Hour

In the 2026 PM peak hour, the intersection of US 250 and N Gayton Road is projected to operate with the most overall intersection delay of 40.4 seconds per vehicle. The westbound and northbound left-turn movements are projected to operate with delays of 60.8 seconds per vehicle or greater.

The intersection of US 250 and Dominion Boulevard is projected to operate with an overall intersection delay of 37.3 seconds per vehicle. All movements on the northbound approach are projected to operate with delays of 300 seconds of greater. The longest maximum queues in the 2026 PM peak hour are projected on the northbound approach at Dominion Boulevard and extend 1,050 feet.

All other study area intersections are projected to operate with overall intersection delays of 23.9 seconds per vehicle or better. The side street movements at the intersection of Tom Leonard Drive and US 250 are projected to operate with delays of 56.8 seconds per vehicle or greater. The intersections of N Gayton Road and the I-64 ramps are projected to operate with overall intersection delays of 14.4 seconds per vehicle or greater.

By 2046, the intersection of US 250 and N Gayton Road is projected to operate with the most overall intersection delay of 63.9 seconds per vehicle. All left-turn movements at the intersection are projected to operate with 58.7 seconds per

vehicle of delay or greater. The eastbound left-turn queue is projected to extend 995 feet and spill back out of the 545-foot storage bay.

The intersection of US 250 and Dominion Boulevard is projected to operate with 44.5 seconds per vehicle of overall intersection delay. The northbound approach is projected to operate with delays of 367.8 seconds per vehicle or greater, similar to the results identified in the No-Build conditions analysis.

All other study area intersections are projected to operate with overall intersection delays of 27.2 seconds per vehicle or better. The intersections of N Gayton Road and the I-64 ramps are projected to operate with overall intersection delays of 16.8 seconds per vehicle or better. All ramp terminal movements are projected to operate with 31.7 seconds of delay per vehicle or better.

The westbound right-turn vehicles rerouted from Blue Ocean Lane to the Dominion Chevy Access Road are projected to experience 250.3 seconds of delay per vehicle. The westbound right-turn queue is projected to extend 1,265 feet back into the shopping center roadway network. These projections were based on volume rerouting assumptions that increased this right-turn volume from the No-Build scenario to account for vehicles accessing the new interchange from the nearby developments. If this Build package were to be built, these delay and queuing projections may be overstated as drivers may elect to access the new interchange via subsequent right turns onto US 250 and N Gayton Road to avoid long delays. In this case, the delay and queuing would distribute between the westbound right-turn movement at the Dominion Chevy Access Road and the southbound right-turn movements at Henley Drive or Town Center W Boulevard. In the case that long delays and queues persist at the Dominion Chevy Access Road, this intersection should be reviewed for further improvements to mitigate the delay and queuing.

All study area intersections are projected to operate at or better than the No-Build conditions analysis results. The overall travel time on US 250 between Route 288 and Cox Road is projected to decrease by 1 minute and 26 seconds in the eastbound direction and 43 seconds in the westbound direction. As described in the *Build Traffic Volumes* section, the demand on US 250 is projected to decrease with the addition of the new interchange at N Gayton Road. The decreased demand is projected to result in improved intersection operations and improved travel times.

Figure 99: Build Package 2 (2026) AM Peak Hour Intersection Delay

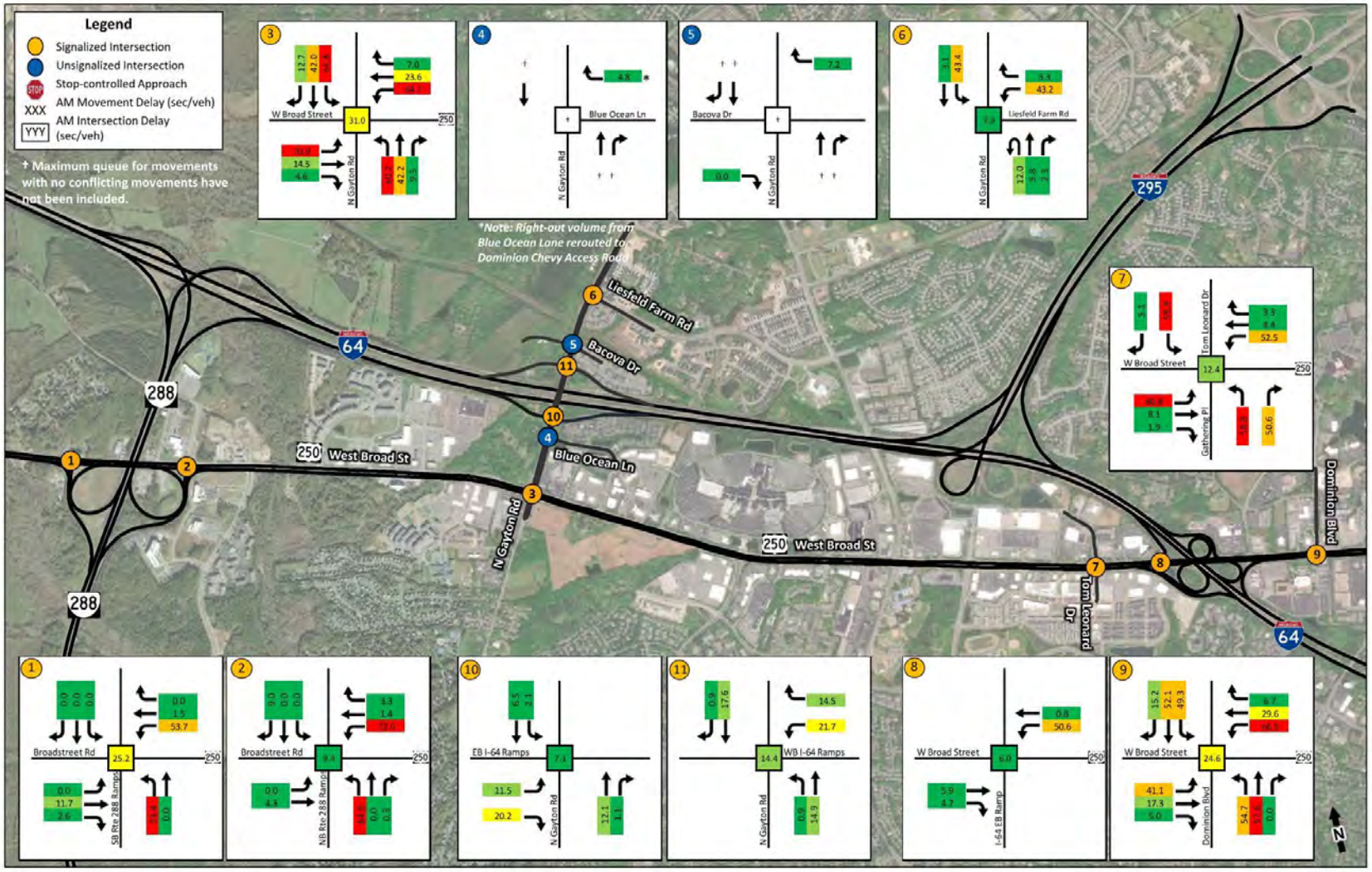


Figure 100: Build Package 2 (2026) AM Peak Hour Maximum Queue Length

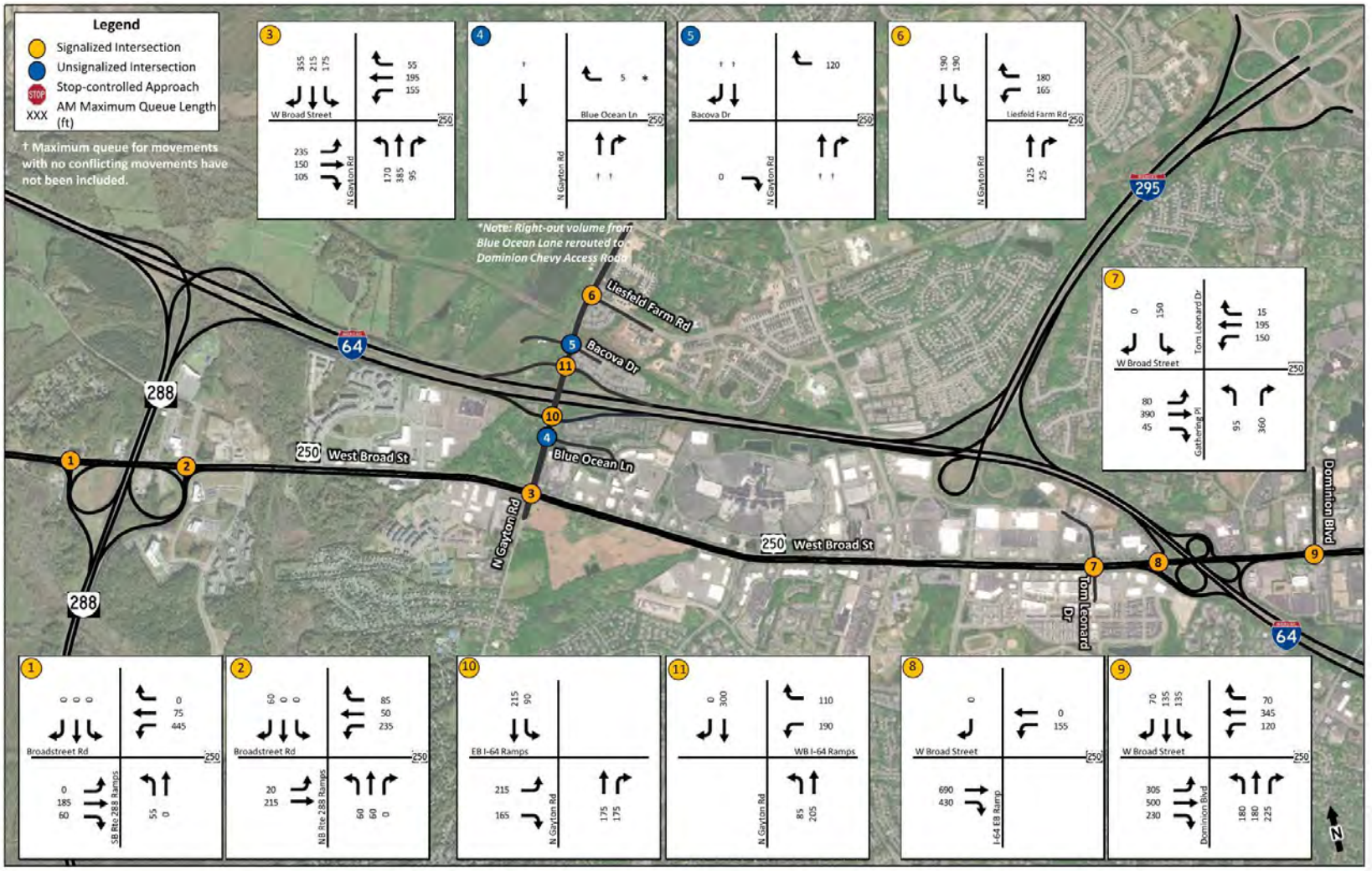


Figure 101: Build Package 2 (2046) AM Peak Hour Intersection Delay

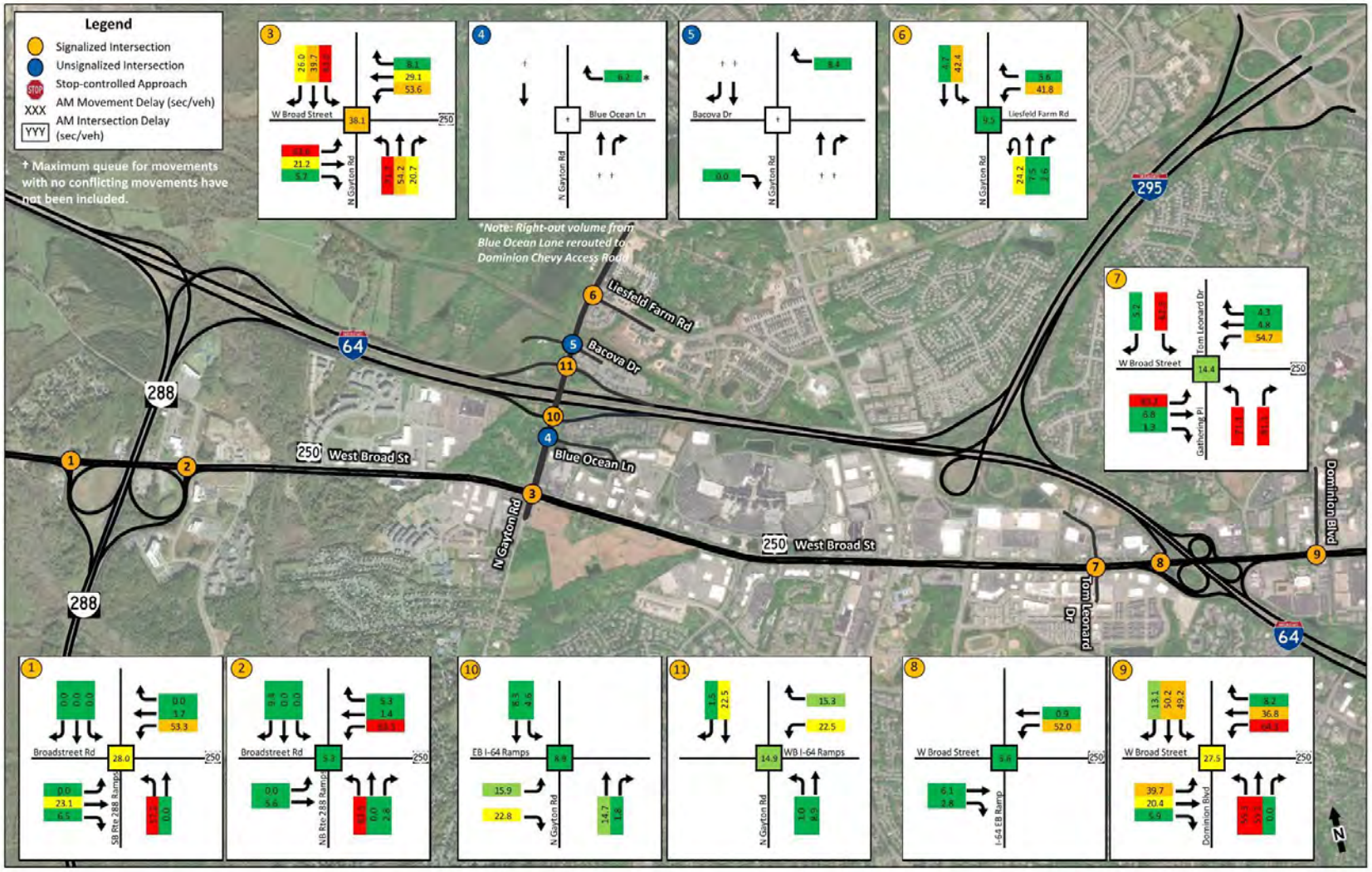


Figure 102: Build Package 2 (2046) AM Peak Hour Maximum Queue Length

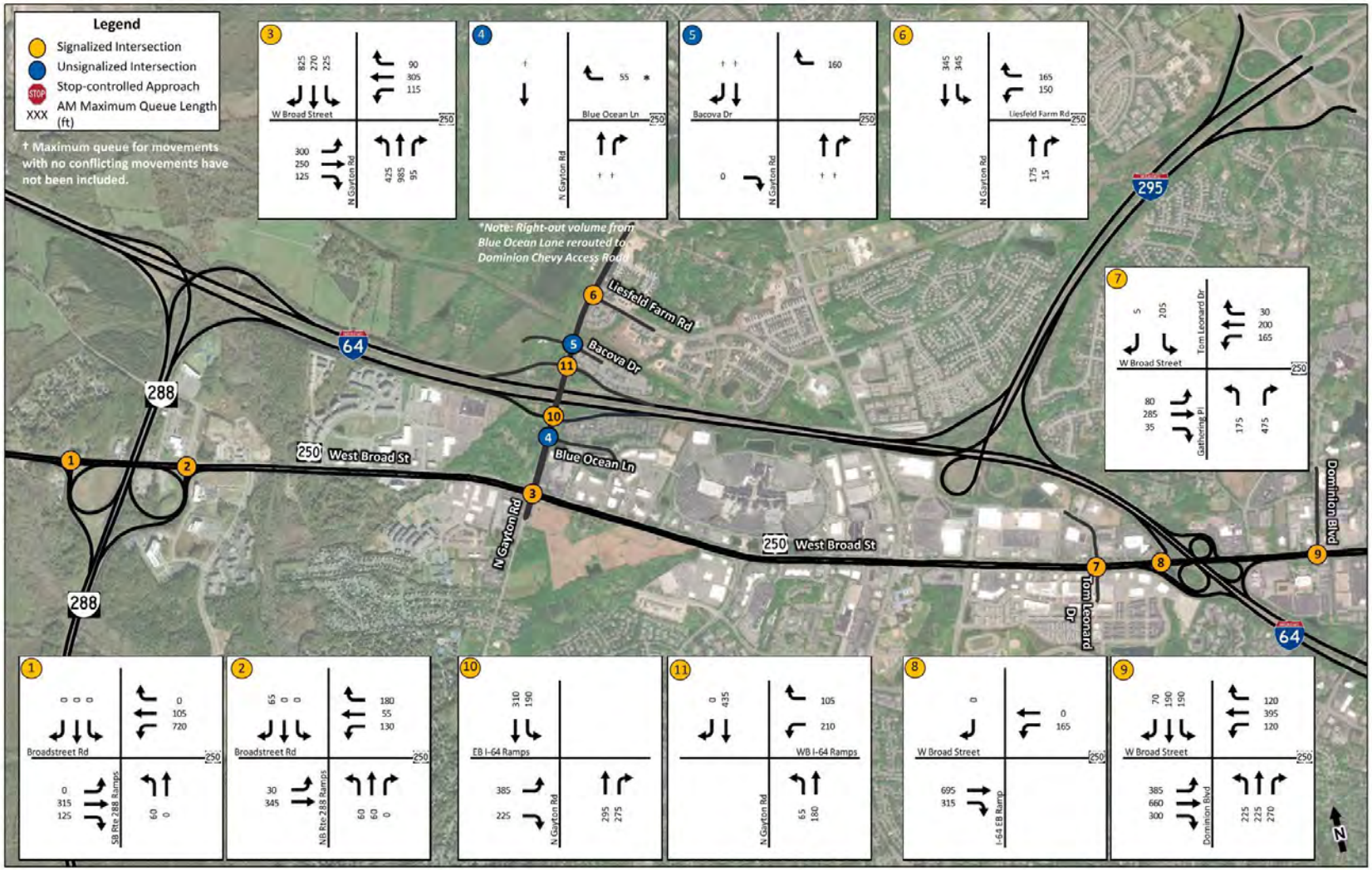


Figure 103: Build Package 2 (2026) PM Peak Hour Intersection Delay

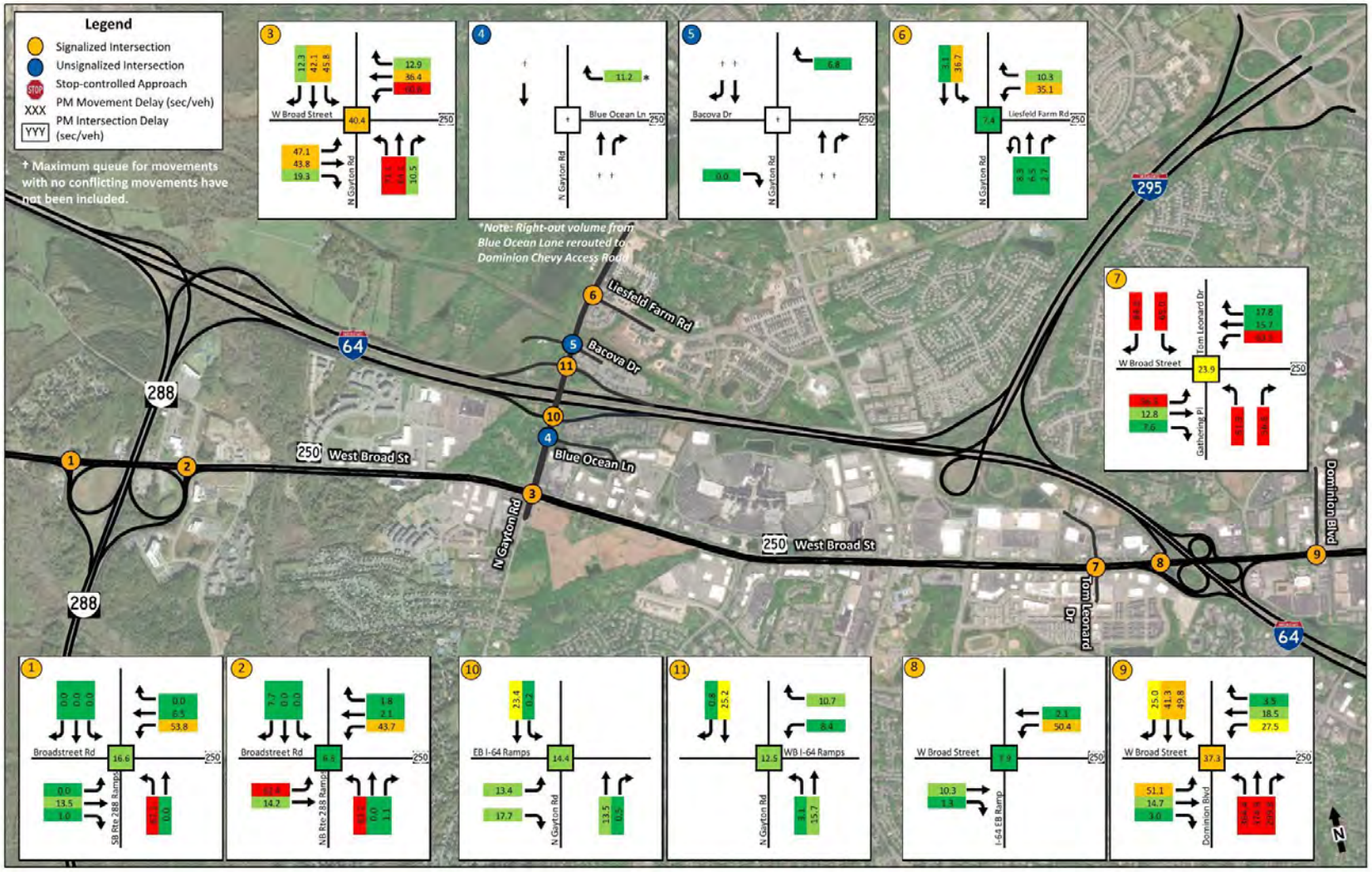


Figure 104: Build Package 2 (2026) PM Peak Hour Maximum Queue Length

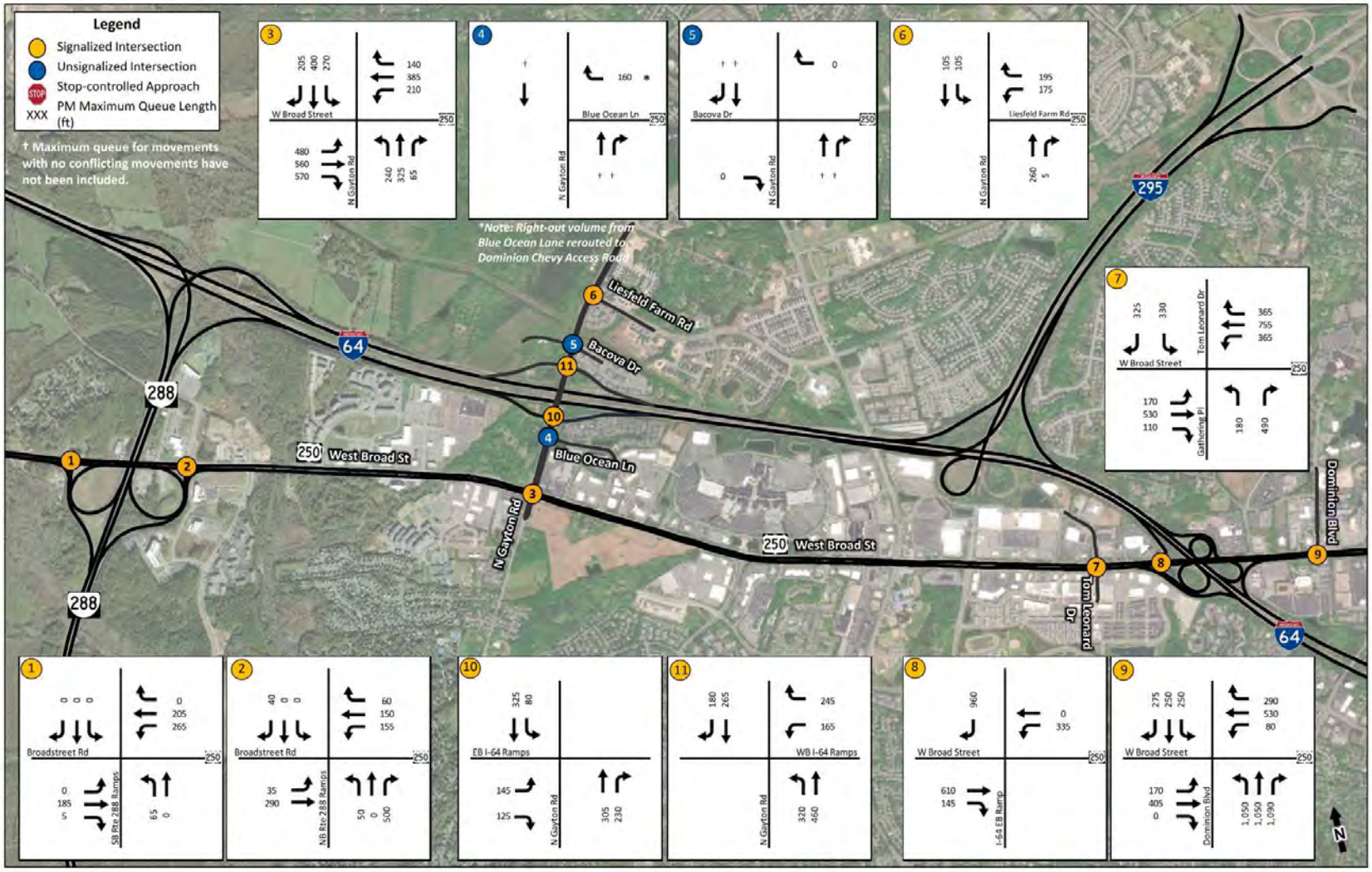


Figure 105: Build Package 2 (2046) PM Peak Hour Intersection Delay

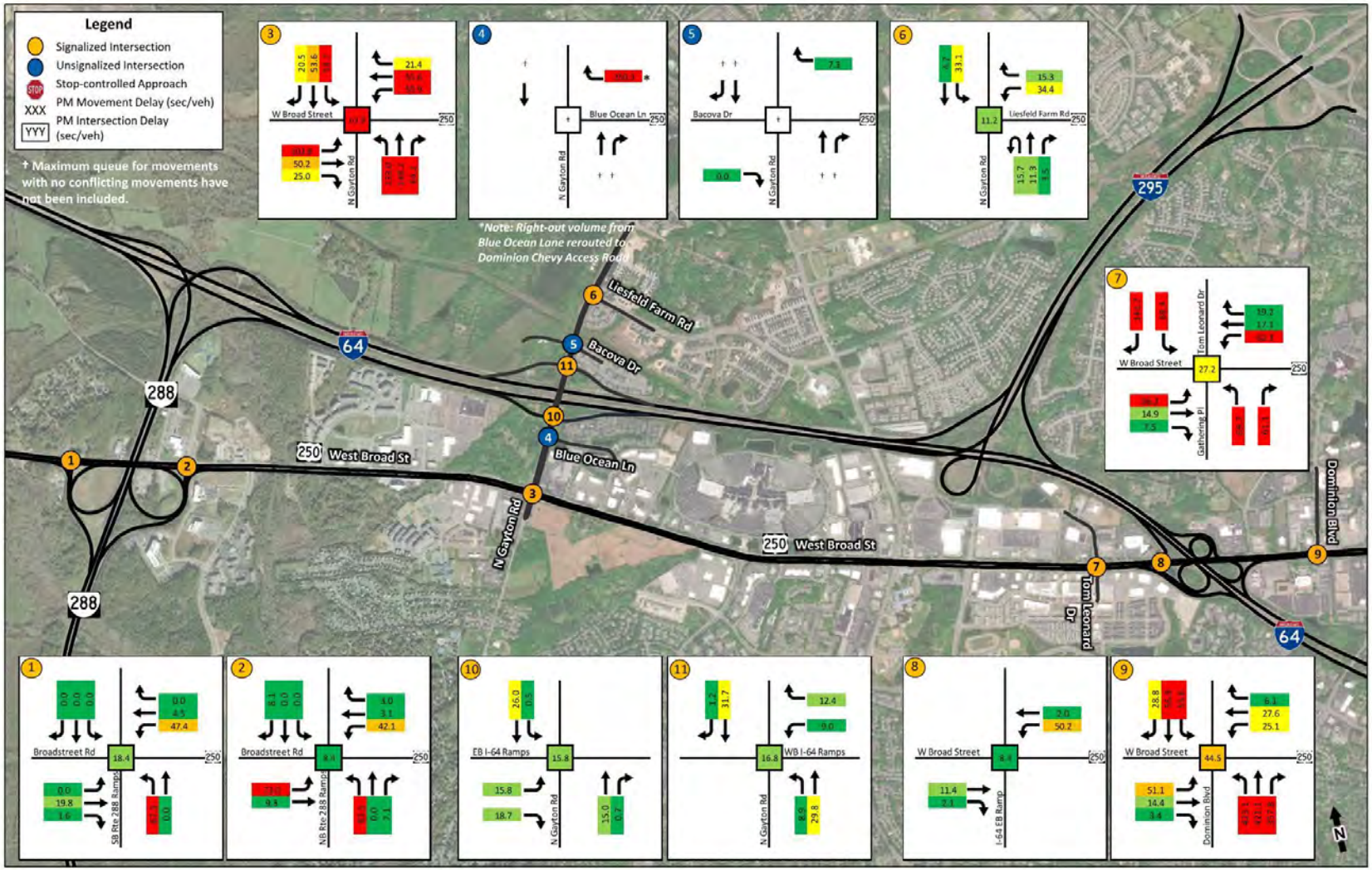
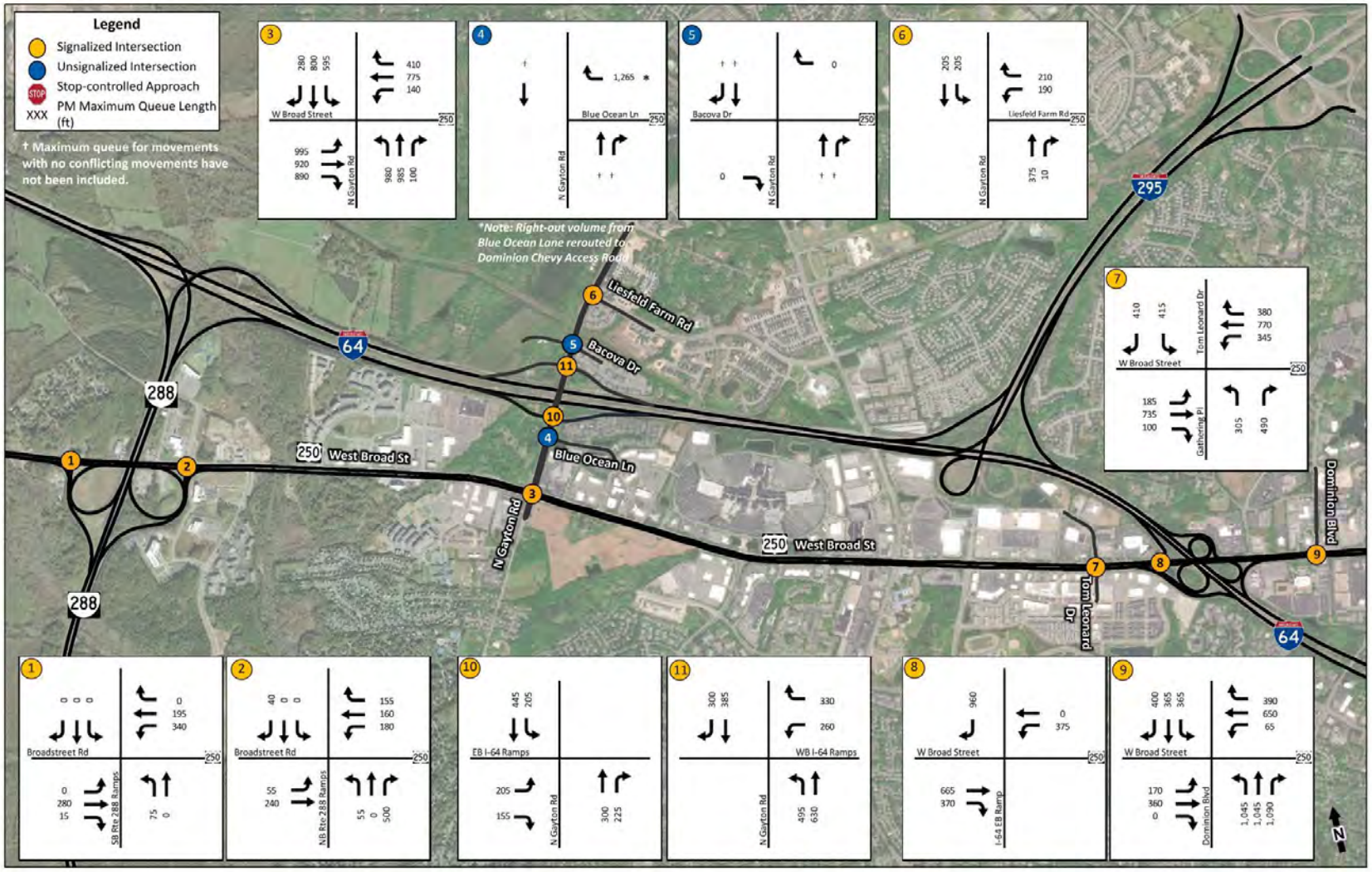


Figure 106: Build Package 2 (2046) PM Peak Hour Maximum Queue Length



Build Package 3

Heavy vehicle, peak hour factor, and traffic signal timing assumptions remained consistent with the No-Build analyses. The input traffic volumes used for Build Package 3 are described and provided in the *Build Traffic Volumes* section of the report. A detailed summary of the Build Package 3 inputs is provided in *Appendix G*.

The VDOT Sample Size Determination Tool, Version 2.0 was used to determine the number of traffic simulation runs required to provide the acceptable 95th percentile confidence level for the 2026 and 2046 Build Package 3 models. Ten simulation runs were conducted for all of the Build Package 3 models using different random seeds and the average of these runs was reported. The VDOT Sample Size Determination Tool summary sheets are provided in *Appendix G.*

Build Package 3 Freeway Analysis Results

The AM and PM peak hour average freeway segment density and speed for the 2026 and 2046 Build Package 3 conditions are illustrated in *Figure 107* through *Figure 114*. Graphical representation of the freeway results by lane is included in *Appendix G*.

AM Peak Hour

In the 2026 AM peak hour, all segments of I-64 in both directions in the study area are projected to operate with speeds of 62 mph or greater.

In 2046, all segments of I-64 in the study area are projected to operate with speeds of 55 mph or greater. The segment of westbound I-64 between ramps at the US 250 interchange is projected to operate with improved speeds of 62 mph or greater. The partial cloverleaf ramp reconfiguration removes the weaving section on westbound I-64 and improves speeds to 62 mph or greater at and approaching the interchange and densities of 31 veh/ln/mi or better.

The turning restriction from the westbound I-64 off-ramp to eastbound US 250 to Dominion Boulevard and the partial cloverleaf ramp reconfiguration are projected to improve operations on eastbound US 250 at the I-64 interchange and prevent any queuing on the arterial from impacting the interchange ramps. *Figure 115* shows the maximum queue results at the interchange ramps. The partial cloverleaf ramp reconfiguration removes the weave on the arterial and removes any friction on eastbound US 250 that was present in the weave in No-Build conditions from impacting the eastbound I-64 off-ramp to eastbound US 250. Additionally, the queuing on eastbound US 250 is not projected to extend to the westbound I-64 off-ramp to eastbound US 250 since the lower demand on eastbound US 250 combined with the turning restriction that prevents vehicles on this ramp from turning left at Dominion Boulevard are projected to improve operations on US 250. In the case that the volumes on US 250 do not decrease as projected, this queue would be projected to operate similarly to the AM peak hour projections for Build Package 1 and be comparable to the No-Build scenario.

The southbound Route 288 auxiliary lane between the US 250 and Tuckahoe Creek Parkway interchanges is projected to provide relief to the congestion on southbound Route 288 that was identified in the No-Build conditions analysis. The additional capacity from the auxiliary lane allows southbound Route 288 to serve the projected 6,500 vehicles per hour south of the US 250 interchange while operating at speeds of 54 mph or greater.

The southwestbound I-295 bottleneck identified in No-Build conditions is still present in Build Package 3 since the study team agreed not to include further improvements on southwestbound I-295 as documented in the *I-64 at US 250 and I-295 Interchanges* screening section. However, the southwestbound I-295 loop ramp to eastbound I-64 is projected to operate with slightly improved speeds from No-Build conditions (between 25 and 42 mph) due to the reduced demand on the loop ramp that is attributed to the change in volume patterns for the new interchange. The congestion on southwestbound I-295 approaching the I-64 ramps is still projected to prevent all the demand on I-295 from being served, but the demand served is projected to increase 8 percent from No-Build conditions.

PM Peak Hour

In the 2026 PM peak hour, all segments of I-64 in the study area are projected to operate with speeds of 61 mph or greater. The segment of westbound I-64 between I-295 and Route 288 is projected to serve 100 percent of the demand, which is an increase of 4 percent from No-Build conditions, even though the demand increased by 1,110 vehicles due to the changing volume patterns attributed to the new interchange.

The segment of westbound I-64 between the ramps at the US 250 interchange is projected to experience speeds of 59 mph, which is an increase from 20 mph in No-Build conditions. The partial cloverleaf ramp reconfiguration reduces congestion on westbound I-64 by removing the weaving segment on the freeway. Due to the change in volume patterns attributed to the new interchange, fewer vehicles are projected to use the westbound I-64 off-ramp to westbound US 250 and the speed is projected to increase from No-Build conditions.

By 2046, all segments of I-64 in the study area are projected to operate with speeds of 59 mph or greater. The projected average link speed on westbound I-64 approaching the off-ramp to westbound US 250 is 61 mph. The removal of the weave on westbound I-64 from the partial cloverleaf ramp reconfiguration and the projected reduction in demand on the westbound I-64 off-ramp to westbound US 250 are projected to improve speeds and significantly reduce queuing on westbound I-64 when compared to No-Build conditions. Despite the projected reduction in demand, the westbound I-64 off-ramp to westbound US 250 is still projected to serve 1,100 vehicles in the peak hour. The operational results show a projected maximum queue of approximately 100 feet on westbound I-64, which is primarily caused by last minute lane changes to decelerate and exit to westbound US 250 based on simulation observations. *Figure 97* shows the residual queuing on westbound I-64 at the interchange; however, significant improvement within this section of I-64 is expected compared to No-Build conditions given the removal of the weave and the reduced demand to the westbound US 250 off-ramp. This segment of westbound I-64 through the US 250 interchange is projected to serve 96 percent of the demand, which is an increase of 31 percent from No-Build conditions.

The changing traffic patterns on the ramp at the US 250 interchange are projected to increase speeds on westbound I-64 upstream of the interchange as well. The vehicles that are rerouted to continue westbound on I-64 to use the N Gayton Road interchange to access the Short Pump area instead of the US 250 interchange are projected to result in a more balancing lane distribution on westbound I-approaching the US 250 interchange. The more balanced lane distribution is projected to result in increased speeds on westbound I-64 through the upstream Gaskins Road and Parham Road interchanges as show in *Figure 117*. The travel time on westbound I-64 between Parham Road and the US 250 interchange is projected to decrease by 9 minutes and 53 seconds compare to the No-Build conditions.

Three of the four bottlenecks identified in the *No-Build Conditions Freeway Analysis Results* were addressed with improvements included in Build Package 3. The bottleneck on southwestbound I-295 is still present in Build conditions due to the over-capacity loop ramp from southwestbound I-295 to eastbound I-64, which has a projected demand of 2,400 vehicles in the PM peak hour. The study team agreed not to include further improvements on southwestbound I-295 to address the bottleneck as documented in the *I-64 at US 250 and I-295 Interchanges* screening section.

The intersection improvements at Tom Leonard Drive are projected to improve operations on westbound US 250 and prevent queuing from impacting the interchange ramps at I-64. The eastbound I-64 off-ramp to westbound US 250 is projected to operate with improved speeds between 25 and 35 mph resulting from the reduced queuing on westbound US 250.

The northeastbound I-295 ramp improvements and the auxiliary lane on northeastbound I-295 to Nuckols Road are projected to reduce the density on the ramp to 24 veh/ln/mi or better and improve speeds up to 53 mph or greater. These

improvements prevent the queuing on the ramp that was identified in No-Build conditions from backing up to westbound I-64.

The improvements to the intersection of US 250 and the northbound Route 288 ramps are projected to relieve congestion on the ramp and prevent queuing from impacting northbound Route 288. Additionally, over 500 vehicles are projected to be rerouted to continue northbound on Route 288 to access the Short Pump area at the N Gayton Road interchange. The proposed improvements are projected to release the ramp bottleneck, but the additional traffic continuing northbound through the interchange is projected to slow on northbound Route 288 between the ramps at the US 250 interchange. The 2-lane section between the ramps at the interchange is over capacity with a projected demand of 4,694 vehicles in the PM peak hour and is projected to operate with speeds of 34 mph or less and densities of 63 veh/ln/mi or greater. Despite the congestion on northbound Route 288, the Build improvements are projected to allow northbound Route 288 to serve an additional 1,200 vehicles in the PM peak hour.

Figure 107: Build Package 3 (2026) AM Peak Hour Average Density

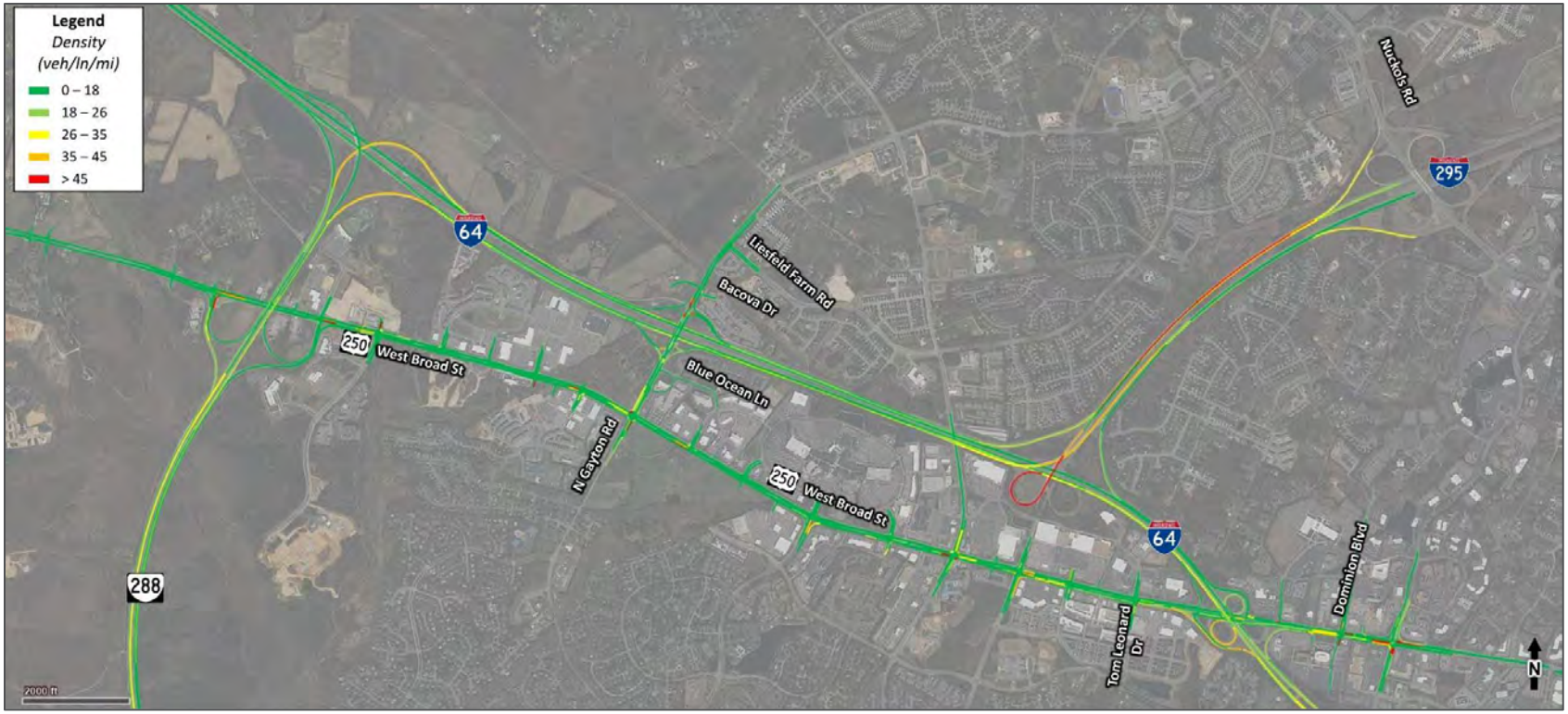


Figure 108: Build Package 3 (2026) AM Peak Hour Average Speed

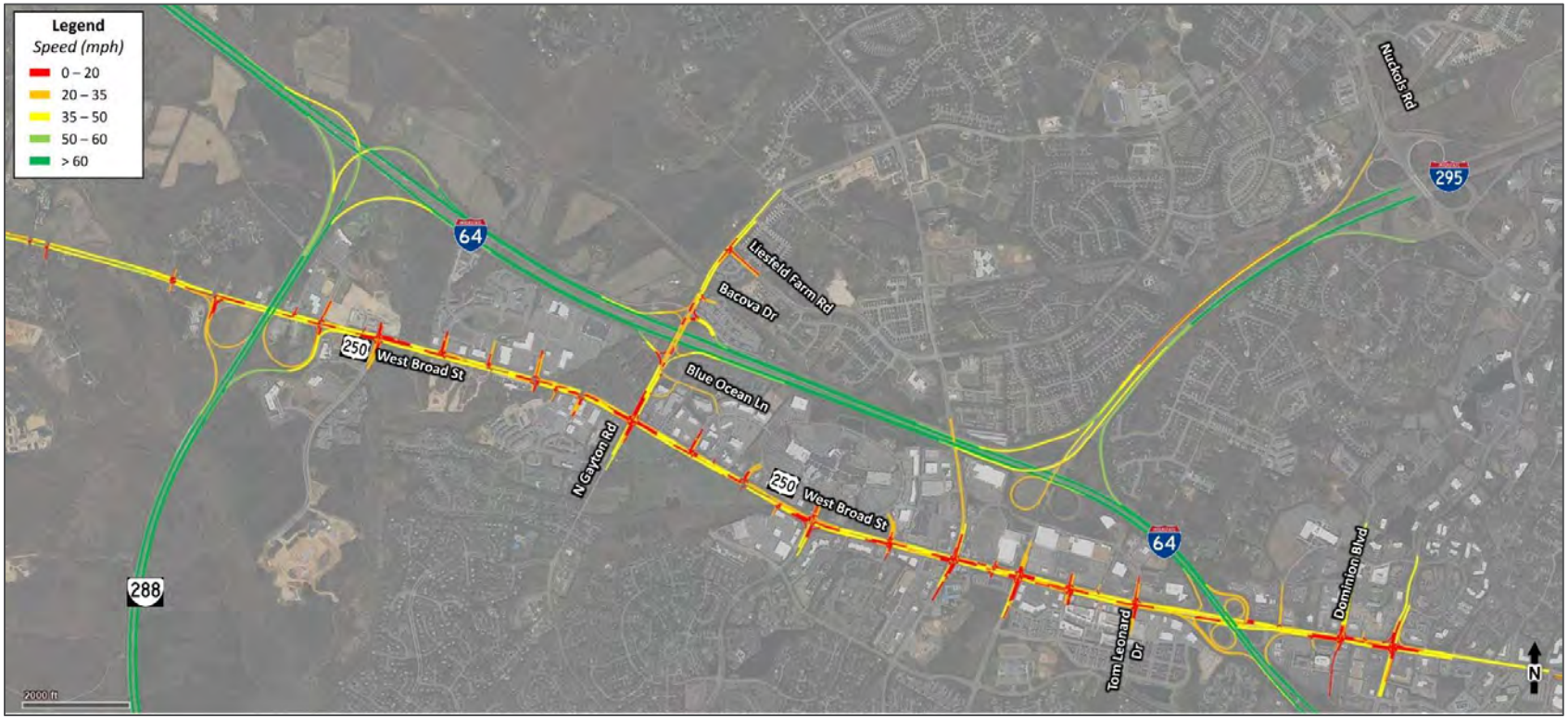


Figure 109: Build Package 3 (2046) AM Peak Hour Average Density

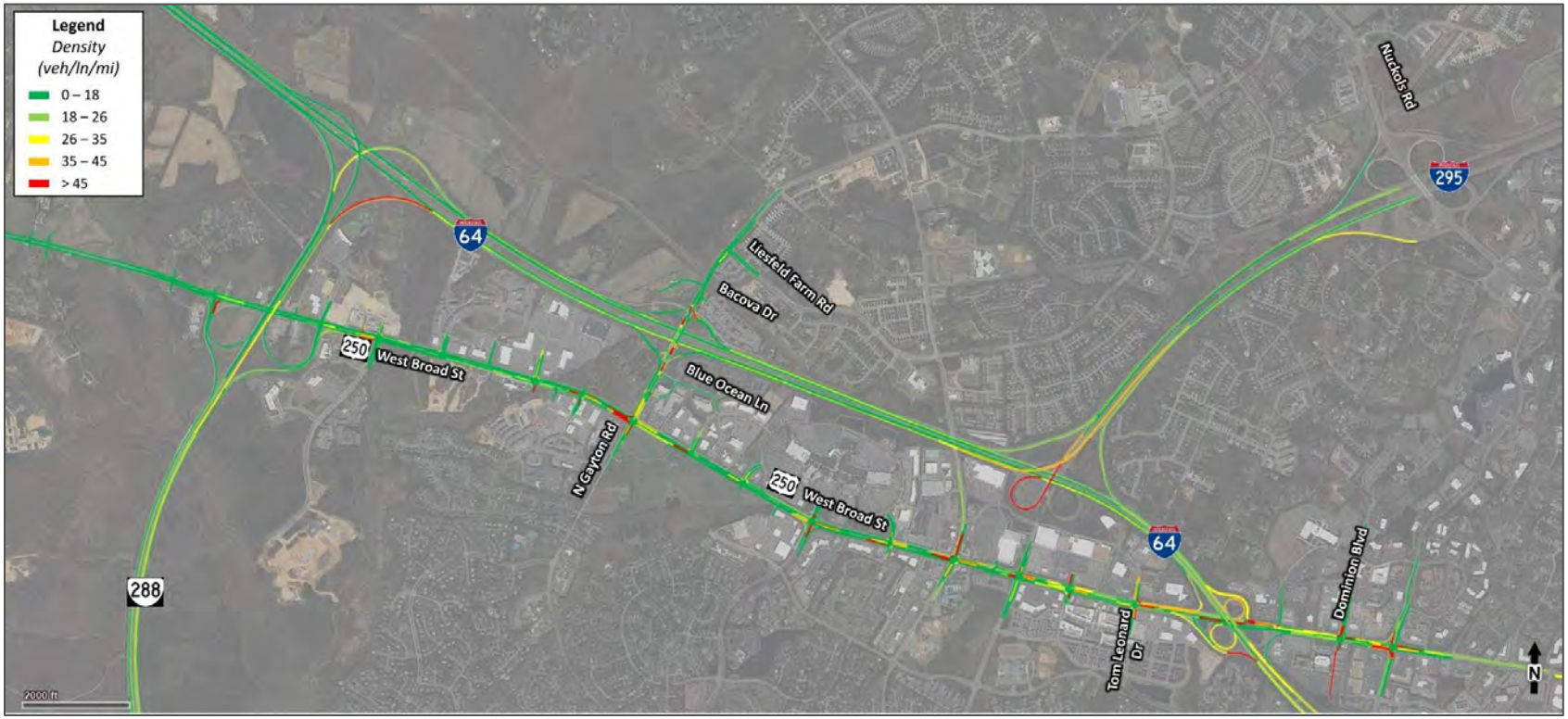


Figure 110: Build Package 3 (2046) AM Peak Hour Average Speed

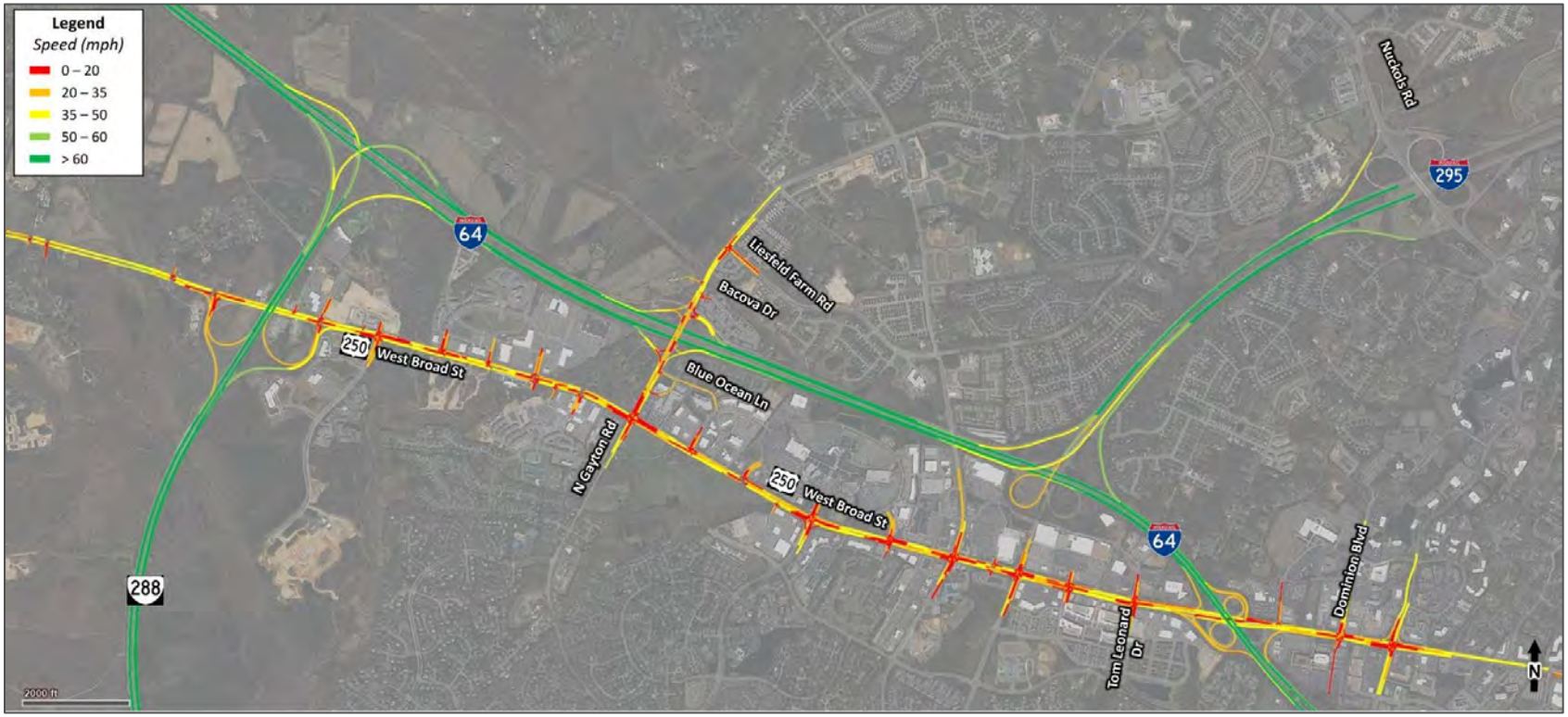


Figure 111: Build Package 3 (2026) PM Peak Hour Average Density

Figure 112: Build Package 3 (2026) PM Peak Hour Average Speed

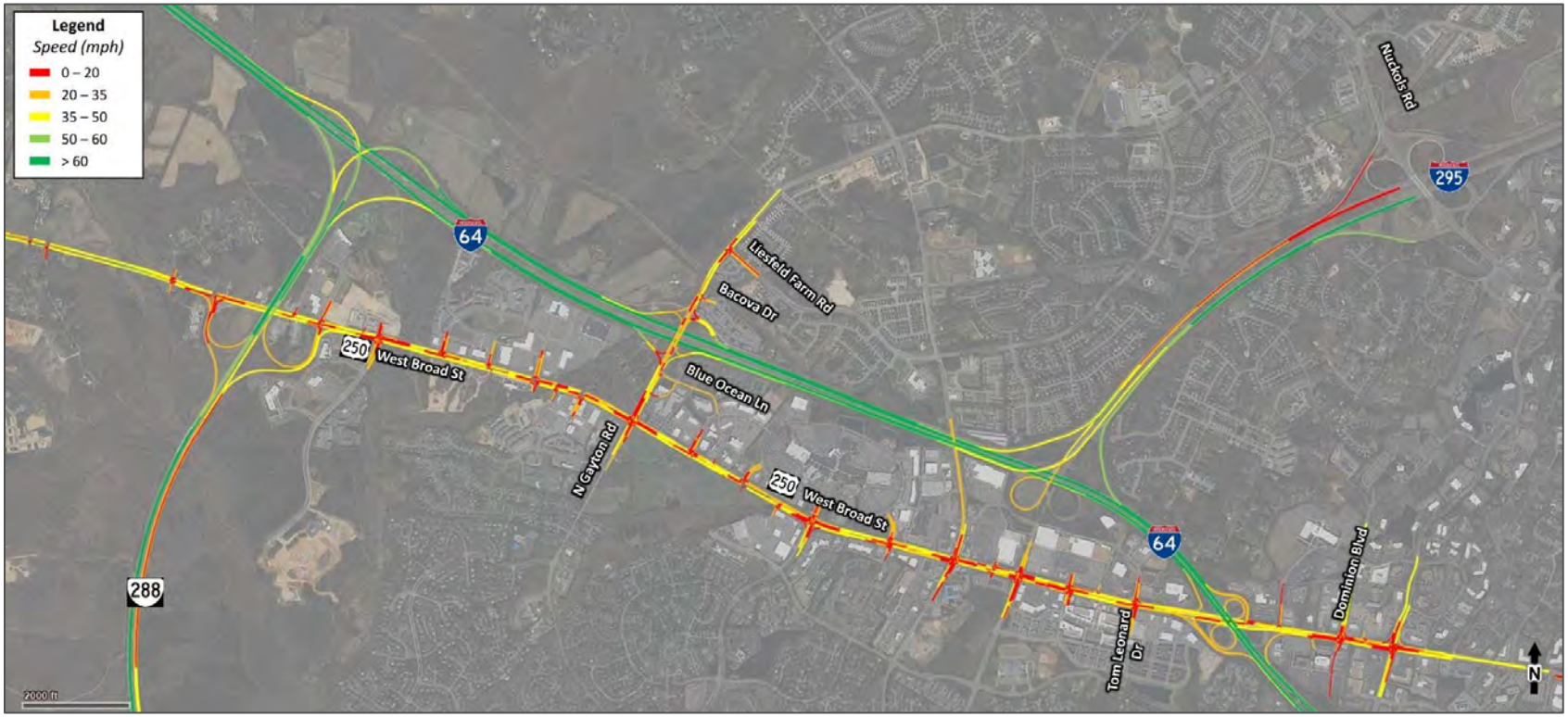


Figure 113: Build Package 3 (2046) PM Peak Hour Average Density

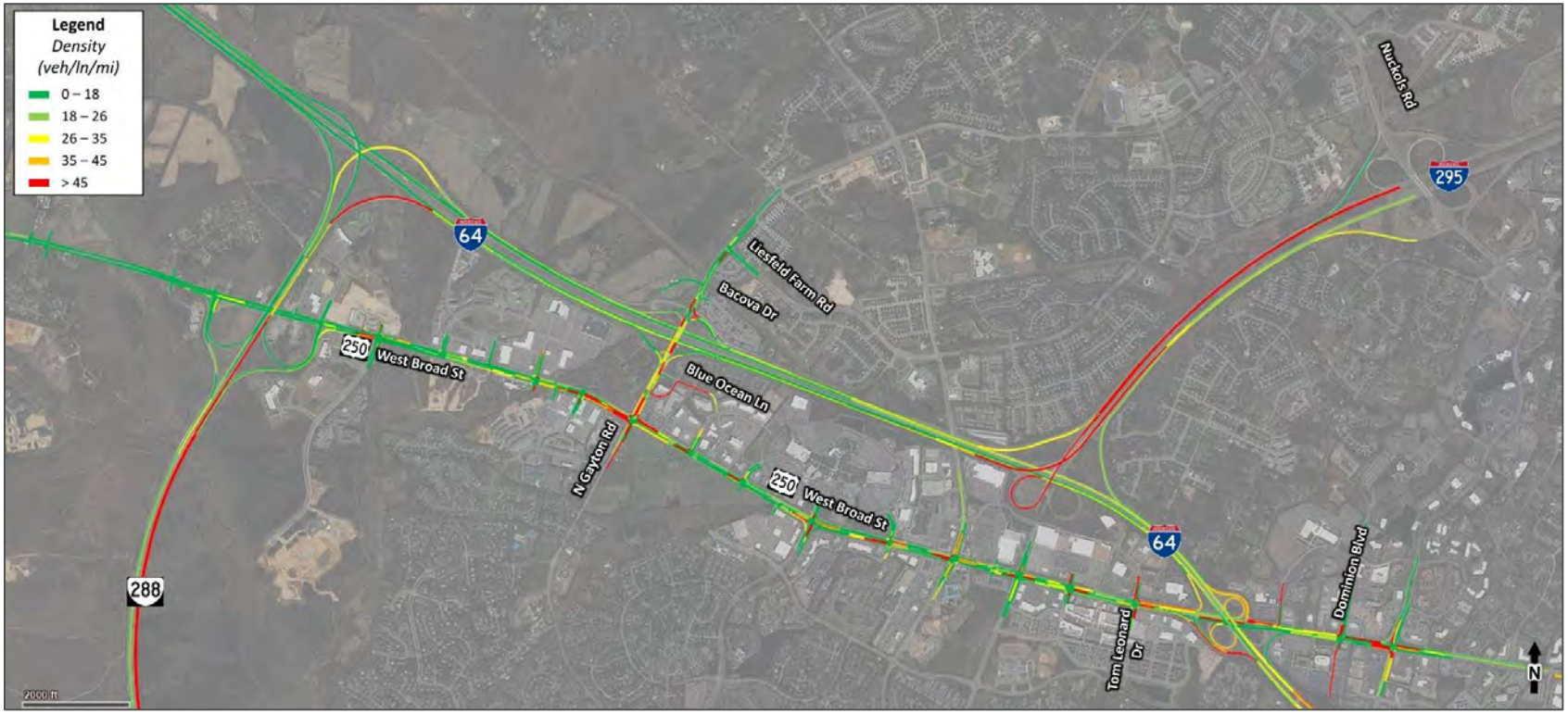


Figure 114: Build Package 3 (2046) PM Peak Hour Average Speed

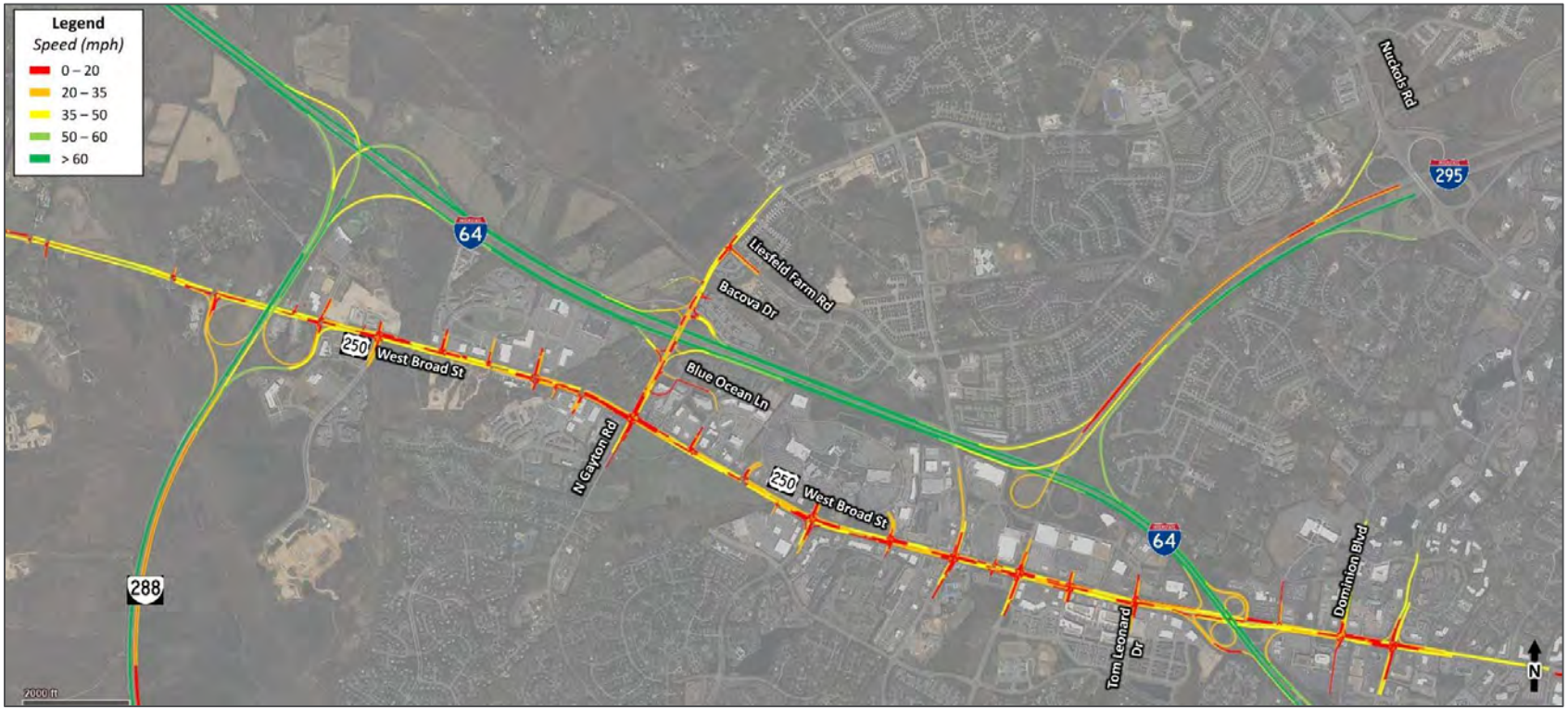


Figure 115: Build Package 3 (2046) AM Peak Hour Maximum Queue Length (Depictive)

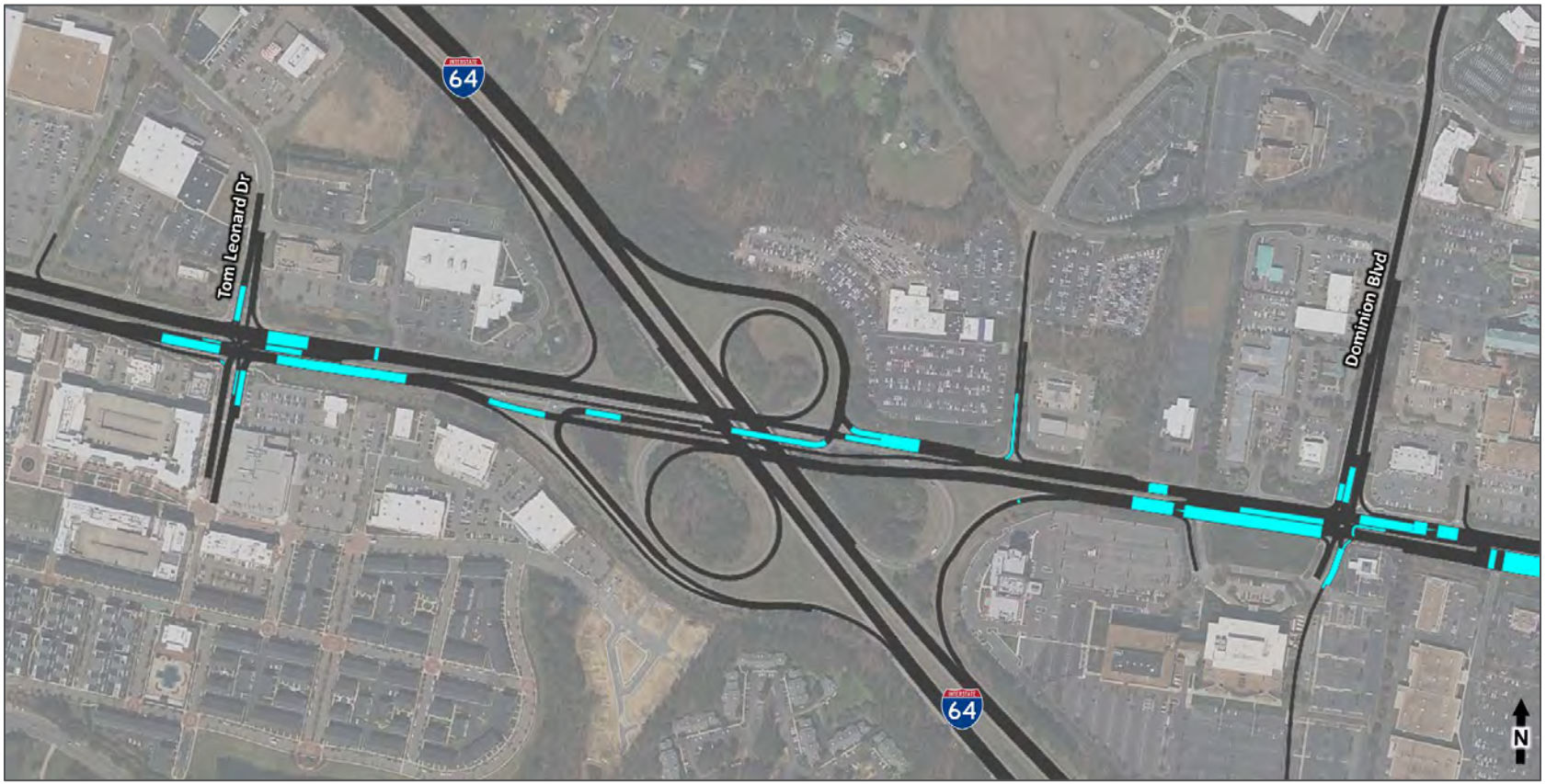


Figure 116: Build Package 3 (2046) PM Peak Hour Maximum Queue Length (Depictive)

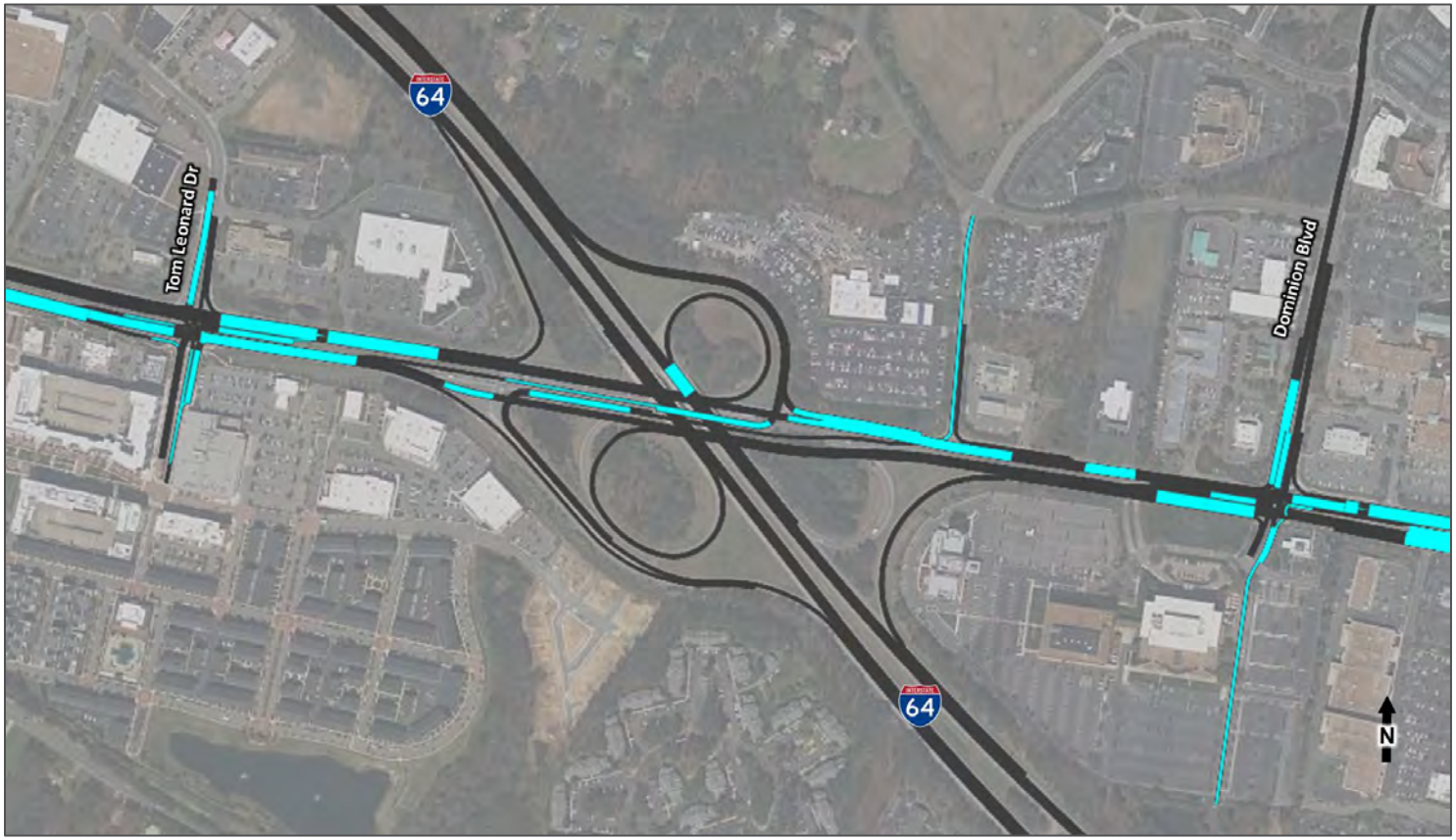


Figure 117: Build Package 3 (2046) PM Peak Hour Average Speed

Build Package 3 Intersection Analysis Results

Graphical representation of the average intersection delay (seconds per vehicle) by movement and maximum queue length (feet) are shown in *Figure 118* through *Figure 125*.

AM Peak Hour

In the 2026 AM peak hour, the intersection of US 250 and N Gayton Road is projected to operate with the most overall intersection delay of 31.1 seconds per vehicle. All left-turn movements at the intersection are projected to operate with delays of 60.1 seconds per vehicle or greater. The southbound right-turn queue is projected to be the longest maximum queue at the intersection, extending 400 feet.

The intersection of US 250 and Dominion Boulevard is projected to operate with an overall intersection delay of 24.6 seconds per vehicle and the intersection of US 250 at the southbound Route 288 ramps is projected to operate with an overall intersection delay of 25.5 seconds per vehicle. All other study area intersections are projected to operate with overall intersection delays of 14.4 seconds per vehicle or better.

The intersections of N Gayton Road and the I-64 ramps are projected to operate with overall intersection delays of 14.4 seconds per vehicle or better. The intersection of US 250 at the westbound I-64 ramps is projected to operate with an overall intersection delay of 8.0 seconds per vehicle.

By 2046, the intersection of US 250 and the northbound Route 288 ramps is projected to operate with the most overall intersection delay of 42.3 seconds per vehicle. The intersection of US 250 and N Gayton Road is projected to operate with an overall intersection delay of 36.7 seconds per vehicle. The southbound right-turn queue is projected to be the longest maximum queue at the intersection, extending 670 feet.

All other study area intersections are projected to operate with overall intersection delays of 27.4 seconds or better. The intersections of N Gayton Road and the I-64 ramps are projected to operate with overall intersection delays of 15.3 seconds per vehicle or better. The intersection of US 250 and the westbound I-64 ramps is projected to operate with an overall intersection delay of 9.9 seconds per vehicle.

All study area intersections are projected to operate at or better than the No-Build conditions analysis results. The overall travel time on US 250 between Route 288 and Cox Road is projected to decrease by 5 minutes and 3 seconds in the eastbound direction. The overall travel time on US 250 between Route 288 and Cox Road is projected to increase by 20 seconds in the westbound direction due to the addition of the signalized intersection at the westbound I-64 ramp terminal. All other segments of westbound US 250 are projected to experience travel times comparable to No-Build conditions

PM Peak Hour

In the 2026 PM peak hour, the intersection of US 250 and N Gayton Road is projected to operate with the most overall intersection delay of 40.4 seconds per vehicle. The intersection of US 250 and Dominion Boulevard is projected to operate with 37.3 seconds of delay per vehicle. All other study area intersections are projected to operate with overall intersection delays of 23.6 seconds per vehicle or better.

The longest maximum queue in the 2026 PM peak hour is projected on the northbound approach at the intersection of US 250 and Dominion Boulevard.

The intersections of N Gayton Road and the I-64 ramps are projected to operate with overall intersection delays of 15.2 seconds per vehicle of better. All movements at the ramp terminal intersections are projected to operate with

25.4 seconds of delay per vehicle or better. The intersection of US 250 and the westbound I-64 ramps is projected to operate with an overall intersection delay of 13.4 seconds per vehicle.

By 2046, the intersection of US 250 and N Gayton Road is projected to operate with the most overall intersection delay of 63.6 seconds per vehicle. The longest maximum queue at the intersection is the eastbound left-turn queue, which is projected to extend 975 feet. This queue is projected to be longer than in the No-Build conditions due to the release of the bottleneck on northbound Route 288, which resulted in an increased percentage of demand served on eastbound US 250.

The intersection of US 250 and Dominion Boulevard is projected to operate with an overall intersection delay of 44.0 seconds per vehicle. All other study area intersections are projected to operate with overall intersection delays of 27.1 seconds per vehicle or better.

The intersections of N Gayton Road and the I-64 ramps are projected to operate with overall intersection delays of 17.0 seconds per vehicle or better. All movements at the ramp terminal intersections are projected to operate with 32.2 seconds per vehicle of delay or better. The intersection of US 250 and the westbound I-64 ramps is projected to operate with an overall intersection delay of 18.9 seconds per vehicle. The eastbound left-turn movement is projected to operate with 48.8 seconds per vehicle of delay and a maximum queue length of 970 feet. Due to the contraflow left-turn interchange configuration, the eastbound left-turn queue is contained to the contraflow storage and does not impact operations on mainline eastbound US 250.

The westbound right turning vehicles out of Blue Ocean Road that were rerouted to the westbound right turn at the Dominion Chevy Access Road are projected to operate with 267.2 seconds of delay per vehicle, resulting in a maximum queue length of 1,305 feet. These projections were based on volume rerouting assumptions that increased this right-turn volume from the No-Build scenario to account for vehicles accessing the new interchange from the nearby developments. These delay and queuing projections may be overstated as drivers may elect to access the new interchange via subsequent right turns onto US 250 and N Gayton Road to avoid long delays. In this case, the delay and queuing would distribute between the westbound right-turn movement at the Dominion Chevy Access Road and the southbound right-turn movements at Henley Drive or Town Center W Boulevard. In the case that long delays and queues persist at the Dominion Chevy Access Road, this intersection should be reviewed for further improvements to mitigate the delay and queuing.

All signalized study area intersections are projected to operate at or better than the No-Build conditions analysis results. The overall travel time on US 250 between Route 288 and Cox Road is projected to decrease by 1 minute and 33 seconds in the eastbound direction and 22 seconds in the westbound direction. The section of westbound US 250 between Cox Road and I-64 is projected to experience an increase in travel time due to the addition of the new signalized intersection at the westbound I-64 ramps. The section of westbound US 250 between Lauderdale Road and N Gayton Road is projected to experience an increase in travel time of 48 seconds from No-Build conditions due to the additional demand traveling to access the new interchange. All other segments of US 250 are projected to experience a reduction in travel times, resulting in an overall travel time improvement for the length of the corridor.

Figure 118: Build Package 3 (2026) AM Peak Hour Intersection Delay

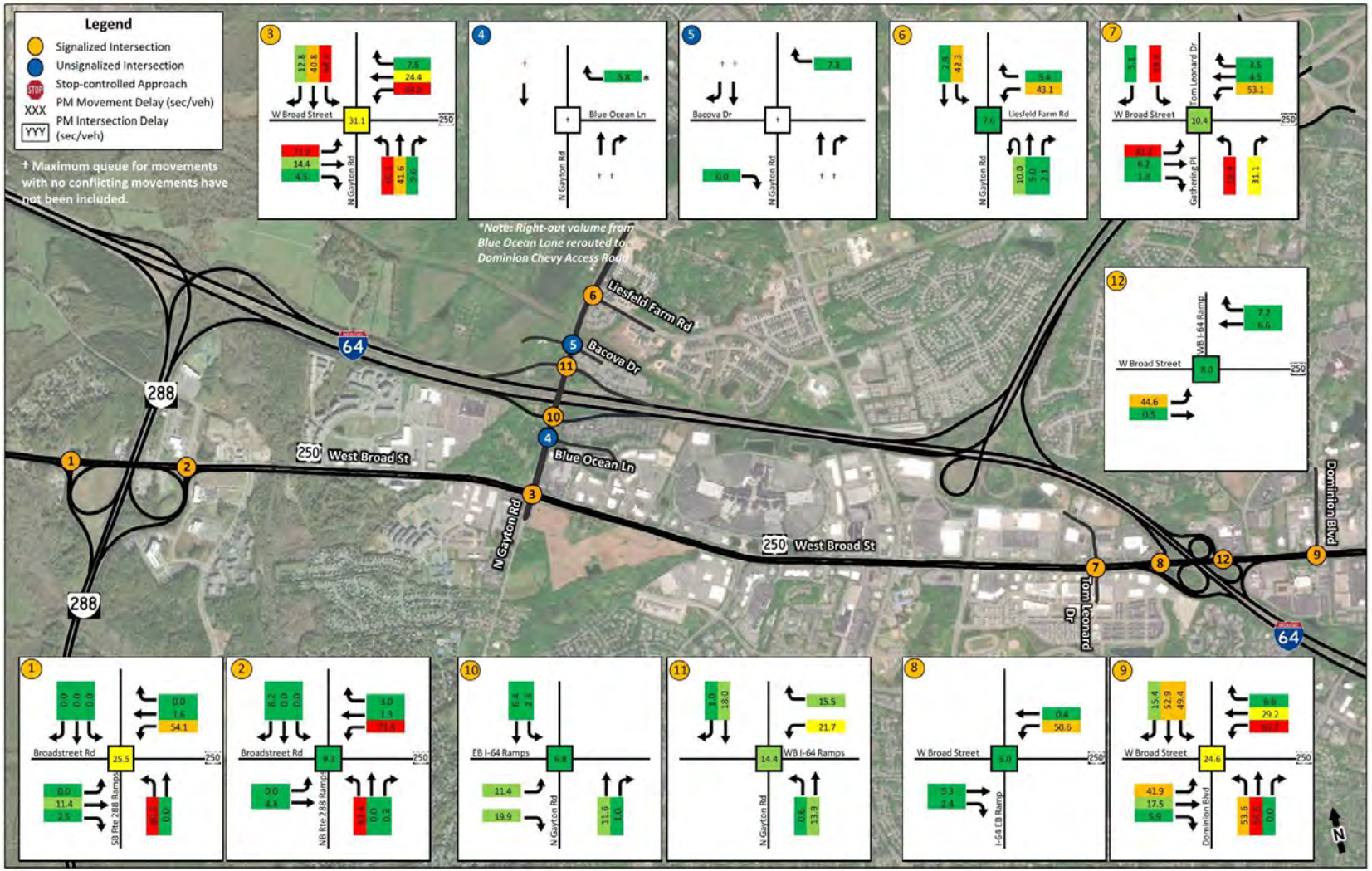


Figure 119: Build Package 3 (2026) AM Peak Hour Maximum Queue Length

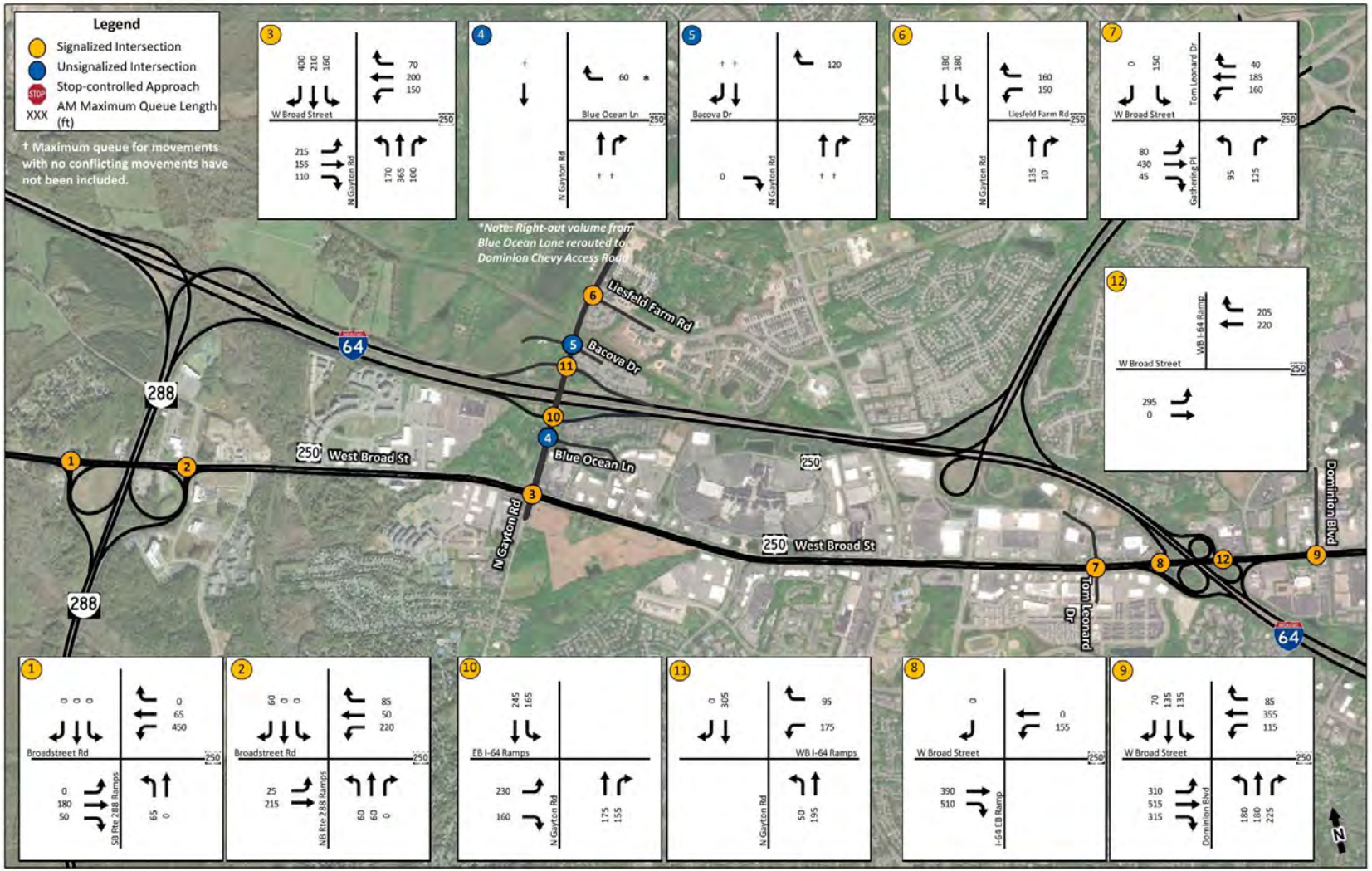


Figure 120: Build Package 3 (2046) AM Peak Hour Intersection Delay

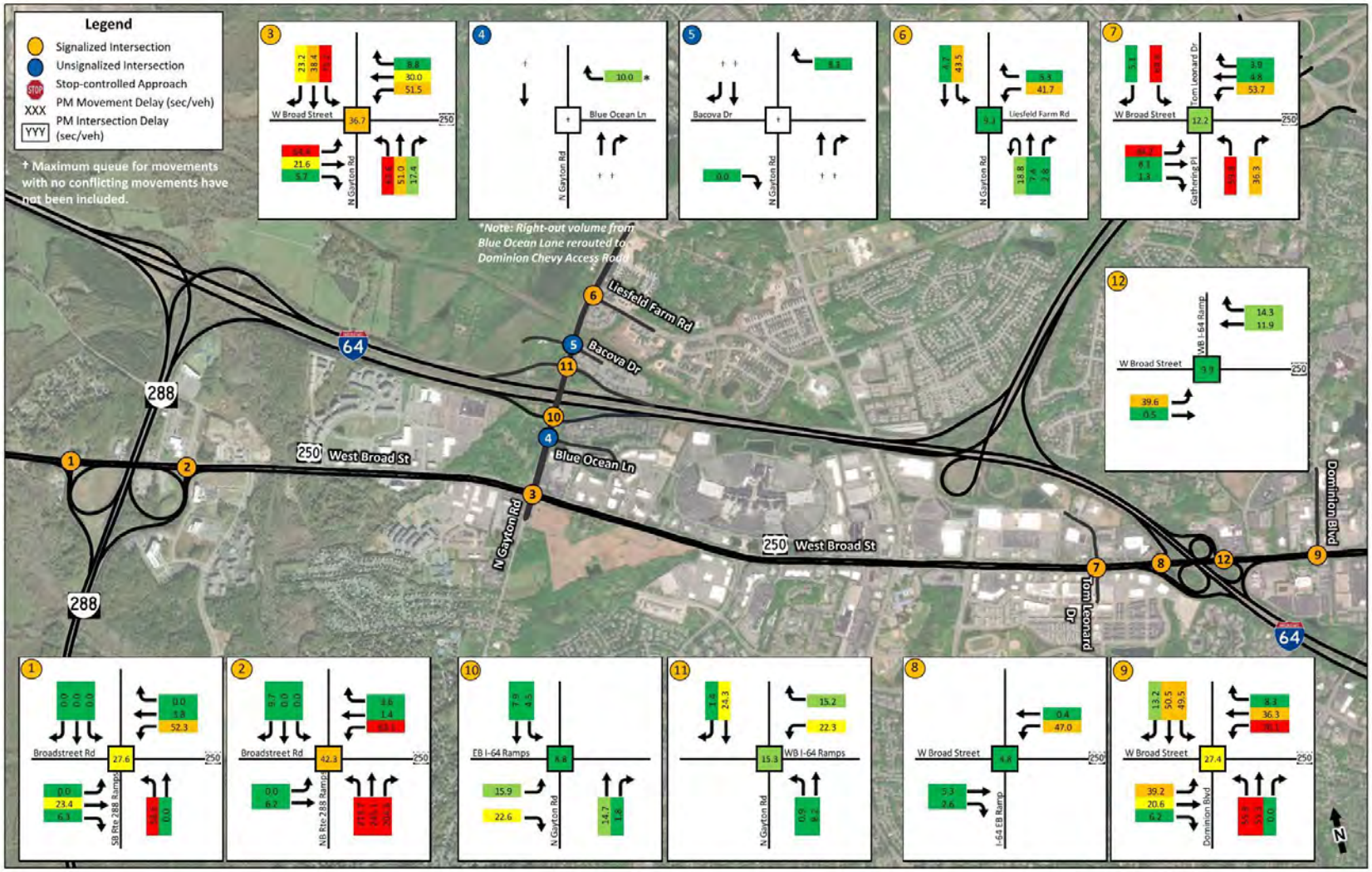


Figure 121: Build Package 3 (2046) AM Peak Hour Maximum Queue Length

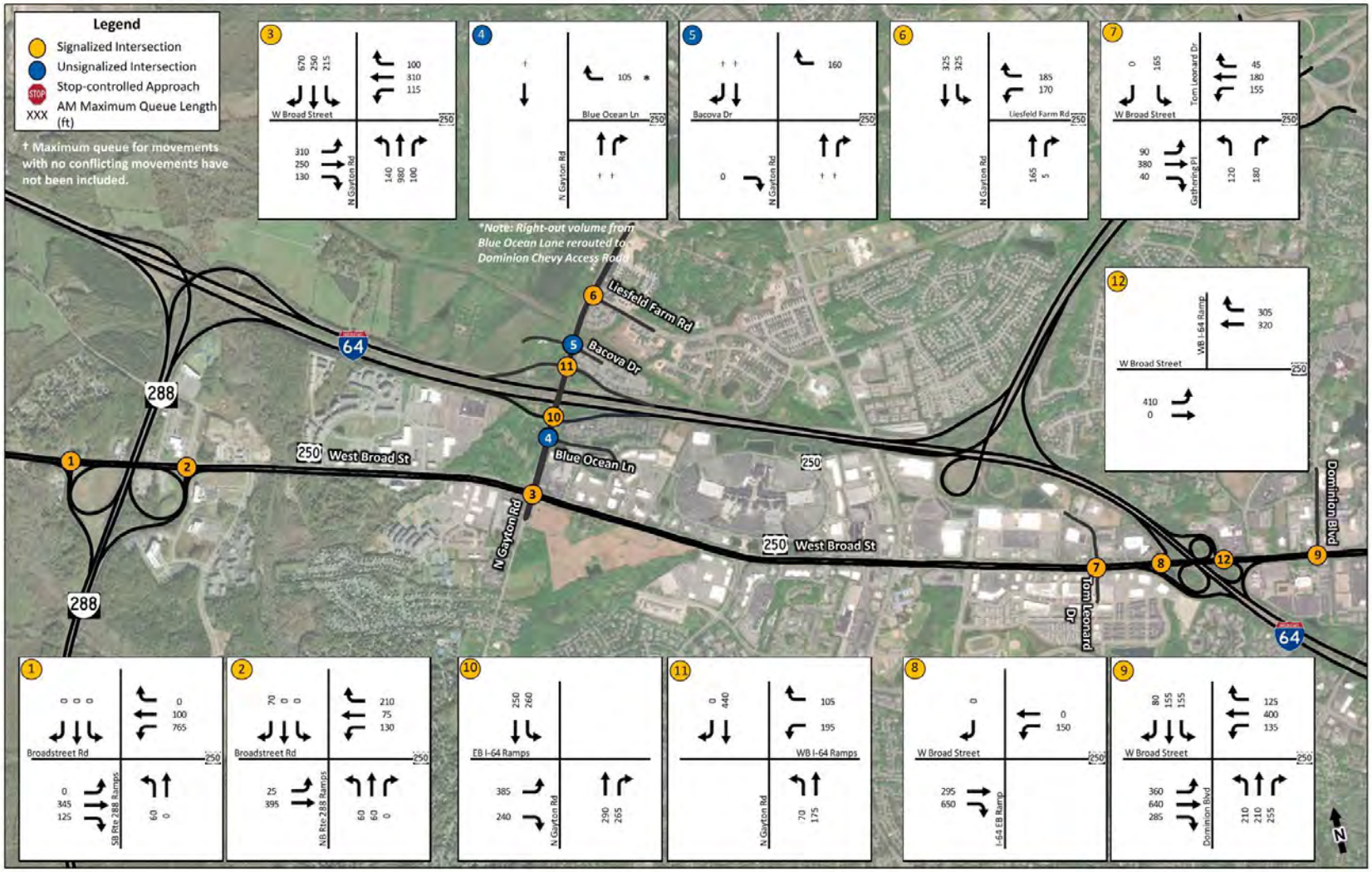


Figure 122: Build Package 3 (2026) PM Peak Hour Intersection Delay

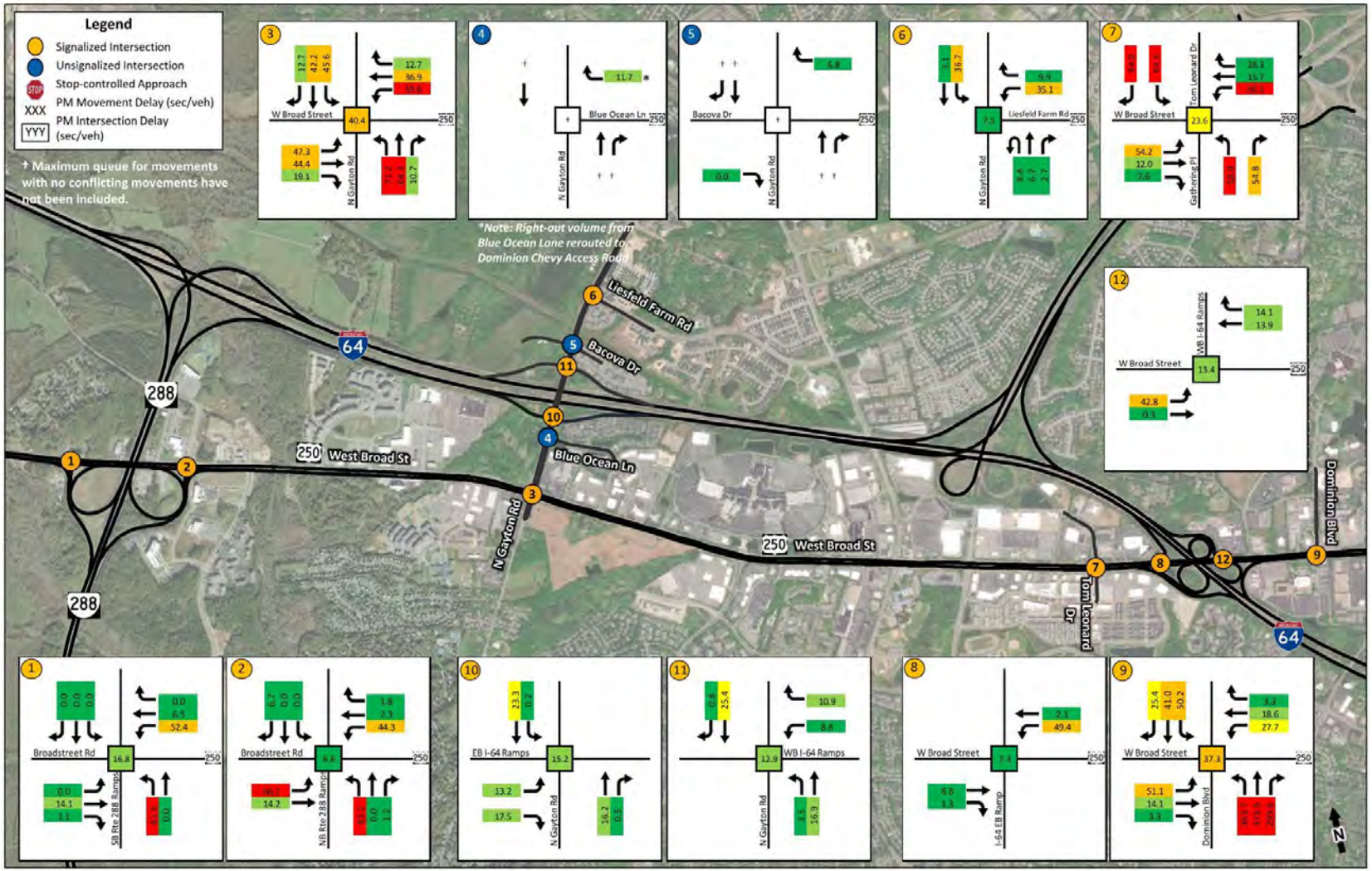


Figure 123: Build Package 3 (2026) PM Peak Hour Maximum Queue Length

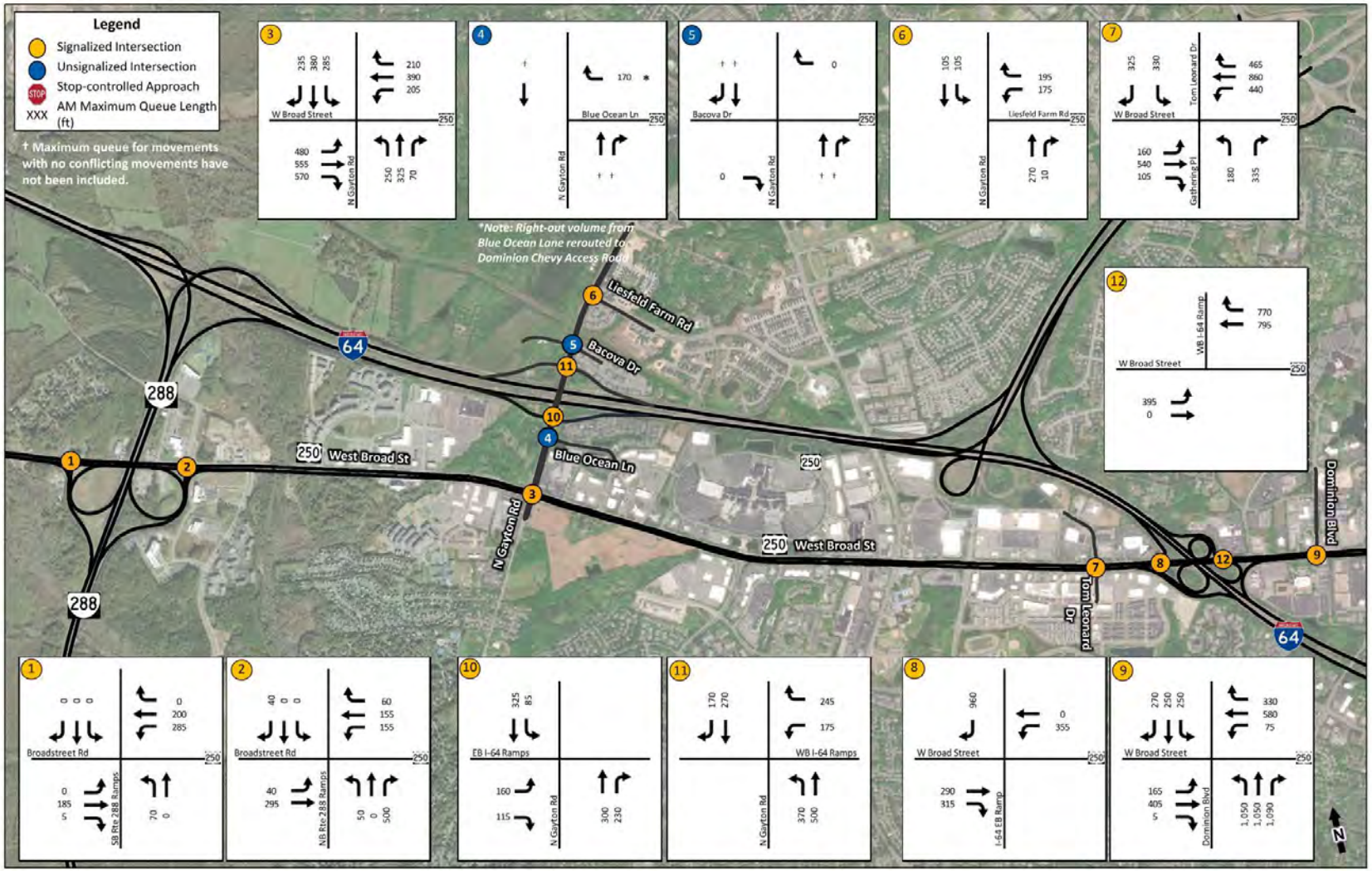


Figure 124: Build Package 3 (2046) PM Peak Hour Intersection Delay

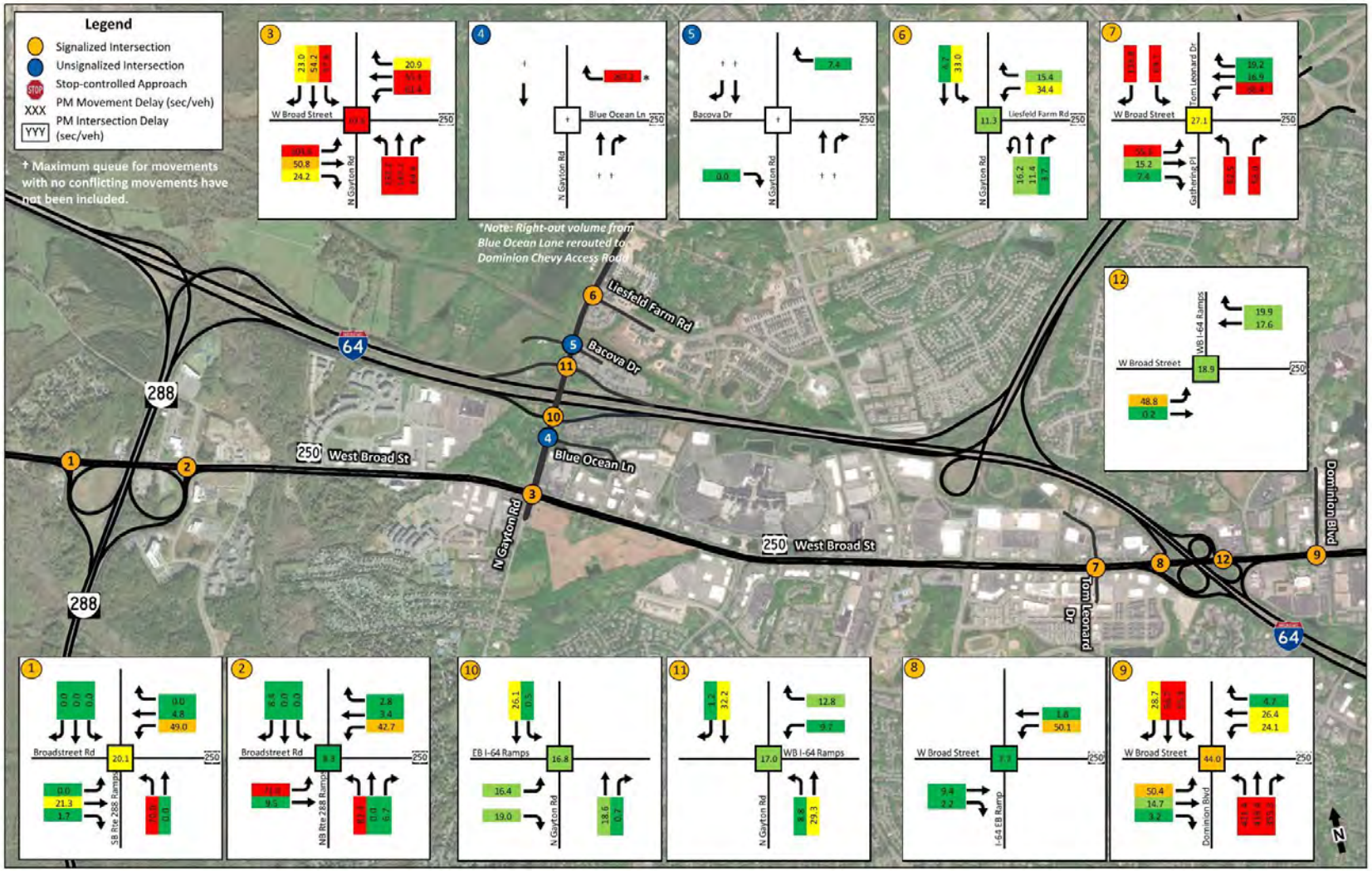
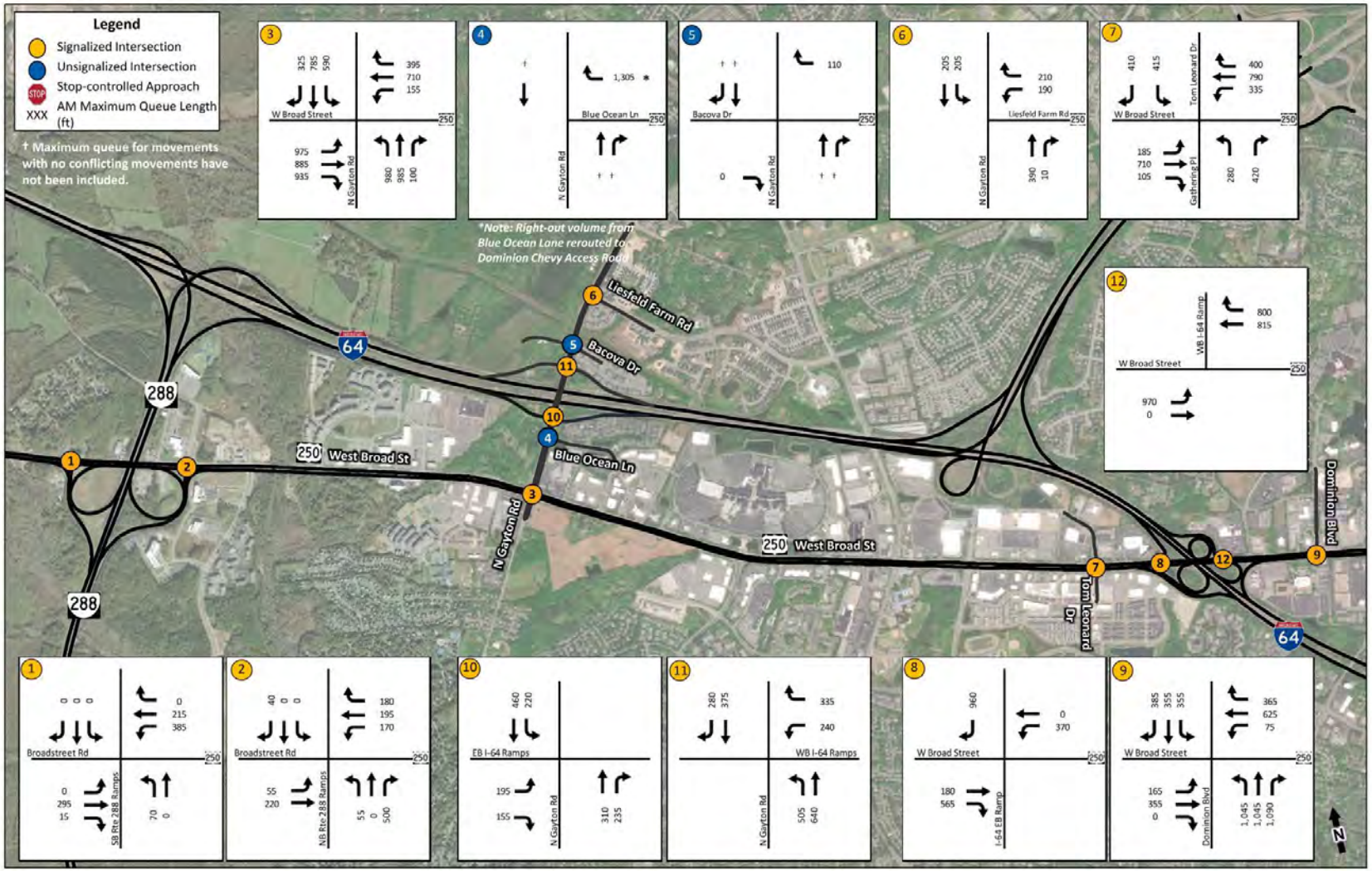


Figure 125: Build Package 3 (2046) PM Peak Hour Maximum Queue Length



Build Package Operational Comparison

All three Build packages are projected to significantly improve operations throughout the study area roadway network and provide relief to multiple bottlenecks that were identified in No-Build conditions. The following sections compare the projected results for the three Build packages for the 2046 peak hours.

AM Peak Hour

In the 2046 PM peak hour, all three Build packages are projected to significantly improve speeds on eastbound I-64 approaching the off-ramp to westbound US 250. Build Packages 1 and 3 are projected to experience the biggest improvements in speed since both remove the weave on US 250, which is projected to prevent queuing from backing up to the freeway. Speeds are projected to improve from 37 mph in the No-Build conditions to 54 and 52 mph, respectively. Build Package 2 is projected to improve speeds to 49 mph.

The increase in speeds is projected to result in upstream increases in throughput. All three Build packages are projected to process 8 percent more demand on southwestbound I-295 prior to the ramps to I-64.

Between I-295 and Route 288, all three Build packages are projected to operate with speeds greater than 60 mph and densities less than 30 veh/ln/mi in both directions except for all three Build Packages at the eastbound I-64 on-ramp from Route 288, which are projected to operate at 57 or 58 mph, and Build Packages 2 and 3 at the eastbound I-64 off-ramp from N Gayton Road, which are projected to operate at 53 mph. The remaining segments on eastbound I-64 between Route 288 and I-295 are projected to operate at speeds greater than 60 mph.

Travel times on I-64 and US 250 in both directions in the AM peak hour are shown *Table 25* and *Table 26.*

In the 2046 AM peak hour, all Build packages are projected to experience an improvement in travel time on the section of westbound I-64 between I-295 and Route 288 resulting from the southbound Roue 288 auxiliary lane improvement. Build Packages 2 and 3 are projected to experience a further reduced travel time on westbound I-64 between the Glenside Drive and US 250 interchanges resulting from the more balanced lane distribution at the US 250 interchange attributed to the changing traffic patterns for the N Gayton Road interchange. Build Package 3 is projected to experience the lowest travel time on westbound I-64 at 8 minutes and 41 seconds, which is 9 seconds less than Build Package 2 and 44 seconds less than Build Package 1.

All Build packages are projected to experience an improvement in travel time on eastbound I-64 between the Route 288 and US 250 interchanges that can be attributed to multiple improvements at the US 250 interchange. In Build Packages 1 and 3, the partial cloverleaf ramp reconfiguration removes the arterial weave, which is projected to relieve congestion on eastbound US 250 and prevent queuing from reaching the eastbound I-64 off-ramp to eastbound US 250. In Build Package 2, the turning restriction at Dominion Boulevard eliminates weaving movements on eastbound US 250 and is projected to prevent intersection queuing from backing up to eastbound I-64, though it is projected to extend 640 feet onto the eastbound I-64 off-ramp to eastbound US 250. Build Package 3 is projected to experience the lowest travel time on eastbound I-64 at 8 minutes and 35 seconds, which is 10 seconds less than Build Package 2 and 19 seconds less than Build Package 1.

Westbound US 250 is projected to operate similarly in all Build packages. Build Packages 1 and 3 are projected to experience a slight increase in travel time from No-Build due to the addition of the signalized intersection with the westbound I-64 ramps for the partial cloverleaf ramp reconfiguration. Eastbound US 250 is projected to experience improved travel times in all three Build packages.

Table 25: I-64 AM Peak Hour (2046) Travel Time Comparison (minutes:seconds)

Location	No-Build	Build Package 1	Build Package 2	Build Package 3
Eastbound I-64				
Between Route 288 and I-295	4:09	2:33	2:40	2:37
Between I-295 and US 250	2:19	0:56	0:56	0:50
Between US 250 and Gaskins Road	1:08	1:25	1:17	1:08
Between Gaskins Road and Parham Road	1:17	1:22	1:17	1:17
Between Parham Road and US 250	2:33	2:39	2:36	2:44
Total	**11:26**	**8:54**	**8:45**	**8:35**
Westbound I-64				
Between US 250 and Parham Road	2:34	2:55	2:43	2:41
Between Parham Road and Gaskins Road	1:21	1:49	1:37	1:32
Between Gaskins Road and US 250	1:15	1:22	1:11	1:10
Between US 250 and I-295	1:00	0:47	0:48	0:47
Between I-295 and Route 288	11:15	2:32	2:31	2:31
Total	**17:26**	**9:24**	**8:50**	**8:41**

Table 26: US 250 AM Peak Hour (2046) Travel Time Comparison (minutes:seconds)

Location	No-Build	Build Package 1	Build Package 2	Build Package 3
Eastbound US 250				
Between Southbound Route 288 Ramps and N Gayton Road	3:19	3:19	2:55	2:56
Between N Gayton Road and Lauderdale Road	1:20	1:32	1:27	1:26
Between Lauderdale Road and John Rolfe Parkway	2:26	1:41	1:50	1:38
Between John Rolfe Parkway and I-64	3:53	1:54	1:44	1:30
Between I-64 and Cox Road	3:14	3:40	1:46	1:38
Total	**14:11**	**12:07**	**9:42**	**9:08**
Westbound US 250				
Between Cox Road and I-64	1:21	1:36	1:26	1:40
Between I-64 and John Rolfe Parkway	1:27	1:19	1:25	1:26
Between John Rolfe Parkway and Lauderdale Drive	1:49	1:51	1:47	1:45
Between Lauderdale Drive and N Gayton Road	1:31	1:45	1:45	1:45
Between N Gayton Road and Southbound Route 288 Ramps	3:13	3:02	3:02	3:05
Total	**9:21**	**9:34**	**9:25**	**9:41**

Table 27 shows the percent demand served on various locations throughout the study area network for all three Build packages. All three Build packages are projected to increase demand on southwestbound I-295 but still only serve 75 percent of the demand since the study team agreed not to include further improvements on southwestbound I-295 as documented in the *I-64 at US 250 and I-295 Interchanges* screening section. This remaining bottleneck contributes to the lower percent served values that are projected on westbound I-64 between I-295 and Route 288. Build Packages 2 and 3

are projected to serve 2 percent less demand on northbound Route 288 than Build Package 1, but all Build packages are projected to serve an increase from No-Build.

Table 27: AM Peak Hour (2046) Freeway Demand (Percent Served)

Location	No-Build	Build Package 1	Build Package 2	Buil0d Package 3
Westbound I-64 approaching the US 250 interchange	98	94	98	98
Westbound I-64 between I-295 and Route 288	81	88	87	86
Eastbound I-64 between Route 288 and I-295	93	99	98	98
Northbound Route 288 approaching I-64	88	98	96	96
Southwestbound I-295 approaching I-64	66	75	75	75

PM Peak Hour

In the 2046 PM peak hour, all three Build packages are projected to significantly improve speeds on westbound I-64 in the existing weaving segment at the US 250 interchange, which was projected to operate at 10 mph in the No-Build conditions. Build Package 2 is projected to increase speeds to 37 mph. Since Build Packages 1 and 3 both remove the freeway weave, speeds are projected to further increase to 58 and 61 mph, respectively.

The increase in speeds is also projected to result in increases in throughput downstream on westbound I-64. All three Build packages are projected to process a higher percentage of demand on westbound I-64 between the US 250 and I-295 interchanges. Build Package 1 is projected to increase the percentage of demand served from 63 percent in the No-Build conditions to 93 percent. Build Packages 2 and 3 are projected to have higher demand in this segment due to the change in travel patterns attributed to the new interchange yet are still projected to serve a higher percentage of demand at 94 and 96 percent, respectively.

Between I-295 and Route 288, all three Build packages are projected to operate with speeds greater than 60 mph and densities less than 24 veh/ln/mi in both directions except for Build Package 1 before the westbound off-ramp to Route 288, which is projected to slow to 48 mph due to some friction in advance of the diverge, and Build Packages 2 and 3 immediately after the eastbound on-ramp from Route 288, which are projected to operate at 58 mph. The remaining segments on eastbound I-64 between Route 288 and I-295 are projected to operate at speeds greater than 60 mph.

Travel times on I-64 and US 250 in both directions in the PM peak hour are shown in *Table 28* and *Table 29*.

In the 2046 PM peak hour, all three Build packages are projected to operate with significantly improved travel times on westbound I-64 throughout the study area. In Build Packages 1 and 3, the partial cloverleaf ramp reconfiguration removes the weave on westbound I-64, which is projected to reduce the queue on the freeway and improve speeds at the interchange. Build Packages 2 and 3 are projected to experience improved speeds and decreased travel time due to the changing traffic patterns at the US 250 interchange that are attributed to the new N Gayton Road interchange. Build Packages 2 and 3 are projected to experience further reductions in travel times on westbound I-64 upstream of the US 250 interchange due to the more balanced vehicle lane distribution resulting from the new interchange.

Eastbound I-64 from Route 288 to Glenside Drive is projected to experience an increase in travel time in all three Build packages on the segment between Parham Road and Glenside Drive. All three Build packages are projected to increase throughput on eastbound I-64 through the study area to 92 percent of the demand or greater, which causes downstream congestion at the eastbound I-64 on-ramp from the eastbound I-64 C-D road that serves the US 250 and Glenside Drive interchanges. Eastbound I-64 in the vicinity of the Glenside Drive interchange was identified as an area in need of

improvement in the I-64/I-664 Corridor Improvement Plan On all other segments of I-64 through the study area, all three Build packages are projected to operate with travel times comparable to No-Build conditions.

Build Packages 2 and 3 are projected to experience improved travel times on westbound US 250 from Cox Road to Route 288 compared to No-Build conditions. Build Package 1 is projected to experience a 32 second increase in travel time on westbound US 250 compared to No-Build conditions. Build Packages 1 and 3 are projected to experience an increase in travel time from No-Build on westbound US 250 between Cox Road and the I-64 interchange due to the addition of the signalized intersection at the westbound I-64 ramps. Build Package 1 is projected to experience additional increase in travel time on westbound US 250 between N Gayton Road and Wilkes Ridge Parkway due to the increased traffic eastbound on US 250 from the northbound Route 288 improvements. The additional traffic results in increased delay in the westbound direction because of the competing signal operations trying to serve both directions of US 250. These changes lead to an overall increase in travel time on westbound US 250 from No-Build conditions in Build Package 1. Build Packages 2 and 3 are projected to experience an increase in travel time from No-Build on westbound I-64 between Lauderdale Road and N Gayton Road due to the additional demand traveling to access the new interchange, but the travel time reductions on all other sections of westbound US 250 lead to an overall decrease in travel time.

Build Packages 2 and 3 are projected to experience improved travel times on eastbound US 250 from Route 288 to Cox Road compared to No-Build conditions. The section of eastbound US 250 between John Rolfe Parkway and I-64 is projected to experience the most travel time improvement of 1 minute and 24 seconds in Build Package 2 and 1 minute and 31 seconds in Build Package 3. The Tom Leonard Drive intersection improvements and the reduction in demand on the eastbound I-64 on-ramp from eastbound US 250 are projected to reduce queuing on eastbound US 250 at the interchange and improve travel times. Build Package 1 is projected to experience the largest increase in travel times on eastbound US 250 in the section between Route 288 and N Gayton Road due to the increased volumes traveling eastbound. The northbound Route 288 ramp intersection improvements combined with the auxiliary lane allow northbound Route 288 to serve 95 percent of the demand. Releasing this bottleneck allows additional vehicles to reach the arterial, causing increased queuing and congestion on eastbound US 250. While the partial cloverleaf interchange improvement at US 250, which is the major improvement unique to Build Package 1, does not contribute to the increased travel time on eastbound US 250 in this area, it is not projected to mitigate the increase. This increase is not as significant in Build Packages 2 and 3 since the demand decreases on the northbound Route 288 off-ramp to eastbound US 250.

Table 28: I-64 PM Peak Hour (2046) Travel Time Comparison (minutes:seconds)

Location	No-Build	Build Package 1	Build Package 2	Build Package 3
Eastbound I-64				
Between Route 288 and I-295	2:31	2:32	2:33	2:32
Between I-295 and US 250	0:49	0:48	0:48	0:49
Between US 250 and Gaskins Road	1:08	1:08	1:08	1:08
Between Gaskins Road and Parham Road	1:16	1:16	1:16	1:16
Between Parham Road and US 250	2:43	3:25	4:53	4:58
Total	**8:27**	**9:18**	**10:38**	**10:43**

Location	No-Build	Build Package 1	Build Package 2	Build Package 3
Westbound I-64				
Between US 250 and Parham Road	13:10	5:51	4:28	4:29
Between Parham Road and Gaskins Road	9:22	4:08	3:20	3:23
Between Gaskins Road and US 250	6:18	2:51	2:21	2:24
Between US 250 and I-295	1:08	0:48	0:51	0:48
Between I-295 and Route 288	2:32	2:32	2:32	2:32
Total	**32:30**	**15:59**	**13:32**	**13:36**

Table 29: US 250 PM Peak Hour (2046) Travel Time Comparison (minutes:seconds)

Location	No-Build	Build Package 1	Build Package 2	Build Package 3
Eastbound US 250				
Between Southbound Route 288 Ramps and N Gayton Road	4:05	6:32	3:44	3:45
Between N Gayton Road and Lauderdale Road	1:33	1:58	1:50	1:47
Between Lauderdale Road and John Rolfe Parkway	2:11	4:03	2:26	2:28
Between John Rolfe Parkway and I-64	3:20	3:49	1:33	1:30
Between I-64 and Cox Road	1:37	1:42	1:47	1:43
Total	**12:46**	**18:04**	**11:20**	**11:13**
Westbound US 250				
Between Cox Road and I-64	1:52	1:58	1:33	1:53
Between I-64 and John Rolfe Parkway	3:07	1:55	1:36	1:37
Between John Rolfe Parkway and Lauderdale Drive	1:37	1:48	1:42	1:41
Between Lauderdale Drive and N Gayton Road	1:33	1:44	2:21	2:21
Between N Gayton Road and Southbound Route 288 Ramps	2:51	4:03	3:05	3:06
Total	**11:00**	**11:28**	**10:17**	**10:38**

Table 30 shows the percent demand served at various locations throughout the study area roadway network for all three Build packages. All three Build packages are projected to experience a significant increase in percent demand served on westbound I-64 approaching the US 250 interchange. Build Packages 2 and 3 are projected to serve additional demand over Build Package 1 due to the more balanced lane distribution upstream of the US 250 interchange that improves speeds and reduces congestion on westbound I-64. Build Packages 2 and 3 are also projected to serve the most demand on southwestbound I-295 since the changing traffic patterns that are attributed to the new N Gayton Road interchange are projected to reduce traffic volume on the over-capacity loop ramp. This change is projected to result in increases to the percent demand served on westbound I-64 between the I-295 and Route 288 interchanges as well. Build Package 1 is projected to serve the most percent demand on northbound Route 288 which then increases the percent demand served on eastbound I-64 between the Route 288 and I-295 interchanges.

Table 30: PM Peak Hour (2046) Freeway Demand (Percent Served)

Location	No-Build	Build Package 1	Build Package 2	Build Package 3
Westbound I-64 approaching the US 250 interchange	65	91	94	94
Westbound I-64 between I-295 and Route 288	78	88	90	92
Eastbound I-64 between Route 288 and I-295	74	97	92	92
Northbound Route 288 approaching I-64	65	95	88	89
Southwestbound I-295 approaching I-64	80	79	84	84

Figure 126 through *Figure 129* show the 2046 maximum queue lengths in the PM peak hour for the eastern intersections on US 250 for the No-Build scenario and all three Build packages. Build Package 1 is projected to have slight reductions in queue on westbound US 250 when compared to the No-Build conditions. Build Packages 2 and 3 are projected to have a greater reduction in queuing for both directions of US 250 due to the reduced traffic volumes. *Figure 130* through *Figure 133* show the 2046 maximum queue lengths in the PM peak hour for the western intersections on US 250. Build Package 1 is projected to experience increased queuing on eastbound US 250 due to the release of the northbound Route 288 bottleneck. Build Packages 2 and 3 are projected to experience less queueing on eastbound US 250 when compared to the No-Build conditions except at the intersection of US 250 and N Gayton Road.

Figure 126: No-Build (2046) PM Maximum Queue Length (Depictive) – Eastern Intersections on US 250

Figure 127: Build Package 1 (2046) PM Maximum Queue Length (Depictive) – Eastern Intersections on US 250

Figure 128: Build Package 2 (2046) PM Maximum Queue Length (Depictive) – Eastern Intersections on US 250

Figure 129: Build Package 3 (2046) PM Maximum Queue Length (Depictive) – Eastern Intersections on US 250

Figure 130: No-Build (2046) PM Maximum Queue Length (Depictive) – Western Intersections on US 250

Figure 131: Build Package 1 (2046) PM Maximum Queue Length (Depictive) – Western Intersections on US 250

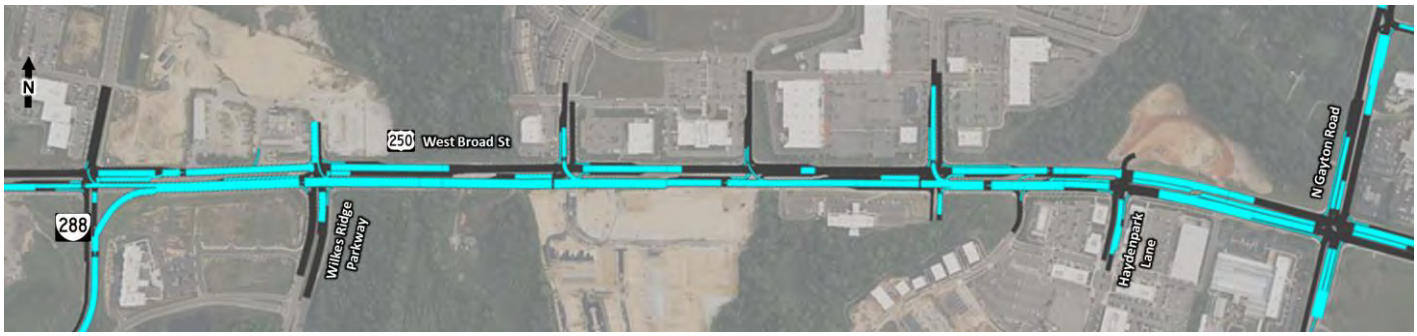
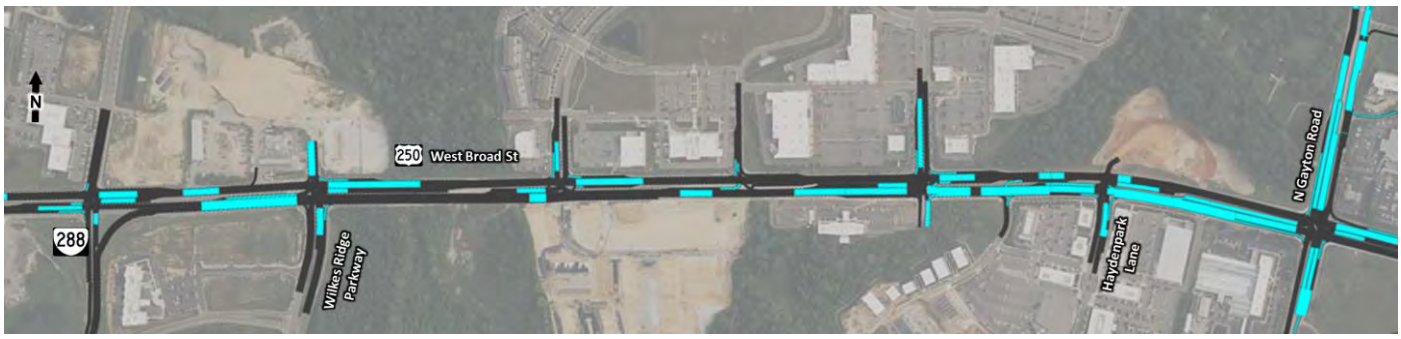


Figure 132: Build Package 2 (2046) PM Maximum Queue Length (Depictive) – Western Intersections on US 250

Figure 133: Build Package 3 (2046) PM Maximum Queue Length (Depictive) – Western Intersections on US 250



Safety Analysis

The Enhanced Interchange Safety Analysis Tool (ISATe) was used to analyze the 2046 No-Build scenario and all three 2046 Build packages to determine if the Build packages were projected to results in a safety benefit.

EXISTING CONDITIONS ISATE ANALYSIS

Prior to conducting the analysis for 2046, the study team analyzed the study area in the existing year to determine how accurately ISATe predicts crashes in the study area between 2015 and 2019. The existing conditions analysis helps to understand if the base crash prediction can be used in future years to project the potential change in crashes associated with recommended improvements. This analysis was performed only for freeway segments within the study area.

The predicted crashes from ISATe were used as the primary analysis output, which is the base crash prediction based on geometry and volume inputs. The expected number of crashes, which also considers crash history inputs, were not used for the Build packages since the proposed improvements differ enough from the existing geometry that the crash history should not be used to influence the future year crash prediction.

- ***Predicted crashes:*** the base crash prediction from ISATe that is based on geometry and volume inputs
- ***Expected crashes:*** the crash prediction from ISATe that is based on geometry, volume, and crash history inputs. This value falls in between the base crash prediction and the annual crash history. Expected crashes were not calculated for the Build packages since the proposed improvements differ enough from the existing geometry that the crash history should not be used to influence the future year crash prediction.

The predicted crashes were within 12 percent of the annual crash history on I-64 west of the westbound I-64 off-ramp to westbound US 250, within 20 percent on Route 288, and within 21 percent on I-295 as shown in *Table 31*. Additionally, the predicted crashes were all within 10 percent of the expected crashes. These results indicate that ISATe is reasonably accurate when predicting crashes for these areas and that predicted crashes can be used for future year analyses to understand the potential change in crashes associated with recommended improvements.

However, the predicted crashes were 78 percent lower than the annual crash history on I-64 east of the westbound I-64 off-ramp to westbound US 250. This indicates that ISATe cannot accurately predict the magnitude of crashes on westbound I-64 approaching the US 250 interchange, which is likely because the crashes are largely attributed to queuing on I-64 that is caused by congestion on westbound US 250 that backs up to the interstate and friction associated with vehicles weaving on westbound I-64 as documented in the *Existing Mainline Freeway Crash Summary* section. ISATe freeway predictions do not account for operating speed, freeway queuing, or congestion on arterials that impact freeway operations. These results indicate that predicted crashes from ISATe are likely not reliable enough to be used for future year analyses in this area to understand the potential change in crashes associated with recommended improvements.

Table 31: Existing Conditions ISATe Analysis Results

Freeway	2015-2019 Annual Crash History	Predicted Crashes	Expected Crashes	Percent Difference from Crash History	Percent Difference from Expected Crashes
I-64 west of the westbound I-64 off-ramp to westbound US 250	49.20	55.00	50.83	12%	8%
I-64 east of the westbound I-64 off-ramp to westbound US 250	37.80	25.84	8.22	-78%	-68%
Route 288	19.20	15.43	16.50	-20%	-6%
I-295	11.00	13.27	12.16	21%	9%

BUILD PACKAGE FREEWAY ANALYSIS

ISATe crash predictions for all freeways for the No-Build scenario and all three Build packages are shown in *Table 32*. The two Build packages that contain a new interchange at N Gayton Road are projected to increase crashes on I-64 between the Route 288 and I-295 interchanges since there are four new ramps and the AADT in this segment is projected to increase for vehicles accessing the proposed interchange. *Table 33* summarizes the projected crash rates for the No-Build scenario and all three Build packages. While Build Packages 2 and 3 are projected to increase crashes by 6 percent across all freeways, the crash rate is only projected to increase by 1 percent.

Table 32: Build Package ISATe Freeway Analysis Crash Predictions (2046)

Freeway	Crash Prediction			
	No-Build	Build Package 1	Build Package 2	Build Package 3
I-64 west of the westbound I-64 off-ramp to westbound US 250	111	109	125	125
I-64 east of the westbound I-64 off-ramp to westbound US 250	16	14	16	15
Route 288	47	43	43	43
I-295	28	30	31	31
Total	**201**	**196**	**214**	**213**

Table 33: Build Package ISATe Freeway Analysis Crash Rate Predictions (2046)

Freeway	Crash Rate Prediction (crashes per 100M VMT)			
	No-Build	Build Package 1	Build Package 2	Build Package 3
I-64 west of the westbound I-64 off-ramp to westbound US 250	61.6	60.8	64.4	64.3
I-64 east of the westbound I-64 off-ramp to westbound US 250	73.1	69.0	74.0	70.2
Route 288	77.9	71.1	71.2	71.2
I-295	69.2	73.6	73.9	73.9
Total	**66.7**	**65.2**	**67.6**	**67.3**

ISATe crash predictions for all ramps for the No-Build scenario and all three Build packages are shown in *Table 34*. Build Package 1 is projected to have a reduction in crashes at the I-64 interchange with US 250 since one loop ramp is removed. Build Packages 2 and 3 are projected to reduce crashes at most existing interchanges because fewer vehicles

are projected to use several existing ramps since they are redirected to ramps at the new interchange. However, Build Packages 2 and 3 are projected to add ramp crashes due to the addition of four ramps at the proposed interchange.

Table 34: Build Package ISATe Ramp Analysis Crash Predictions (2046)

Interchange	Crash Prediction			
	No-Build	Build Package 1	Build Package 2	Build Package 3
I-64 at Ashland Road	2	2	2	2
I-64 at Route 288	27	27	26	26
I-64 at I-295	29	29	31	31
I-64 at US 250	29	27	27	25
Route 288 at US 250	9	9	7	7
I-295 at Nuckols Road	3	3	3	3
I-64 at N Gayton Road	N/A	N/A	12	12
Total	**98**	**97**	**107**	**105**

Note: Individual crash predictions may not sum to total value due to rounding

ISATe crash predictions for ramp terminals for the No-Build scenario and all three Build packages are shown in *Table 35*. The ISATe ramp terminal crash module only includes certain configurations, so the ramp terminal analysis only included the following ramp terminals:

- Northbound Route 288 at US 250
- Southbound Route 288 at US 250
- Eastbound I-64 at Ashland Road
- Westbound I-64 at Ashland Road
- Eastbound I-64 at US 250
- Westbound I-64 at US 250 (for Build Packages 1 and 3)
- Eastbound I-64 at N Gayton Road (for Build Packages 2 and 3)
- Westbound I-64 at N Gayton Road (for Build Packages 2 and 3)

Since ISATe does not have crash prediction methodologies for ramp terminals that cover DDIs, the crash predictions for the ramp terminals at N Gayton Road summarized in *Table 35* were developed using the methodologies for a traditional signalized ramp terminal and were multiplied by a crash modification factor (CMF) from the VDOT State Preferred CMF List for converting a signalized ramp terminal to a DDI (0.59 for fatal and injury crashes and 0.67 for property damage only crashes).

Table 35: Build Package ISATe Ramp Terminal Analysis Crash Predictions (2046)

Interchange	Crash Prediction			
	No-Build	Build Package 1	Build Package 2	Build Package 3
I-64 at Ashland Road	13	13	13	13
I-64 at US 250	23	33	17	26
Route 288 at US 250	21	21	16	16
I-64 at N Gayton Road	N/A	N/A	30	30
Total	**57**	**67**	**76**	**85**

Limitations of ISATe Analysis

As mentioned in the *Existing Conditions ISATe* Analysis section, ISATe cannot accurately predict the magnitude of congestion-related crashes on westbound I-64 approaching the off-ramp to westbound US 250. *Table 36* summarizes the ISATe crash predictions on westbound I-64 between the off-ramp to eastbound US 250 and the off-ramp to westbound US 250. The crash prediction for 2046 in this area is approximately three times lower than the annual crash history for 2015-2019. The crash prediction methodologies from the *Highway Safety Manual* that are used in ISATe are bidirectional, so the tool does not differentiate what percentage of crashes are associated with each direction of travel.

Similarly, ISATe does not project a crash reduction on westbound I-64 in this area for Build Package 2 as shown in *Table 36*. This increase in crashes for Build Package 2 is contrary to reasonable expectation since the existing crashes in this section are largely rear end crashes that are attributed to congestion on I-64 and Build Package 2 is projected to reduce queuing on I-64 as documented in the *Build Package 2 Freeway Analysis Results* section.

Table 36: ISATe Crash Predictions on I-64 Between the Two Westbound I-64 Off-Ramps to US 250 (2046)

Interchange	Crash Prediction			
	No-Build	Build Package 1	Build Package 2	Build Package 3
Existing crashes per year (2015-2019)	25.6	N/A	N/A	N/A
2046 crash prediction	8.6	7.3	9.1	8.3

Alternative Analysis Methodologies

The study team considered applying crash modification factors to better understand the potential crash reduction on westbound I-64 approaching the off-ramp to westbound US 250 that can be attributed to the projected improvement in operations on I-64 in all three Build packages. The following three approaches were used to develop a range of potential benefits that were applied to the 2015-2019 crashes on westbound I-64 over the extent of the maximum queue (from the westbound I-64 off-ramp to westbound US 250 back to the Cox Road bridge).

- ***Low-range estimate:*** a custom CMF was calculated based on a ratio comparing the percentage of ramp volume to total volume on westbound I-64 within the existing weaving area at the US 250 interchange between each Build package and the No-Build scenario. This approach is similar to assumptions that may be made for safety scoring in SMART SCALE when reliable CMFs are not available. The resulting CMFs are summarized in *Table 37*.

Table 37: Low-range CMF Estimates for Westbound I-64 at US 250 Interchange

Build Package	CMF	Projected Annual Crash Reduction (2015-2019)
1	0.72	8.7
2	0.83	5.3
3	0.55	14.0

- ***High-range estimate:*** since the Build packages are projected to improve operations in the PM peak period and significantly reduce the queue on the freeway as documented in the *Build* analysis results section, this custom CMF assumes a reduction in rear end crashes that were mainly attributed to congestion and queuing on the freeway. The CMF was assumed to mitigate those rear end crashes that occurred during the PM peak period (3:00 – 7:00 PM) over the extent of the maximum queue (from the westbound I-64 off-ramp to westbound US 250 back to the Cox Road bridge) where the crash description specifically mentioned traffic, congestion, or stopped or slowing vehicles. Seventy-three rear end crashes fit these criteria, which equates to a reduction of 48 percent of all crashes and 58 percent of rear end crashes. Although the other rear end crashes may have been attributed to congestion on the freeway, the study team did not assume that all rear end crashes would be mitigated by the improvements since rear end crashes can still occur at interchanges without recurring congestion issues.

  This CMF results in a reduction of 14.6 rear end crashes per year on westbound I-64 based on 2015-2019 crash history. The Build packages that include the partial cloverleaf at the US 250 interchange are also projected to mitigate angle and sideswipe crashes over the same extent since the improvement removes the weave on the freeway. This results in a further reduction in 2 crashes per year based on 2015-2019 crash history.

The low- and high-range estimates were calculated based on the 2015-2019 crash history and were factored to project the potential crash reduction for each Build package in 2046. *Table 38* summarizes the ISATe crash prediction for 2019 and 2046. The annual crash prediction was projected to at least double across all three freeways by 2046. As such, the study team assumed that the potential reduction in crashes on westbound I-64 associated with the low-, medium-, and high-range estimates would double by 2046. This estimate was deemed to be conservative since the maximum freeway queue on westbound I-64 was projected to increase approximately tenfold between 2019 (*Figure 11*) and 2046 (*Figure 54*), which would likely increase the number of rear end crashes by more than two times. *Table 39* summarizes the resulting projections for crash reductions on westbound I-64 between the Cox Road Bridge and the off-ramp to westbound US 250 for all three Build packages.

Table 38: ISATe Crash Predictions per Year

Year	Crash Prediction		
	I-64	I-295	Route 288
2019	63.2	13.3	15.4
2046	126.3	28.1	46.9
Percent Increase	**100%**	**111%**	**205%**

Table 39: Projected Crash Reduction on Westbound I-64 between the Cox Road Bridge and the Off-Ramp to Westbound US 250

Build Package	Cause of Crash Reduction	Projected Crash Reduction (2046) on Westbound I-64	
		Low Range	High Range
1	Improved operations; removal of weave	17.7	33.2
2	Improved operations	10.6	29.2
3	Improved operations; removal of weave	28.0	33.2

BUILD PACKAGE ARTERIAL ANALYSIS

The two Build packages that include a new interchange at N Gayton Road are projected to decrease crashes on US 250 since volumes on US 250 are projected to decrease on US 250 as described in the *Build Traffic Volumes* section. Crash prediction methodologies are not available for six-lane urban and suburban arterials in the Highway Safety Manual spreadsheet tools developed and maintained by AASHTO. The study team developed a low- and high-range projection for the reduction in annual crashes on US 250 between the intersection with the northbound Route 288 ramps and the intersection with the eastbound I-64 ramps. The low- and high-range projections were based on a test performed for a six-lane arterial in the Interactive Highway Safety Design Model (IHSDM) to compare the same roadway with different volume inputs. This test showed that a 1 percent decrease in traffic volume was projected to reduce segment- and driveway-related crashes by 1 percent and projected to reduce intersection-related crashes by 0.25 percent.

- ***Low-range estimate:*** a custom CMF was calculated based on a four-to-one relationship between a percent change in traffic volume and the resulting percent change in crashes
- ***High-range estimate:*** a custom CMF was calculated based on a one-to-one relationship between a percent change in traffic volume and the resulting percent change in crashes. This approach is similar to assumptions made for safety scoring in SMART SCALE when reliable CMFs are not available as documented in the *SMART SCALE Technical Guide*.

Table 40 summarizes the potential reduction in crashes on US 250 between the northbound Route 288 ramps and the eastbound I-64 ramps. Crashes were grown from 2015-2019 to a 2046 projection by comparing the projected 2019 and 2046 AADTs and increasing crashes by 0.25 percent for every one percent increase in AADT. The volume reductions on US 250 are projected to reduce by 22 to 86 crashes per year.

Table 40: Projected Crash Reduction on US 250

Segment	Projected Reduction in AADT	2015-2019 Annual Crashes	Projected 2046 Crashes	Projected Annual Crash Reduction	
				Low Range	High Range
US 250 between Route 288 and N Gayton Road	29%	33.4	38.6	2.8	11.2
US 250 between N Gayton Road and Lauderdale Drive	13%	21.4	24.5	0.8	3.2
US 250 between Lauderdale Drive and Pouncey Tract Road	23%	34.0	37.0	2.1	8.5
US 250 between Pouncey Tract Road and I-64	31%	192.8	204.4	15.8	63.4
Total		**281.6**	**304.5**	**21.6**	**86.2**

SAFETY CONCLUSIONS

All three Build packages are projected to significantly reduce crashes at the highest freeway crash density hot spot in the study area – westbound I-64 approaching the US 250 interchange – since the existing crash pattern is largely attributed to the existing bottleneck and all three Build packages are projected to significantly improve operations. As shown in *Table 39*, Build Packages 1 and 3 have the greatest potential for crash reductions at this location using the high-range estimate since both eliminate the weave on westbound I-64. Build Package 3 has the greatest potential for crash reductions at this location using the low-range estimate since it removes the weave and reduces the traffic volume exiting the freeway at the remaining ramp.

For the Build packages that contain a new interchange at N Gayton Road, the goal of the safety analysis was to determine if the projected reduction in crashes at the existing freeway hot spots outweighs the crashes that are projected to be added to the network in the vicinity of the new interchange. As shown in *Table 32*, Build Packages 2 and 3 are projected to increase crashes on I-64 in both directions by 14 crashes in 2046. As shown in *Table 39*, the low-range

projection is not projected to offset that increase for Build Package 2, but the high-range projection for Build Package 2 and all projections for Build Package 3 are projected to offset that increase.

Additionally, the Build packages that contain a new interchange at N Gayton Road are projected to reduce crashes on US 250, which targets several of the highest-ranked intersections and segments in Richmond District for safety needs as documented in the *Existing Safety Data and Identification of Problem Areas* section.

The results of the safety analyses for all three Build packages are summarized in *Table 41*. Based on the low-range estimates of safety benefits, Build Package 1 is projected to have the greatest reduction in crashes throughout the study area. However, since Build Packages 2 and 3 are projected to remove traffic volume from US 250, these Build packages have the greatest potential to reduce crashes throughout the study area, based on the high-range estimates of safety benefits.

While the low-range estimates of safety benefits for Build Package 2 are projected to increase crashes throughout the study area, the study team determined that Build Package 2 was a better alternative than the No-Build scenario because it was projected to decrease crashes at several of the high crash locations on the freeway and arterial and because the high-range estimates of safety benefits were projected to decrease crashes overall. However, since crashes are projected to increase on I-64 between I-295 and Route 288 due to the new access point, the study team recommends that crash mitigation strategies are incorporated into the final design to help minimize the crash increase on this segment if this Build package were to be selected as the preferred alternative. Potential mitigation strategies include interchange lighting, high-friction surface treatment on ramps, and changeable message signs that can be used to warn motorists of an incident or upcoming congestion. Interchange lighting has the potential to reduce 50 percent of nighttime crashes; high-friction surface treatment has the potential to reduce 24 percent of all crashes on ramps; changeable message signs have the potential to reduce the frequency of secondary crashes.

The study team determined that Build Package 3 had the highest potential safety benefit since it is projected to improve freeway operations on westbound I-64, remove the freeway weave at the US 250 interchange, and reduce crashes on US 250. Build Package 3 was projected to reduce crashes overall using the low-range estimates of safety benefits and had the second largest potential to reduce crashes using the high-range estimates. Like in Build Package 2, crashes are projected to increase on I-64 between I-295 and Route 288 due to the new access point, so the study team recommends that crash mitigation strategies are incorporated into the final design to help minimize the crash increase on this segment if this Build package were to be selected as the preferred alternative.

Table 41: Network Safety Summary for Low- and High-Range Projections for Change in Annual Crash Frequency)

Analysis Component		Projected Change in Annual Crash Frequency for Each Build Package					
		Build Package 1		Build Package 2		Build Package 3	
		Low	High	Low	High	Low	High
Freeway Segments	I-64	-20	-35	+3	-15	-14	-19
	I-295	+2		+3		+3	
	Route 288	-4		-4		-4	
	Total	-22	-37	+2	-16	-15	-20
Ramp Segments	Existing	-2		-3		-5	
	Proposed	N/A		+12		+12	
Ramp Terminals	Existing	No change		-11		-11	
	Proposed	+10		+30		+39	
US 250 Segments		No change		-22	-86	-22	-86
Overall Network Summary		-14	-29	+8	-74	-2	-71

Environmental Considerations

As part of the IAR, a high-level review of environmental considerations was undertaken to better understanding the existing environment, potential impacts of alternatives being considered, and future steps that may need to be taken to comply with state and federal environmental review regulations. The environmental considerations discussed in this section cover the three Build packages under consideration. Prior to reaching a consensus on this combination of design elements and Build packages, multiple other concepts were considered. In order to narrow down the list of concepts being considered, a high-level review of environmental considerations was completed to identify any major issues. This helped guide the team in selecting concepts to carry forward that would meet the purpose and need of the project and were not anticipated to have a high likelihood of substantial impacts to the environment.

METHODOLOGY

A desktop review using readily available GIS data, online environmental resource maps, and other relevant data were referenced from national, statewide, and county agencies to identify existing environmental resources within the project study areas. Data was gathered to cover resources pertaining to the natural and human environment consistent with the resource categories included in the VDOT Categorical Exclusion checklist (EQ-104). A summary of the resources identified in the study areas is shown in *Figure 134* through *Figure 136*.

Presence of resources was determined using a study area that was defined for each design element within the Build packages. These study areas were defined as a 100-foot buffer of the current proposed concept designs to conservatively capture an inventory of known resources surrounding the current design, which would then be further evaluated for the potential to be impacted by the proposed project. Four study areas were defined as follows to capture the different design elements that are being considered in different combinations to form the three Build packages.

- Diverging Diamond Interchange on I-64 at N Gayton Road
  - Included in Build Packages 2 and 3
  - Shown in yellow in *Figure 135*
- Partial Cloverleaf on I-64 at US 250
  - Included in Build Packages 1 and 3
  - Shown in green in *Figure 136*
- Restriping on eastbound I-64 off-ramp to I-295
  - Included in Build Package 1
  - Shown in purple in *Figure 136*
- Common design elements included in all three Build Packages
  - Southbound Route 288 auxiliary lane
  - Northbound Route 288 auxiliary lane and US 250 improvements
  - Northeastbound I-295 auxiliary lane
  - Improvement at US 250 and Tom Leonard Drive
  - Turning restriction at Dominion Boulevard
  - Shown in orange in *Figure 134* and *Figure 136*

The footprint of the current concept designs was referenced to determine whether resources identified within the study areas would likely be impacted by the project. Engineering judgment considering the proposed improvements and the attributes of the existing resources were used to make a preliminary determination of whether the project would have no impact, a positive impact, or an adverse impact to individual resources.

For the purposes of this study, community services were defined as publicly accessible facilities used to provide services to the public or as gathering spaces for organizations. These may include public education, welfare, emergency services, mail, libraries, social work, food banks, health care, police, fire services, public transportation, and public housing.

Figure 134: Environmental Features and Proposed Improvement Impact Areas (1)

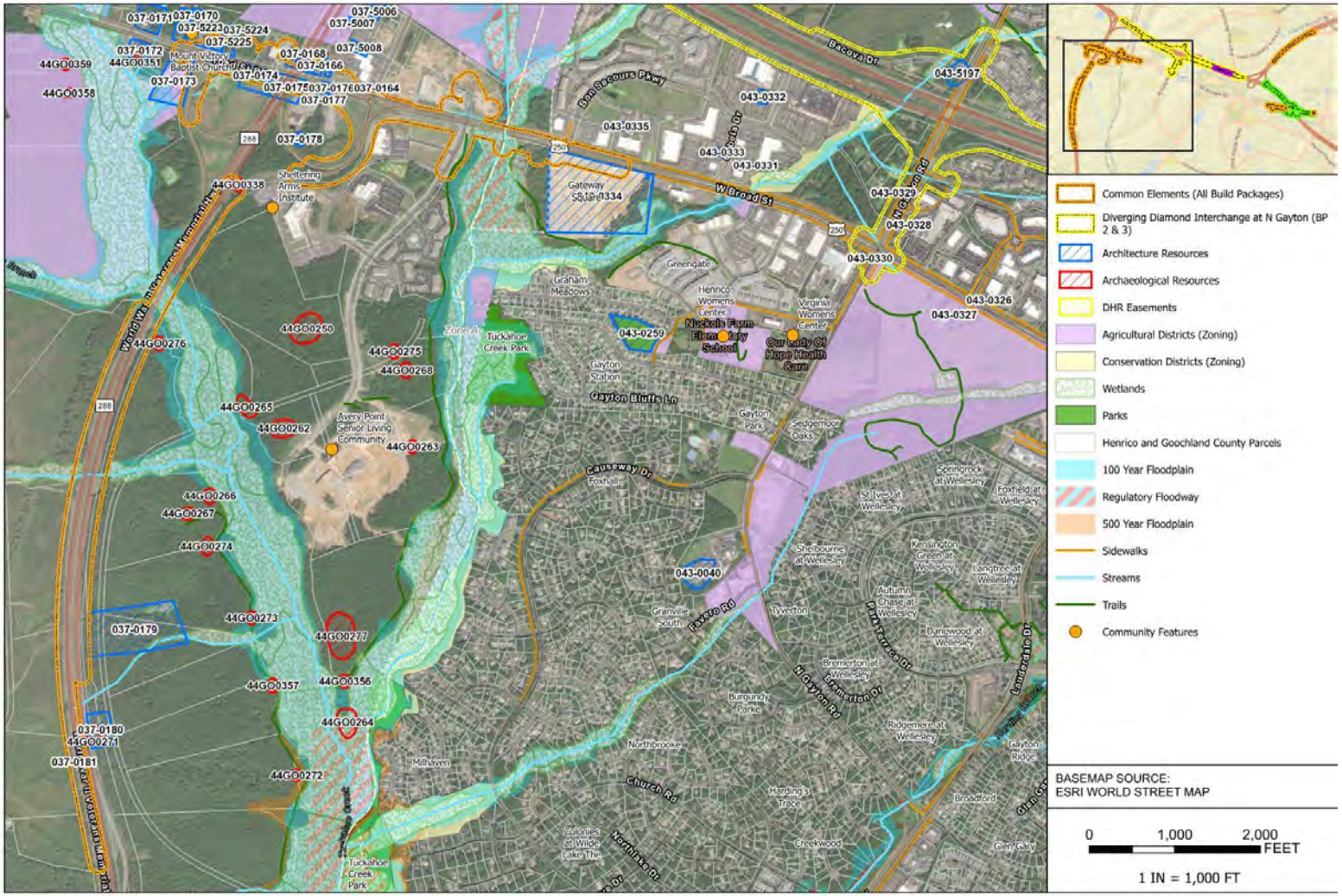


Figure 135: Environmental Features and Proposed Improvement Impact Areas (2)

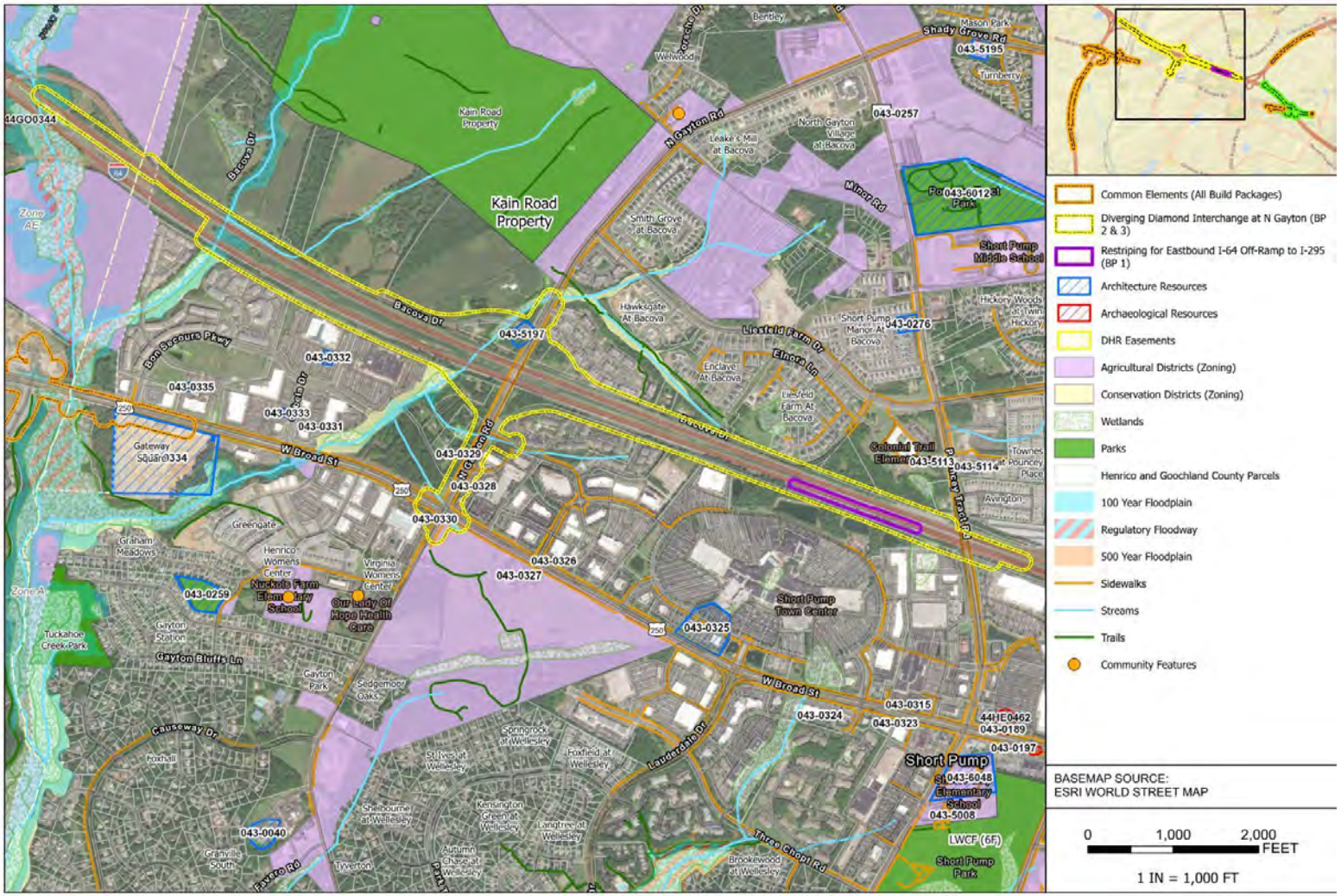
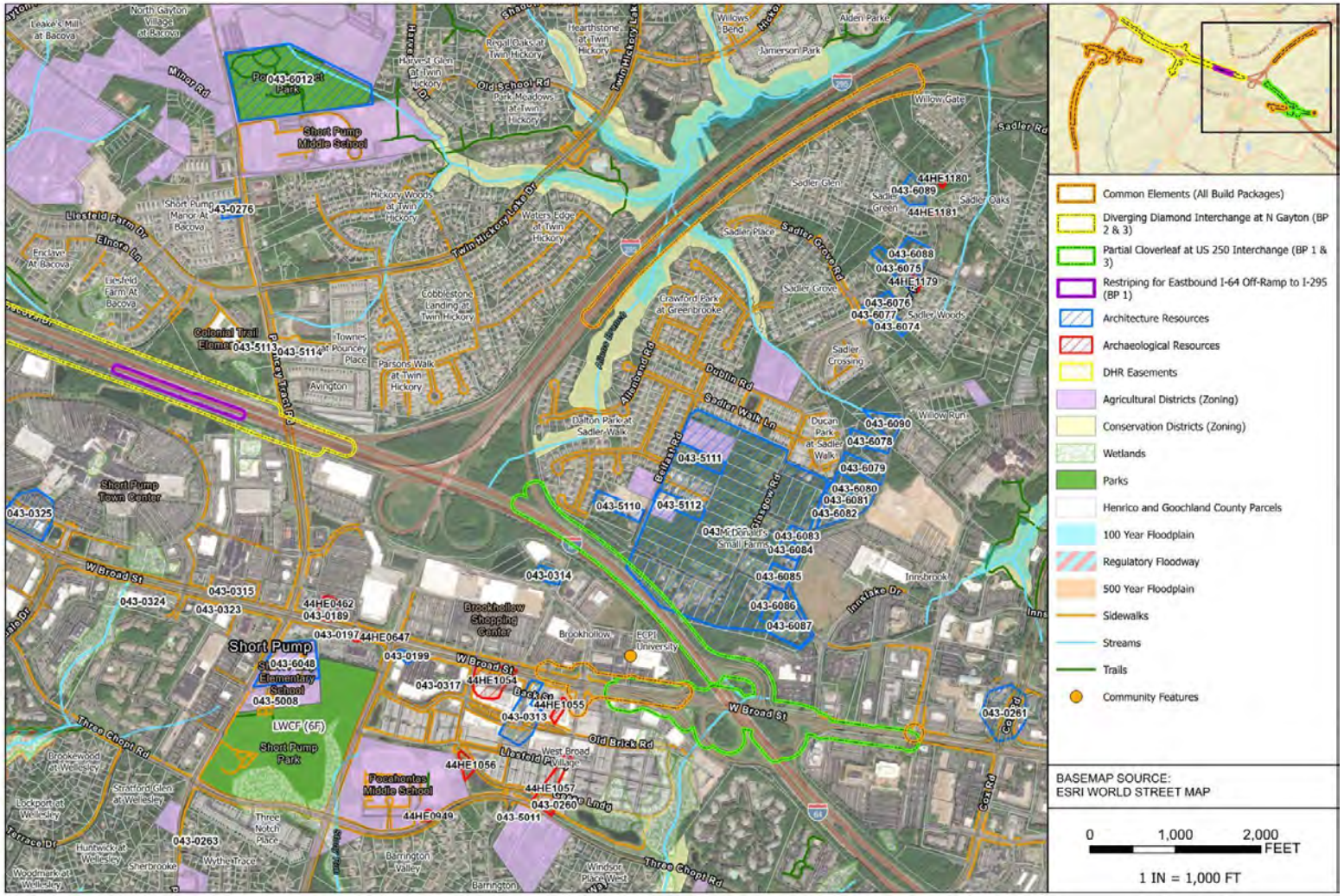


Figure 136: Environmental Features and Proposed Improvement Impact Areas (3)



ENVIRONMENTAL CONSEQUENCES

Using the study areas and impact areas defined in the *Environmental Considerations Methodology* section, existing resources were identified and potential for impacts were determined and are described in detail below.

No-Build Alternative

The No-Build alternative would result in no construction or ground disturbing activities and therefore would have no impacts to natural or human environment resources. However, the No-Build alternative would not address the purpose and need of the project.

Common Elements in All Build Packages

Environmental Justice – Minority and Low-Income Populations

Minority (80th percentile nationally) and low-income (below 50th percentile nationally) populations were identified in the areas within and surrounding the study area. The proposed project is not anticipated to result in major traffic disruptions, more than minor amounts of temporary or permanent right-of-way acquisition, or more than limited displacements, community disruptions, or a disruption to emergency services. Therefore, these elements are not anticipated to result in a disproportionately high and adverse effect on low-income or minority populations.

Community Services

Three community service sites were identified within the study area: The Sheltering Arms Institute: Physical Rehabilitation Hospital, Mount Victory Baptist Church, and ECPI University. Though some partial right-of-way acquisition may be necessary on these three properties, the level of impact is not anticipated to have an adverse effect on the community's use and operation of the facilities. Access to these locations is anticipated to be maintained during construction.

Bike and Pedestrian Facilities

Existing sidewalks were identified along US 250 within the study area. The proposed project is anticipated to require temporary closures or detours of segments to accommodate construction of new segments of sidewalk. These impacts are anticipated to be temporary and result in an overall positive benefit to users upon completion of new segments of sidewalks.

Historic Properties and Archaeological Resources – Section 106

Multiple previously recorded cultural resource sites were identified within the study area, as listed in *Table 42*. However, none of the sites are listed on, or have been determined eligible for, the National Register of Historic Places (NRHP) and are still extant. Therefore, no impacts to Section 106 resources are anticipated. Additional studies and field surveys of potential sites with no prior evaluation may be required during the environmental review process.

Section 4(f)

No recreational resources subject to Section 4(f) regulations were identified within the study area. There are also no previously documented cultural resource sites that are listed on, or have been determined eligible for, the National Register of Historic Places (NRHP) (and are still extant) located within the study area. There is one site located within the study area that has been documented but not evaluated and may require evaluation during the environmental review process. If this site were to be determined eligible for the NRHP, it would become protected under Section 4(f).

Table 42: Previously Recorded Cultural Resources within the Common Elements Study Area

VDHR ID	Evaluation Status
44GO0338	No Evaluation
043-0334 037-0164 037-0177 037-0176 037-0165 037-0166 037-0167 037-0169 037-0175 037-0174 037-0173 037-5225 037-5224 037-5223 037-0170	VDHR Staff: Not Eligible
037-0179 037-0181 037-0168	Recommended Not Eligible

Surface Water

Based on Virginia Department of Environmental Quality (VDEQ) data, seven stream crossings were identified within the study area. Based on the extents and scope of the current design concepts, approximately 215 linear feet of stream impacts are possible.

Floodplains

Three Federal Emergency Management Agency (FEMA) listed floodplain crossings were identified within the study area. Based on the extents and scope of the current design concepts, approximately 0.5 acres of floodplain impacts are possible.

Wetlands

National Wetlands Inventory (NWI) data hosted by the US Fish and Wildlife Service (USFWS) was reviewed and four separate wetland areas were identified within the study area. Based on the extents and scope of the current design concepts, approximately 0.15 acres of wetland impacts are possible.

Conservation, Agricultural, and Forestral Districts

An area zoned as a conservation district was identified along the eastern edge of the study area associated with the northeastbound I-295 auxiliary lane improvements. The proposed construction is not anticipated to extend beyond the existing right-of-way though, so no impacts are anticipated.

Farmland

The majority of the study area is located within the urbanized area associated with Richmond, Virginia as designated by the 2010 US Census Bureau Urbanized Area Map with the exception of portions of the study area located in Goochland County. Suitable farmland soils were identified within these non-urbanized areas using the Natural Resources Conservation Service (NRCS) Web Soil Survey. Since the design concepts are anticipated to have impacts outside of

existing right-of-way (areas already converted to transportation use), impacts to farmland soils are possible and a further analysis using the NRCS-CPA-106 form for corridor type projects should be conducted during the environmental review process for the project.

Invasive Species

Invasive species are anticipated to be present within the study area. However, the nature of the project is not anticipated to result in impacts to native species in such a manner that would result in proliferation of invasive species.

Noise

Although the improvements included as "common elements" across all of the Build packages are not anticipated to be considered Type I noise projects, they are proposed to be combined with elements (partial cloverleaf or diverging diamond interchanges) that would be considered Type I noise projects as part of the ultimate Build Packages. Therefore, a noise analysis would be required for the entire Build package, including these "common elements", during the project development phase of the project.

Right-of-Way Relocations

The proposed improvements along I-295 and Route 288 are not anticipated to require right-of-way acquisition. Improvements along US 250 and at the Route 288 interchange are anticipated to require minimal amounts of right-of-way acquisition and are not anticipated to include any relocations or full takes of property. A total of approximately 3 acres of temporary construction easements across 26 parcels may be required for these elements.

Resources Not Present Within Study Area

- Recreational Facilities
- Section 6(f)
- Protected Species
- Open Space and Conservation Easements

Restriping for Eastbound I-64 Off-Ramp to I-295

Environmental Justice – Minority and Low-Income Populations

Minority (69th percentile nationally) and low-income (below 50th percentile nationally) populations were identified in the areas within and surrounding the study area. The proposed project is not anticipated to result in major traffic disruptions, more than minor amounts of temporary or permanent right-of-way acquisition or more than limited displacements, community disruptions, or a disruption to emergency services. Therefore, this alternative is not anticipated to result in a disproportionately high and adverse effect on low-income or minority populations.

Invasive Species

Invasive species are anticipated to be present within the study area. However, the nature of the project is not anticipated to result in impacts to native species in such a manner that would result in proliferation of invasive species.

Noise

Although the restriping described here is not anticipated to be considered a Type I noise project, it is proposed to be combined with the partial cloverleaf (in Build Package 1) that would be considered a Type I noise project. Therefore, a noise analysis would be required for the entire Build Package 1 project during the project development phase.

Resources Not Present Within Study Area

- Recreational Facilities
- Community Services

- Bike and Pedestrian Facilities
- Historic Properties and Archaeological Resources – Section 106
- Surface Water
- Floodplains
- Wetlands
- Conservation, Agricultural, and Forestral Districts
- Farmland
- Section 4(f)
- Section 6(f)
- Protected Species
- Open Space and Conservation Easements
- Right-of-Way Relocations

Partial Cloverleaf at US 250 Interchange (Build Packages 1 and 3)

Environmental Justice – Minority and Low-Income Populations

Minority (80th percentile nationally) and low-income (below 50th percentile nationally) populations were identified in the areas within and surrounding the study area. The proposed project is not anticipated to result in major traffic disruptions, more than minor amounts of temporary or permanent right-of-way acquisition or more than limited displacements, community disruptions, or a disruption to emergency services. Therefore, this improvement is not anticipated to result in a disproportionately high and adverse effect on low-income or minority populations.

Community Services

One community service site, ECPI University, was identified within the study area. Though some partial right-of-way acquisition may be necessary on this property, the level of impact is not anticipated to have an adverse effect on the community's use and operation of the facilities. Access to this location is anticipated to be maintained during construction.

Bike and Pedestrian Facilities

Existing sidewalks were identified along US 250 within the study area. The proposed project is anticipated to require temporary closures or detours of segments to accommodate construction of new segments of sidewalk. These impacts are anticipated to be temporary and result in an overall positive benefit to users upon completion of new segments of sidewalks which will connect facilities on the east and west sides of I-64 along the southern side of US 250.

Historic Properties and Archaeological Resources – Section 106

One previously recorded cultural resource site (043-5109) was identified within the study area but has been determined by VDHR to be not eligible for the NRHP. Therefore, no Section 106 resources have been identified within the study area.

Surface Water

Based on VDEQ data, a single stream with two crossing points were identified within the study area. Based on the extents and scope of the current design concepts, approximately 480 linear feet of stream impacts are possible.

Wetlands

NWI data was reviewed, and two wetland areas were identified within the study area. Based on the extents and scope of the current design concepts, approximately 0.2 acres of wetland impacts are possible.

Invasive Species

Invasive species are anticipated to be present within the study area. However, the nature of the project is not anticipated to result in impacts to native species in such a manner that it would result in proliferation of invasive species.

Noise

The partial cloverleaf being proposed is anticipated to be considered a Type I noise project and would therefore require further analysis during the project development phase of the project. The area surrounding the interchange is mostly commercial with few sensitive noise receptors. Along the east side of I-64, where the additional auxiliary lane to I-295 is proposed, some residential properties within the McDonald's Small Farms and Dalton Park at Sadler Walk neighborhoods which may require noise walls to be studied along this segment of the corridor.

Right-of-Way Relocations

Improvements associated with the US 250 and I-64 interchange are anticipated to require minimal amounts of right-of-way acquisition and are not anticipated to include any relocations or full takes of property. A total of approximately 0.25 acres of permanent right-of-way across three parcels may be required for this project.

Resources Not Present Within Study Area

- Recreational Facilities
- Section 4(f)
- Section 6(f)
- Floodplains
- Conservation, Agricultural, and Forestral Districts
- Farmland
- Protected Species
- Open Space and Conservation Easements

Diverging Diamond Interchange at N Gayton Road (Build Packages 2 and 3)

Environmental Justice – Minority and Low-Income Populations

Minority (69th percentile nationally) and low-income (below 50th percentile nationally) populations were identified in the areas within and surrounding the study area. The proposed project is not anticipated to result in major traffic disruptions, more than minor amounts of temporary or permanent right-of-way acquisition or more than limited displacements, community disruptions, or a disruption to emergency services. Therefore, this improvement is not anticipated to result in a disproportionately high and adverse effect on low-income or minority populations.

Bike and Pedestrian Facilities

Existing sidewalks were identified along N Gayton Road within the study area. The proposed project is anticipated to require temporary closures or detours of segments to accommodate construction of new segments of sidewalk. These impacts are anticipated to be temporary and result in an overall positive benefit to users upon completion of the project to include new segments of sidewalks and the proposed multi-use trail on the west side of N Gayton Road.

Historic Properties and Archaeological Resources – Section 106

Four previously recorded cultural resource sites were identified within the study area. Three of these sites (043-0328, 043-0329, 043-0330) have been determined by VDHR to be not eligible for the NRHP. The fourth site (043-5197) has been evaluated and recommended to be not eligible for the NRHP but has not yet received confirmation from VDHR. Therefore, no Section 106 resources have been identified within the study area. Confirmation by VDHR of the recommendation for site 043-5197 may be required during the environmental review process.

Section 4(f)

No recreational resources subject to Section 4(f) regulations were identified within the study area. There are also no previously documented cultural resource sites that are listed on, or have been determined eligible for, the National Register of Historic Places (NRHP) (and are still extant) located within the study area. There is one site located within the

study area that has been documented but whose eligibility has not been confirmed by VDHR and therefore may require confirmation by VDHR during the environmental review process. If this site were to be determined eligible for the NRHP, it would become protected under Section 4(f).

Surface Water

Based on VDEQ data, six streams with nine crossing points were identified within the study area. Based on the extents and scope of the current design concepts, approximately 1,910 linear feet of stream impacts are possible.

Floodplain

Two Federal Emergency Management Agency (FEMA) listed floodplain crossings were identified within the study area. Based on the extents and scope of the current design concepts, approximately 2.0 acres of floodplain impacts are possible.

Wetlands

NWI data was reviewed, and seven wetland areas were identified within the study area. Based on the extents and scope of the current design concepts, approximately 1.1 acres of wetland impacts are possible.

Conservation, Agricultural, and Forestral Districts

An area zoned as a conservation district, associated with the floodplain crossing, and an area zoned as agricultural were identified in the study area. The proposed project is anticipated to require acquisition of a portion (approximately 0.15 acres) of the designated conservation district to construct the eastbound off-ramp which would be considered a conversion of the zoned conservation district to right-of-way. Though the area is zoned conservation, no conservation easements have currently been identified.

Farmland

The study area is located within a non-urbanized area as designated by the 2010 US Census Bureau Urbanized Area Map for the Richmond, Virginia area. Suitable farmland soils were identified within the study area using the NRCS Web Soil Survey. Since the design concept is anticipated to have impacts outside of existing right-of-way (areas already converted to transportation use) impacts to farmland soils are possible and a further analysis using the NRCS-CPA-106 form for corridor type projects should be conducted during the environmental review process for the project.

Invasive Species

Invasive species are anticipated to be present within the study area. However, the nature of the project is not anticipated to result in impacts to native species in such a manner that would result in proliferation of invasive species.

Noise

The diverging diamond interchange being proposed is anticipated to be considered a Type I noise project and would therefore require further analysis during the project development phase of the project. The area surrounding the interchange is mostly residential properties which are considered sensitive noise receptors. Based on the results of the noise analysis to be conducted at a later date, noise walls may be warranted.

Right-of-Way Relocations

Improvements associated with the Gayton Road interchange are anticipated to require more than minimal amounts of right-of-way acquisition including some relocations or full takes of property. A total of approximately 9 acres of permanent right-of-way across 13 parcels may be required for this project.

Resources Not Present Within Study Area

- Recreational Facilities

- Community Services
- Section 6(f)
- Protected Species
- Open Space and Conservation Easements

ALTERNATIVES MATRIX

Based on the review of existing conditions and potential for impacts, a matrix of these conclusions was created to compare the impacts to the environment of the three Build packages and the No-Build alternative across all of the environmental resource categories considered, as shown in *Table 43*. A color-coding system was used to summarize the anticipated level of impacts that the specific alternative would have on each environmental resource category. This color-coding system is defined in *Table 44*.

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Table 43: Build Package Environmental Impacts Matrix

Environmental Resource	No-Build	Build Package 1	Build Package 2	Build Package 3	Source
Minority/Low Income Populations					EPA EJ Screen Justice40
Recreational Facilities					VDCR Natural Heritage Data Explorer Henrico County and Goochland County GIS VDCR Virginia Outdoor Plan Mapper
Community Services		<0.1 acres TCE	<0.1 acres TCE	<0.1 acres TCE	Aerial Imagery Henrico County and Goochland County GIS Google Maps
Bike/Pedestrian Facilities					Henrico County and Goochland County GIS Aerial Imagery Google Maps VDCR Virginia Outdoor Plan Mapper
Section 6(f)					VDCR Virginia Outdoor Plan Mapper
Historic Properties*					VDHR Virginia Cultural Resource Information System
Section 4(f)*					VDCR Natural Heritage Data Explorer Henrico County and Goochland County GIS VDCR Virginia Outdoor Plan Mapper VDHR Virginia Cultural Resource Information System
Surface Water		695 LF	2,125 LF	2,605 LF	VDEQ Virginia Water Quality Standards
Protected Species					VDWR Wildlife Environmental Review Map Service VDWR Fish and Wildlife Information Service VDGIF NLEB Winter Habitat and Roost Tree Application VDGIF MYLU PESU Habitat PESU Habitat Application
Floodplains		0.5 acres	2.5 acres	2.5 acres	FEMA Flood Hazard Areas
Wetlands		0.35 acres	1.25 acres	1.45 acres	USFWS National Wetland Inventory
Open Space and Conservations Easements					VDCR Natural Heritage Data Explorer
Conservation, Agricultural, and Forestral Districts			0.15 acres	0.15 acres	Henrico County and Goochland County GIS Henrico County and Goochland County Zoning Map
Farmland					US Census Bureau Urban Area Maps NRCS Web Soil Survey
Invasive Species					VDCR Natural heritage Invasive Species USADA Forest Service Raster Data
Noise					Aerial Imagery Google Maps
Right of Way Relocations		3 acres TCE; 0.25 acres ROW	3 acres TCE; 9 acres ROW	3 acres TCE; 9.25 acres ROW	Henrico County and Goochland County GIS

*Assessment based on the currently listed, determined eligible, or recommended eligible for the NRHP properties pending potential further investigations for recommendations not yet confirmed by VDHR or for individual sites not yet evaluated. TCE = Temporary Construction Easement; ROW = Right-of-Way

Table 44: Environmental Impacts Matrix Legend

Legend	Description
	None Present/Non-applicable This color is used if there are no resources related to the subject category identified within any of the study areas for elements included in the subject Build package.
	Present – No Adverse Impacts Anticipated This color is used if at least one resource related to the subject category is identified within any of the study areas for elements included in the subject Build package AND impacts to these resources have been preliminary determined to have a low likelihood of impacting in an adverse nature. This may include natural resources present in the study area but not within the footprint of the concept, right-of-way impacts that are limited to partial acquisitions, or impacts to a resource that are positive in nature such as temporary closures of sidewalks to tie to extensions of said facilities.
	Present – Impacts Anticipated This color is used if at least one resource related to the subject category is identified within any of the study areas for elements included in the subject Build package AND impacts to these resources have been preliminary determined to occur, potentially in an adverse nature. This may include natural resources present in the study area and within the footprint of the concept or right-of-way impacts that include complete takes and relocations.

PROJECT ENVIRONMENTAL REVIEW COMPLIANCE

Further analysis of environmental resources and potential impacts will be necessary including consideration of measures to avoid, minimize, and mitigate impacts. Regardless of the potential funding source, the project will have a federal nexus due to the proposed changes to the interchanges on interstate facilities. Therefore, the environmental review process will need to follow the National Environmental Policy Act of 1969 regulations and the implementing regulations of FHWA. Based on the scope of the proposed projects outlined in the three Build packages, it is anticipated that Build Package 1 may qualify as Categorical Exclusion actions under the NEPA Programmatic Agreement between FHWA and VDOT, dated October 2017, and that Build Packages 2 and 3 may require completion of an Environmental Assessment and Finding of No Significant Impact. Further analyses to be conducted during this process should include, but not be limited to a noise analysis, stream and wetland delineations, Section 106 coordination with VDHR, public involvement, and floodplain impact studies.

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Planning Level Cost Estimate

A planning level cost estimate in 2022 dollars was developed for the proposed improvements as summarized in *Table 45*. Construction (CN) costs were estimated based on conceptual major quantity estimates. Unit costs were identified using VDOT's Statewide Bid Tab Query to utilize recent bid tabs for similar projects based on overall size and location. Preliminary engineering (PE) and construction engineering and inspection (CEI) costs were estimated as a percentage of construction costs. A contingency and allowance were documented for the proposed improvements based on a risk analysis that noted identified and unidentified project risks. A detailed cost estimate should be prepared during the design phase of this project.

Table 45: Planning Level Cost Estimates

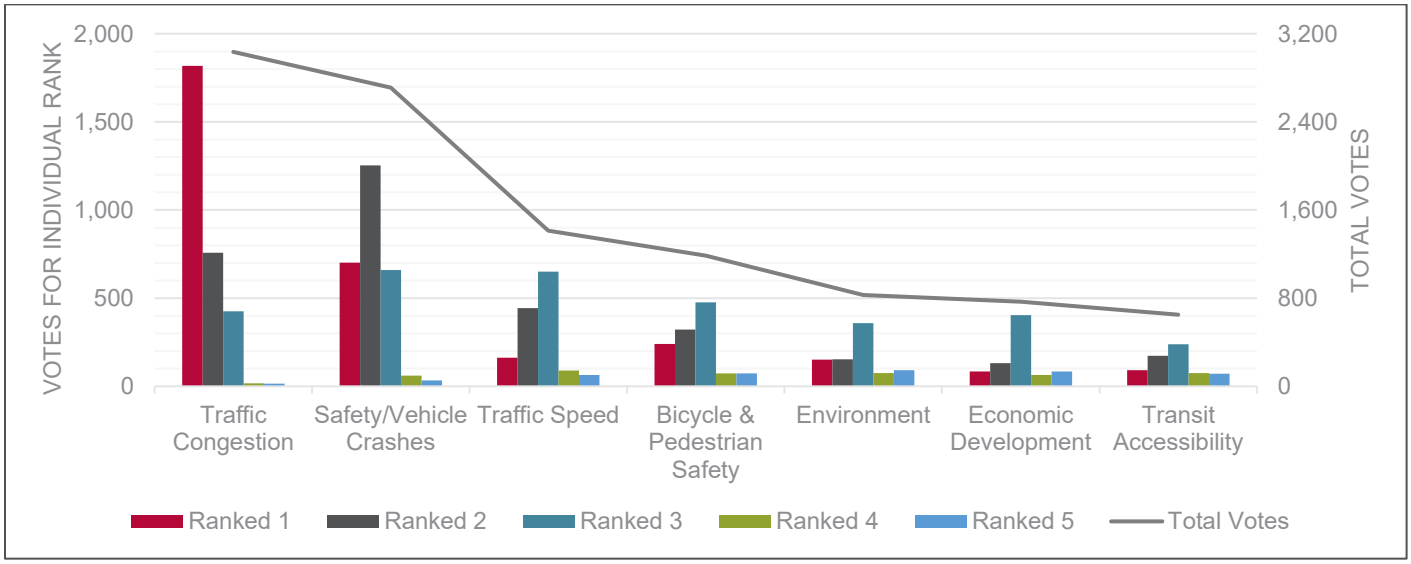
Build Package	Total Project Cost
1	$209,000,000
2	$177,000,000
3	$305,000,000

Selection of Preferred Alternative

PUBLIC INVOLVEMENT

The study team prepared an online public survey using MetroQuest that was open to the public from December 15, 2022, to January 2, 2023. The public survey prompted responders to rank up to their top 5 priorities in the study area. *Figure 137* illustrates that the public's highest priority within the study area was reducing traffic congestion, which was listed as the number one priority 1,818 times and was ranked in top five priorities 3,035 times. Safety received the second-most votes as the number one priority (702) and was ranked in the top five priorities 2,711 times. Overall, 3,610 people participated in the survey.

Figure 137: Public Survey Rankings of Priorities within Study Area



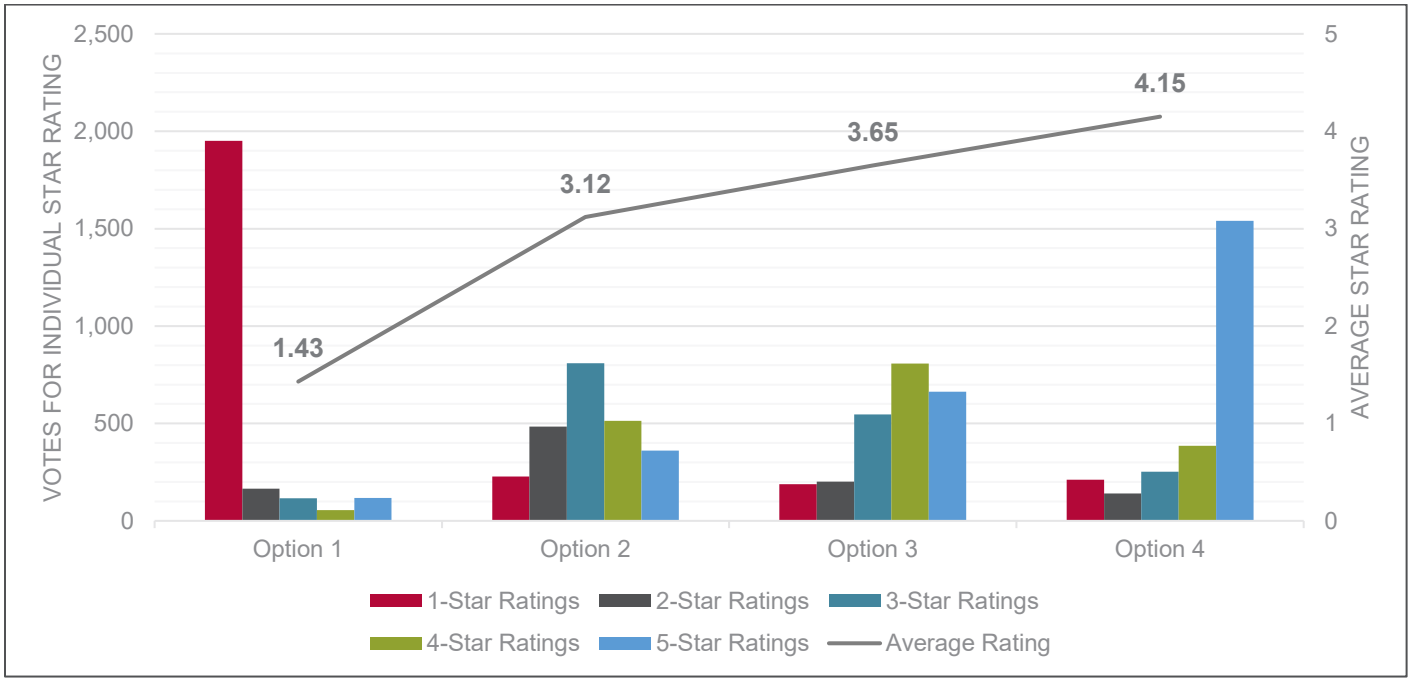
The survey also asked participants to rate four options from one (least desirable) to five (most desirable) stars and allowed the participants to provide open comments on the options. Since the three Build packages had several common

improvements, the survey focused on the major interchange improvements that differed across the Build packages as follows:

- Option 1: No-Build
- Option 2: The partial cloverleaf interchange at US 250 in Build Package 1
- Option 3: The diverging diamond interchange at N Gayton Road in Build Package 2
- Option 4: Both interchange improvements in Build Package 3

Figure 138 summarizes the number of ratings given for each option and the average star rating. The combined interchange improvements in Build Package 3 (Option 4) received the highest average rating. Approximately one half of a rating point separated both the top (Build Package 3) and second (Build Package 2) options and the second and third (Build Package 1) options. Participants submitted more than 300 comments specific to the Build packages and more than 1,100 general comments. All comments from the survey are compiled in *Appendix I*.

Figure 138: Public Survey Ratings for Build Options



MATRIX

The study team prepared an alternatives comparison matrix to evaluate differences between the three Build packages using the following criteria and weights. The bicycle and pedestrian accommodation category was not given a weight and instead was treated as a checkbox item to indicate if bicyclists and pedestrians can be accommodated with all proposed improvements. This same approach applies for the ability to meet the Purpose and Need of the project.

- Right-of-way (RW) and utility impacts (weight = 1)
- Safety impacts (weight = 2)
- Operational impacts (weight = 2)
- Bicycle and pedestrian accommodation (no weight)
- Meets Purpose and Need (no weight)
- Environmental impacts (weight = 1)
- Preliminary cost of construction (weight = 1)

The concepts were then ranked relative to each other based on total score. *Table 46* documents the weighted scores given in each category for the No-Build scenario and three Build packages. The complete matrix that summarizes the score by criteria, criteria weight, and cumulative scores and ranks is provided in *Appendix H*. Build Package 3 scored the highest and was advanced to discussions on phasing as the preferred alternative. Build Package 3 was also the highest-rated option in the online public survey as documented in the *Public Involvement* section.

Table 46: Build Package Simplified Matrix

Alternative	R/W and Utility Impacts	Safety	Operations	Bicycle & Pedestrian	Meets Purpose and Need	Environmental	Cost of Construction	Total	Rank
No-Build	5	2	2			5	5	19	4
1	3	8	6	✓	✓	3	3	23	2
2	2	6	8	✓	✓	2	4	22	3
3	2	10	10	✓	✓	2	1	25	1

Category Score	Description for Safety Improvements and Operational Improvements	Descriptions for R/W and Utility Impacts, Environmental Impacts, and Cost of Construction
5	Positive effect or best alternative	Generally no change from No-Build conditions
4	Moderate improvement from No-Build conditions	Minimal impact from No-Build conditions
3	Mild improvement from No-Build conditions	Mild impact from No-Build conditions
2	Minimal improvement from No-Build conditions	Moderate impact from No-Build conditions
1	Generally no change from No-Build conditions	Negative effect or worst alternative

IMPROVEMENT PHASING

To best address the needs in the study area, all seven improvements included in Build Package 3, which was selected as the preferred alternative, should be constructed by 2046 to meet the safety and operational needs identified for the design year. The study team developed a phasing plan to determine the recommended order of construction for the seven improvements. The goal of the phasing plan was to verify that each proposed phase of improvements is projected to improve operations and safety throughout the network compared to the No-Build scenario, while prioritizing improvements that would more effectively facilitate the maintenance of traffic during construction of subsequent improvements, and for which local or regional funding for design and construction could be expected to be reasonably available. The phasing plan was informed based on the results of the No-Build conditions analyses, the alternatives screening analyses, and the Build conditions analyses for each of the Build packages.

Since the Build conditions analysis did not summarize operational or safety results for individual improvements within a given Build package, the study team did not recommend dividing the project into phases where an individual improvement would be constructed before others that it is paired with in that Build package. This approach was taken so that the conclusions made in the *Build Package Operational Comparison*, *Safety Conclusions*, and *Selection of Preferred Alternative* sections could justify that the phasing of the recommended first Build package is projected to improve operations and safety throughout the network when compared to the No-Build scenario. Since all Build packages were rated higher than the No-Build scenario for both operations and safety, the study team concluded that any Build package could be phased before others to see an overall benefit for the study area network.

While all Build packages are projected to improve operations for the study area network, the study team recommends that all improvements in Build Package 1 are not constructed prior to the new interchange at N Gayton Road to avoid localized degradation on US 250. If the bottleneck on northbound Route 288 is released with the construction of the northbound Route 288 auxiliary lane and the improvements at the Route 288 interchange with US 250, the additional vehicles reaching US 250 are projected to create a new bottleneck on eastbound US 250. The new bottleneck is projected to result in a significant increase in travel time from the No-Build scenario on eastbound US 250 and a slight increase in travel time on westbound US 250 during the PM peak hour as documented in the *Build Package Operational Comparison* section for Build Package 1. Build Packages 2 and 3 were not projected to experience an increase in travel time on US 250 since the new interchange at N Gayton Road was projected to reduce traffic volumes on US 250. While the increase in travel time in Build Package 1 is not attributed to the partial cloverleaf interchange, the study team recommends that the improvements to northbound Route 288 should not be phased before the new interchange at N Gayton Road to prevent any degradation in travel time on US 250.

Additionally, the new interchange at N Gayton Road and other improvements included in Build Package 2, if phased first, are projected to alleviate the negative impacts of construction of the partial cloverleaf at the US 250 interchange on study area traffic. These improvements are projected to more effectively facilitate the maintenance of traffic in the following ways:

- The AM and PM peak hour volumes are projected to decrease from the No-Build scenario on the following ramps that will be modified due to the new access point to the Short Pump area. The reduced demand on the ramps during construction will allow for a safer work zone, shorter construction duration, and improved work zone operations.
  - Westbound I-64 on-ramp from eastbound US 250 (AM peak hour only)
  - Westbound I-64 off-ramp to westbound US 250
  - Westbound I-64 on-ramp from westbound US 250
  - Eastbound I-64 on-ramp from US 250

- The AM and PM peak hour volumes are projected to increase on the eastbound I-64 off-ramp to eastbound US 250. However, all vehicles making this movement will have the option to exit I-64 via the new interchange at N Gayton Road during the construction of the new bridges on I-64. This projected reduction in demand will allow for a safer work zone, shorter construction duration, and improved work zone operations.
    - While the AM and PM peak hour volumes on eastbound US 250 approaching the interchange are projected to increase during the construction of the I-64 bridges, the volumes are projected to decrease from the No-Build scenario once the I-64 bridges are completed. Since the proposed improvements on US 250 are likely to be constructed after the new bridges on I-64 and involve a reduction in travel lanes during construction, this reduced demand on eastbound US 250 approaching the interchange will allow for a safer work zone, shorter construction duration, and improved work zone operations.

Considering that the improvements in Build Package 2 are projected to improve safety and operations within the study area network and that the improvements are projected to facilitate easier maintenance of traffic during construction of subsequent improvements – and that the funding for the anticipated construction costs of Build Package 2 is anticipated to be more readily available by the localities compared with the funding required for the larger costs of Build Package 1 – the study team recommends that all elements in Build Package 2 are constructed in the first phase. The recommended phasing is summarized in *Table 47*. Since some improvements included in Phase 1 were recommended and approved in prior studies, these improvements may be removed from Phase 1 if the improvement is funded separately provided that construction of the individual improvement is completed prior to the construction of the remaining elements in Phase 1. Additionally, coordination of the improvements recommended in this study with any other improvements recommended as part of other studies can be accomplished during the NEPA or preliminary engineering phases.

Table 47: Recommended Improvement Phasing

Phase	Improvements Included
1	Construct auxiliary lane on southbound Route 288
	Construct a new diverging diamond interchange at N Gayton Road
	Construct an auxiliary lane on northbound Route 288. Construct improvements to ramp terminals at US 250 interchange with Route 288.
	Construct improvements at intersection of US 250 and Tom Leonard Drive
	Implement turning restriction at Dominion Boulevard
	Convert the westbound I-64 off-ramp to I-295 to two lanes and construct a continuous auxiliary lane on I-295 between I-64 and Nuckols Road
2	Construct a partial cloverleaf interchange with contraflow left-turn lanes at I-64 interchange with US 250.