Appendix I
2030 AM Westbound Merge Mitigation Analysis

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2030 AM Westbound Merge Mitigation Analysis

1. Introduction

The Vissim analysis for the 2030 AM period with the 2030 Year of Opening indicates that there will be LOS F operations at the merge of the Long Point Road westbound on-ramp (two lanes) with the I-526 westbound mainline (two lanes). This is despite the merge operating at an acceptable LOS D in the 2050 AM analysis of the Preferred Alternative.

By 2050, it is assumed that I-526 will be widened through the project section. The assumed I-526 widening includes a four-lane Wando River Bridge and a three-lane section on I-526 east of Long Point Road on-ramps.

The key reasons for the poor operations estimated in 2030 are:

- The bottleneck point in 2030 and 2050 is the segment just beyond the merge of the ramps.
  - In 2030, the two-lane freeway segment has a demand of 4,105 vph, which exceeds the maximum capacity of a two-lane freeway. This bottleneck results in LOS E on the two-lane freeway segment (Link C.3) and LOS F on the final merge section from 3 to 2 lanes (Link C.4). Travel speeds fall to 18.5 mph through this section of I-526.
  - In 2050, the widening of I-526 results in a minimum 3 lane freeway segment that serves a demand of 5,638 vph. The three-lane freeway segment (Link C.3) operates at LOS D with an average speed of 53.5 mph. Since the bottleneck segment is just under maximum capacity, no queuing or other operational issues affect the upstream links. This analysis confirms the selection of Alternative 2 as the preferred alternative.

Based upon the analysis of the 2030 Westbound AM peak analysis and the LOS F operations on I-526, an evaluation of other options for the interim time periods were examined. The purpose of this analysis was to identify whether there were any alternate laneage treatments that could provide improved operations on I-526 prior to a future widening of I-526.

This analysis is also intended to assist in addressing potential alternative technical concepts that may be proposed by a Design Build contractor.

2. Traffic Demand and Operations

A key element in comparing alternatives is understanding the future traffic volumes from the two ramps merging onto I-526 westbound, i.e., the ramp from Long Point Road and the flyover ramp from the port access road.

2.1 Ramp from Long Point Road

The ramp from Long Point Road serves a higher volume and is planned as a two-lane merge with I-526 westbound. It combines traffic from both the ramp from Long Point Road southbound and the loop from Long Point Road northbound. In the AM peak, the demand volume is estimated as 1,875 vph in 2030 and 2,576 vph in 2050 (an increase of 37 percent in 20 years). The truck percentage is under 2 percent.

Looking at a typical weekday, the traffic from Long Point Road follows a more typical urban commuter type pattern with a distinct AM and PM peak.

2.2 Ramp from the Port Access Road

The primary effect of providing an alternate port access ramp is to divert heavy trucks from Long Point Road to the port access road and provide a separate merge for those vehicles onto I-526 westbound. Separating truck volumes from local automobile traffic, and reducing the conflicts between these traffic sources, is identified as the second purpose and need element for the project.

The ramp from Port Access Road has an anticipated demand of 392 vph in 2030 and 765 vph in 2050 (an increase of 95 percent in 20 years). The truck percentage remains relatively constant from 2030 to 2050 at more than 90 percent.

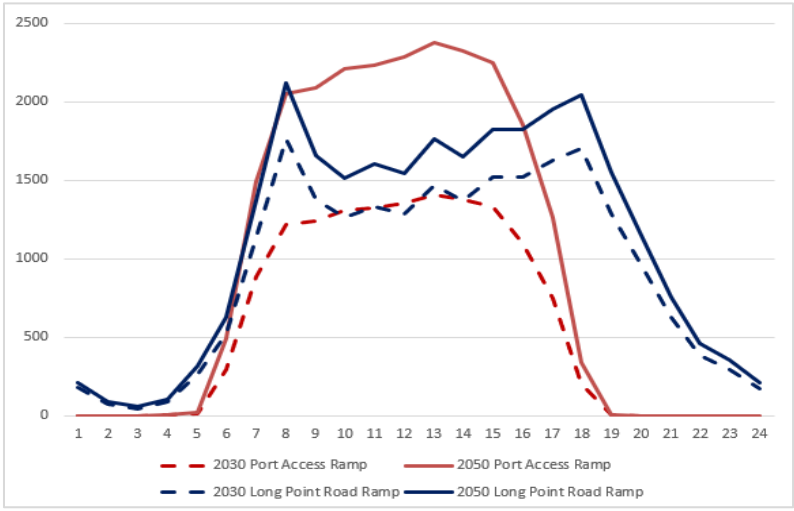
Utilizing HCS methodology, these heavy trucks are equivalent to approximately 3 passenger cars particularly given that the merge begins a 4 percent upgrade onto I-526 for the Wando River Bridge. Assuming 90 percent trucks, the equivalent volumes are approximately 1,100 vph in 2030 and 2,140 vph in 2050.

The traffic from the Wando Port Terminal has a much different daily pattern of flow based on the opening of the port to trucks at approximately 6:00 AM and closing to incoming trucks at 4:00 PM. Instead of having two single peaks during the day, port-oriented truck trips are relatively constant throughout the day, between 8:00 AM to 5:00 PM in the outgoing direction.

To better understand the flow differences throughout the day, **Figure 1** was developed to illustrate daily flows from the Long Point Road ramp (shown in blue) and the port access ramp (shown in red with passenger car equivalents) on both 2030 (shown in dashed lines) and 2050 (shown in solid lines). Key observations include:

- In 2030, the Long Point Road ramp has higher AM and PM peak with similar volumes to the port access ramp throughout the day.
- By 2050, however, the port access ramps increase substantially in the AM peak (to approximately the same as the Long Point Road ramp) and remain higher throughout the day.
- It should be noted that the PM peak analysis is based upon the current operational schedule at the port. The Wando Port Terminal currently has no plans to change these hours, but a change in policy could occur over the next 30 years. Nevertheless, the westbound flow would still be critical in the AM peak.

Figure 1: Comparison of 24-hour Ramp Volumes (pcph)



2.3 Design Impacts of Traffic Flow

The differences in traffic flow were key in selecting Alternative 2 and developing the merge layouts. As a result of the Vissim analysis, the following features were included in the Preferred Alternative:

- The Long Point Road westbound on-ramp will require dual lanes to process traffic in 2050.
- To keep the westbound access points at Long Point Road the same in the future, the single lane loop ramp in the northeast quadrant will merge with the dual lane higher volume ramp in the northeast quadrant before merging with I-526.
- The proposed port access ramp requires a single lane merge onto I-526. Due to the high percentage of trucks (over 90 percent) and due to the truck climbing lane on the Wando River Bridge, merge options that limit trucks merging into mainline truck were selected to minimize truck and auto conflicts as well as provide direct access from the port access ramp into the truck climbing lanes on the Wando River Bridge.

3. BASELINE PREFERRED ALTERNATIVE: 2030 VERSUS 2050

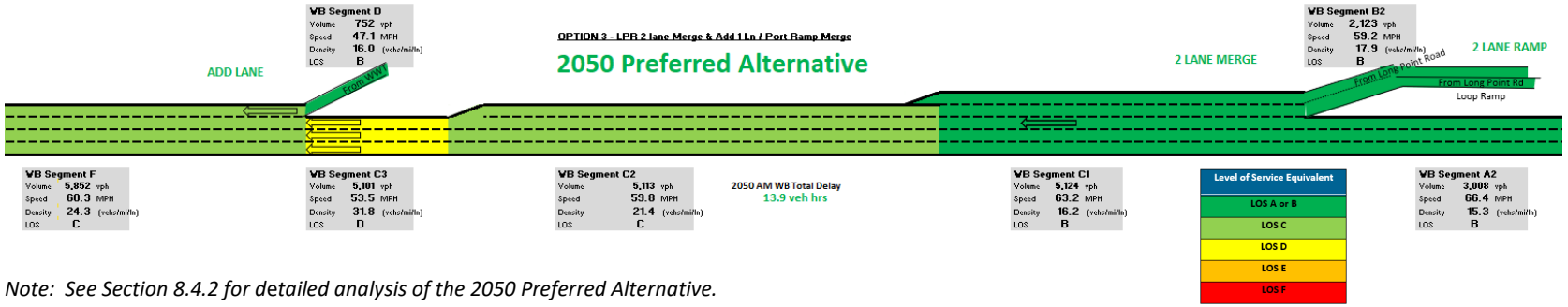
3.1 2050 PREFERRED ALTERNATIVE

Based on the alternative analysis and design refinements documented in Section 7.1 of the IAR, the preferred Option has four major roadway components that affect I-526 westbound traffic operations:

- Widening of I-526 by one lane resulting in three lanes on I-526 under the Long Point Road bridge is assumed by 2050 as part of a separate project. This includes widening of the Wando River Bridge to a future four-lane section with three mainline lanes and a truck lane.
- Conversion of the shoulder on the Wando River Bridge to connect directly to the port access ramp will minimize the need to merge into mainline flow and then merge right to access truck acceleration lane. The opening of the third westbound lane of the existing bridge is required to serve both 2030 and 2050 volumes and is proposed as part of the initial project opening (albeit as part of a separate project).
- The two-lane Long Point Road westbound on-ramp merges both lanes into three I-526 lanes. The bottleneck in the 2050 analysis is the three-lane section just beyond the merge, which is forecast to operate at LOS D in the future. Options which merged one lane and added one lane were examined but not selected primarily due to the resulting need to merge trucks into the mainline at the port access road ramp.
- The one lane ramp from the port access road adds a fourth lane to I-526 and feeds directly onto a widened Wando River Bridge. In addition to reducing trucks merging directly into the adjacent lane, this lane feeds directly into the truck acceleration lane.

For comparison with the 2030 scenarios, **Figure 2** provides an illustration of the proposed laneage and LOS operations in the 2050 AM peak.

Figure 2. 2050 Preferred Alternative – Westbound AM Peak



Note: See Section 8.4.2 for detailed analysis of the 2050 Preferred Alternative.

3.2 2030 Baseline Preferred Alternative - Westbound AM Peak

The starting point for this analysis is an examination of the 2030 Preferred Alternative. As noted, the only difference from the ultimate Preferred Alternative is that I-526 will not be widened prior to the future widening of I-526 as identified in I-526 Lowcountry Corridor East Planning & Environmental Linkages (PEL) document that identified improvements to the Long Point Road interchange as an interim improvement that could be implemented prior to the future I-526 widening.

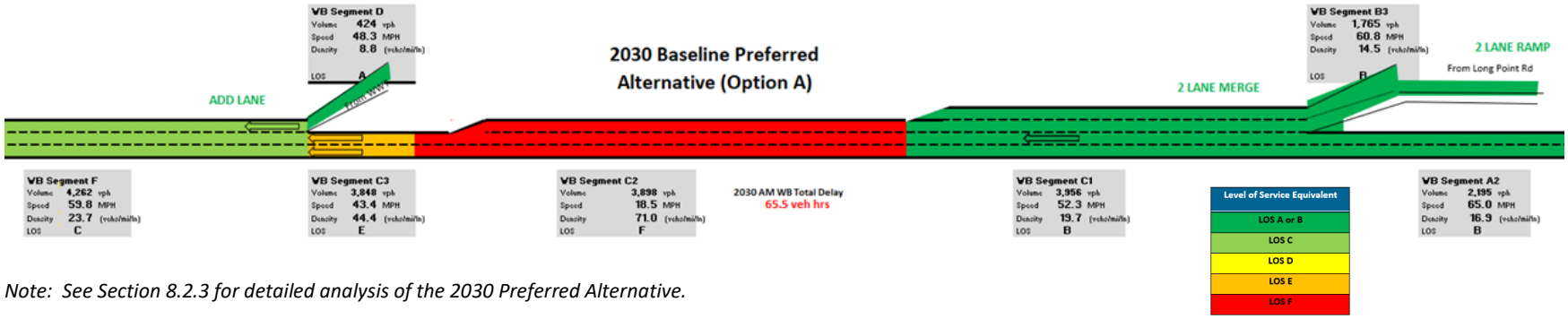
As shown from Table 8.8 in Section 8.2.3 of the IAR document, Links C.2 and C.3 at the end of the Long Point Road westbound on ramp merge operate at LOS E and LOS F respectively with speeds reduced to under 20 mph on I-526. Using these assumptions, the 2030 Preferred Alternative baseline scenario (Option A in this Appendix analysis) is shown graphically in **Figure 3**.

In the westbound direction key observations for the 2030 Build Alternative scenario are:

- Option A has capacity issues on I-526 at the three-lane merge section after the Long Point Road merge (Segment C.2) with LOS F with a speed below 20 mph on I-526.
- The key bottleneck in the system, however, is the subsequent two-lane section before the port ramp merge (Segment C.3). On this two-lane segment, the LOS improves slightly to LOS E and speed increase to near 45 mph due to traffic metering at the bottleneck.

Based on these findings, this analysis is conducted to identify if there is a preferred lane layout that could provide better traffic operations on I-526 in 2030 and be reasonably adjusted as part of the future widening of I-526 which would fully implement the Preferred Alternative.

Figure 3: 2030 Preferred Alternative (Option A) in 2030 AM Peak



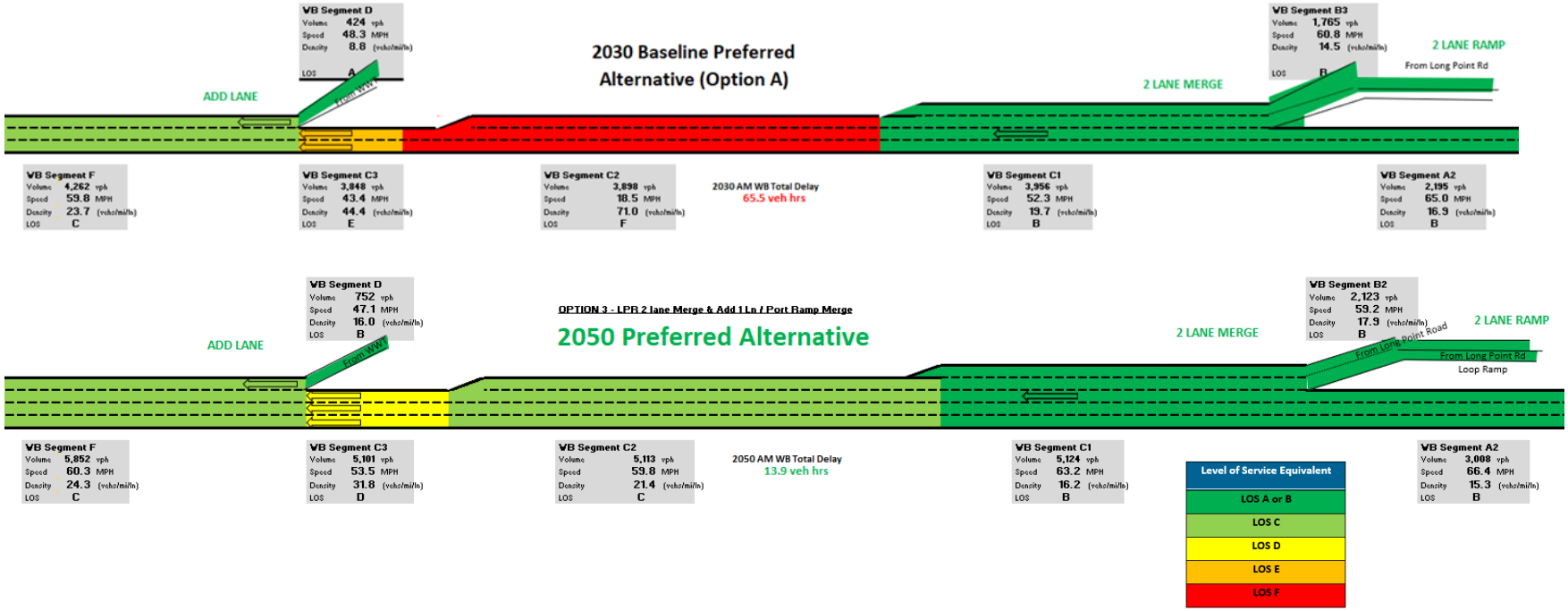
Note: See Section 8.2.3 for detailed analysis of the 2030 Preferred Alternative.

3.3 Comparison of 2030 Preferred Alternative (Option A) to the 2050 Preferred Alternative

To compare the 2030 and 2050 operations with the Preferred Alternative, **Figure 4** provides a visual comparison of both scenarios. The key findings when comparing Figure 3 (2030 Option A Preferred Alternative Baseline) and Figure 2 (2050 Preferred Alternative) are:

- As noted, the primary difference between the 2030 and 2050 scenarios is an additional westbound lane on I-526. When I-526 is widened with an additional lane, Alternative 2 operations would improve to LOS D or better in the bottleneck section. The speed on I-526 in the bottleneck is shown as 53.3 mph which is reflective of the LOS D operations. No spillback queuing is anticipated in 2050.
- In 2030, the existing I-526 has only two through lanes. By 2030, the two-lane freeway capacity will be exceeded with a bottleneck occurring at the end of the two-lane merge from Long Point Road. The LOS E and F operations occur despite lower volumes in 2030. The speed on I-526 in the bottleneck is shown as 18.5 mph through the LOS F section, substantially lower than the posted speed.
- In both scenarios, truck traffic from the port is able to bypass the bottleneck sections and have an add lane instead of a merge onto I-526.

Figure 4: Comparison of 2030 Option A with 2050 Preferred Alternative



4. Comparison of 2030 Mitigation Options

The following analysis examines four options for the laneage treatments on I-526 at the merges for Long Point Road and the port access ramp. In all cases, these options represent interim solutions only. The 2050 Preferred Alternative remains unchanged in all cases.

Note that instead of providing multiple detailed tables and data, the capacity results for the examined options have been converted to a graphic format similar to what was implemented in the colored corridor maps shown in Section 4.5. To facilitate comparisons between options, the 2030 Baseline Preferred Alternative (Option A) is repeated in this discussion.

The scenarios examined for 2030 include:

- No Build
- Baseline Preferred Alternative (Option A) –Two lane merge for Long Point Road Ramp and add 1 lane at port access ramp
- Mitigation Option B – Preferred Alternative with Long Point Road ramp reduced to one lane to meter traffic
- Mitigation Option C – Adjust Preferred Alternative to add 1 lane at Long Point Road ramp and require merge for port access ramp
- Mitigation Option D – Provide an interim left lane drop/merge of I-526 mainline to allow add 1 lane at Long Point Road ramp (similar to Option C) and add 1 lane at port access ramp (similar to Option A)

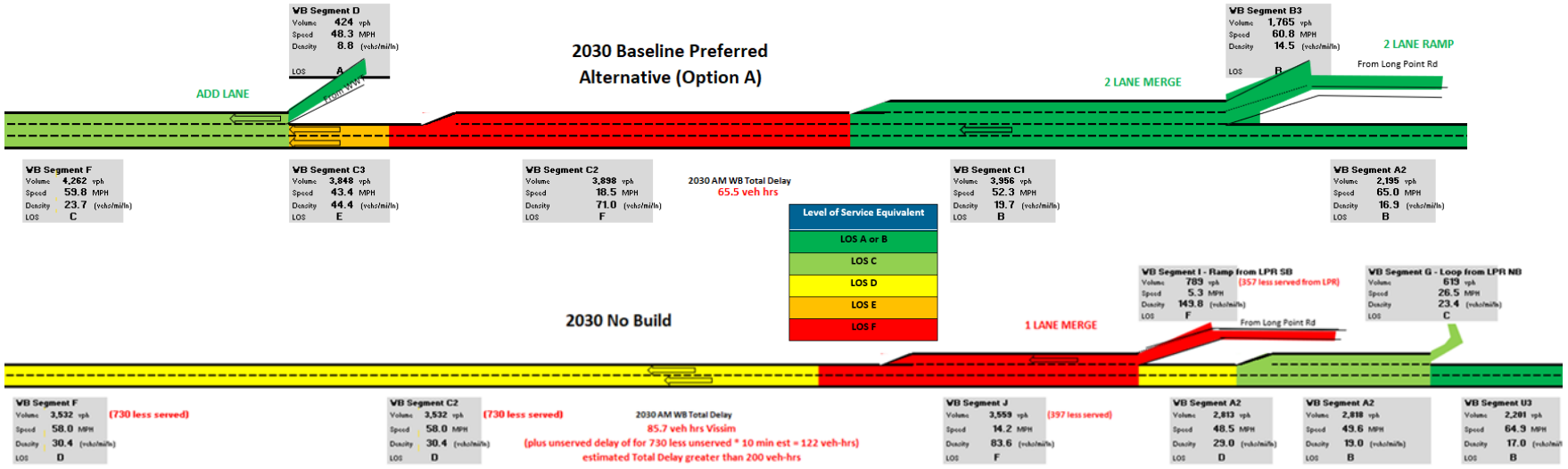
4.1 Comparison of 2030 No Build with Option A

The initial comparison undertaken is a comparison of the 2030 Preferred Alternative (Option A) with the No Build in 2030. This comparison is focused on verifying that the Preferred Alternative functions better than the No Build in the initial 2030 scenario. This is critical as the purpose and need calls for reductions in delay as compared with the No Build. The No Build scenario analysis was initially examined in Section 8.1.2 with analysis results in Table 8.3. The two options are compared in **Figure 5**.

Based on this comparison, Preferred Alternative (Option A) functions better than the No Build in 2030. Key operational comparisons include:

- The bottleneck section for both options occurs at the two-lane section of I-526 with the merge section just upstream operating at LOS F. With Option A, the merge has a density of 71.0 veh/mi/ln and a speed of 18.5 mph. With the No Build, the LOS F is more congested with a density of 83.6 veh/mi/ln and a speed of 14.2 mph.
- The No Build simulation is unable to serve 730 vph fewer than Option A in the peak hour. These "unserved" vehicles encounter severe delays due to queuing or seeking alternate routes.
- The total delay for Option A is 65.5 vehicle hours. For the No Build, the model links summarized in this analysis indicates total delay is 85.7 vehicle hours, not including delays for the 730 unserved vehicles. Conservatively adjusting to assume 10 minutes per unserved vehicle, a total of more than 200 vehicle hours of delay is anticipated for the 2030 No Build.

Figure 5: Comparison of 2030 Preferred Alternative with 2030 No Build

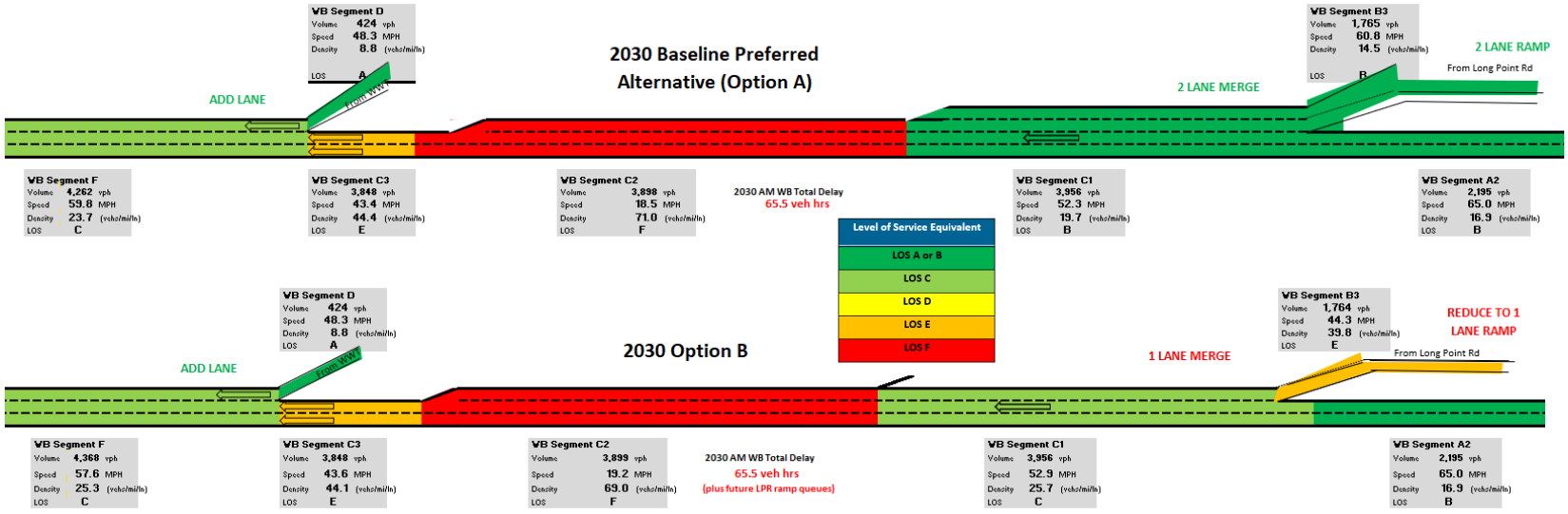


4.2 Comparison of Option A with Mitigation Option B: One Lane Ramp from Long Point Road

Option B was evaluated for the potential to reduce volumes reaching I-526 by reducing the two-lane merge from Long Point Road to a single lane merging onto I-526. Overall delays would increase, but it was tested whether a physical capacity constraint on the ramp itself could shift delays and queuing from I-526, thereby prioritizing I-526 flows over the local roads, particularly Long Point Road. The comparison of the alternatives is shown in **Figure 6**.

The model results, however, are almost identical between the two options in 2030. The one lane ramp with Option B operates at LOS E which, although congested, still services a similar demand volume to the Option A. It was concluded that physical metering of the Long Point Road ramp would be an ineffective solution to the high merge volumes. It should be noted that ramp metering may be a viable option at this location but is not currently being analyzed or proposed. Nevertheless, the Option A Preferred Alternative could be restriped to utilize ramp metering if fully examined and evaluated at a future date.

Figure 6: Comparison of 2030 Preferred Alternative (Option A) with 2030 Option B



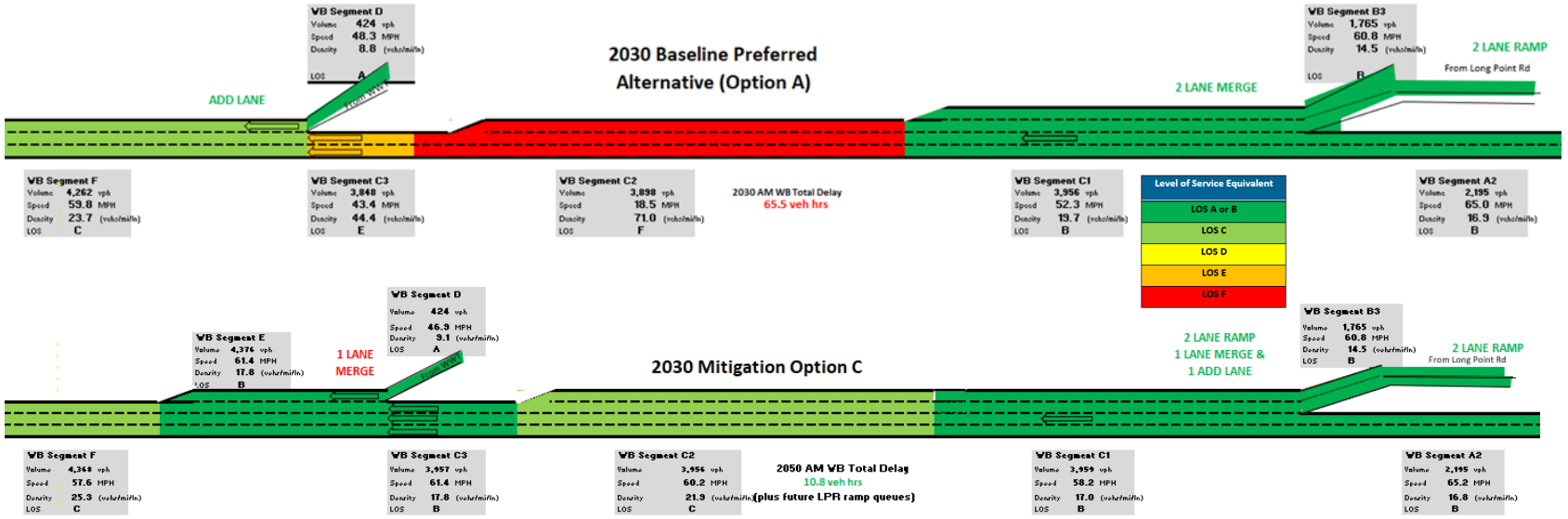
4.3 Comparison of Option A with Mitigation Option C: Add Lane at LPR Ramp Merge and Merge at Port Access Ramp

As documented in Section 7.1.3 of the IAR and summarized in Table 7.11, an analysis of the 2050 volumes was conducted for the Alternative 2 Preferred Alternative to identify the preferred merging pattern through the I-526 westbound merge area. In the prior analysis, two key needs were identified: (1) adding a lane at the port access road ramp minimized truck merge conflicts and was preferable to a merge, and (2) a two-lane ramp was needed to serve the Long Point Road ramp demand. The evaluation of options for merging onto I-526 westbound ultimately resulted in refinements of merge lengths and selection of Option 4A. Option 4A is now defined as the Preferred Alternative layout (Option A in the current 2030 analysis.)

A key finding of the analysis was by 2050, the Long Point Road ramp merge carried slightly higher volumes in the AM peak than the port access ramp, but a very high percentage of trucks. As explained in Figure 1, the 2050 scenario has higher port access ramp volumes throughout the day than Long Point Road. In contrast, in 2030 the Long Point Road merge carries higher volumes in the AM peak and approximately the same volumes throughout the day as the port access ramp. (Note: This analysis is based upon assuming a truck equivalency factor of 3 passenger vehicles per truck). For this reason, Option C was developed to test 2030 volumes.

The primary difference in Option C from Option A is that Option B merges only one of the two Long Point Road ramp lanes and adds a westbound lane at the merge. As a result, Option C requires trucks on the port access ramp to merge into I-526 traffic before the Wando River Bridge section. It was anticipated that this option would provide improved LOS on I-526 but would result in an increase in truck conflicts in 2030. A comparison of Option A (merge two lanes at Long Point Road ramps and add a lane at the port access ramp) versus Option C (merge one lane and add one lane at the Long Point Road ramp merge area and create a one lane merge area at the tie in of the port access ramp). **Figure 7** provides a graphic comparison of the merge options.

Figure 7: Comparison of 2030 Preferred Alternative (Option A) with 2030 Option C



Based on this comparison, the Option C configuration provides better interim LOS operations in 2030 during the 2030 AM peak. Key operational differences as well as truck conflict issues include:

Traffic Operations

- The bottleneck section for both options occurs at the end of the Long Point Road merge.
  - In Option A, the I-526 bottleneck is two lanes, with the merge section just upstream operating at LOS F. With Option A, the merge has a density of 71.0 veh/mi/ln and a speed of 18.5 mph.
  - With Option C, the I-526 bottleneck is three lanes. As a result, operations on I-526 westbound reflect LOS C conditions with a speed of 58.2 mph in the merge section.
- The total delay for Option A is 65.5 veh hrs. In comparison, Option C has a total delay of 10.8 veh hours in 2030. This is approximately 1 minute per vehicle for Option A and 10 seconds per vehicle for Option C during a 2030 AM peak hour.

Truck Conflicts

- Option A allows for an add-lane section at the port access ramp connection with I-526 westbound. In contrast, Option B requires the predominantly truck traffic at the to merge into I-526 at the port access ramp. The add lane option is strongly preferred based on the project purpose and need that includes a reduction in conflicts between port related trucks and general-purpose traffic.
- Based on the issues illustrated above, it was unclear as to a preferred interim layout for the project as to whether operational LOS or the reduction of truck conflicts should carry greater weight. Option A provides for better reduction in truck conflicts and is more consistent with the ultimate Preferred Alternative. Option C provides improved LOS operations on I-526 with LOS C (compared with LOS E and F with Option A).

Constructability

- In reviewing Option C, concerns were raised by SCDOT and the design team regarding the future constructability and compatibility of Option C with the planned future widening of I-526. All mainline widening concepts developed during the PEL study involved add an additional through lane to the inside in the EB direction.
  - For Option C, the 2030 bottleneck section would be constructed as three lanes. Simply widening to the median in the future would result in a four lane bottleneck and issues further west adding a lane for the port access ramp. After considering options shifting lanes or widening to the median, the likely solution would be to construct the I-526 widening to the median.
  - The Long Point Road would need changed from an add plus merge to a dual lane merge. This would require removing the outside most section of pavement to reduce the bottleneck to 3 lanes.
  - Although this introduces additional construction expenses, it is a feasible approach to transitioning from the 2030 Option C laneage to meet the Preferred Alternative requirements in 2050.

4.4 Comparison of Option A with Mitigation Option D: Create 3 Lane I-526 Section at Bottleneck and Drop Left Lane from I-526 before Wando River Bridge

A review of Option C led to consideration of methods to provide an alternative that can (1) provide a three lane I-526 westbound segment at the bottleneck merge for the Long Point Road ramp combined with providing a free flow add lane from the port access road ramp onto I-526 westbound. The key challenge is that both Long Point Road and the port access ramp must merge in on the right side despite having higher volumes and high truck volumes that the I-526 mainline as it enters into the westbound merge areas.

The 2050 Preferred Alternative analysis of the westbound merge treatment in Section 7.1.3 involved the analysis of multiple options before Option 4A was selected and identified for the Preferred Alternative. In that analysis, the same dilemma was recognized, and the possibility of a lane drop of the leftmost I-526 lane was not pursued as it was not desired for the ultimate Preferred Alternative layout. There are multiple valid concerns with left lane drops (even with adequate merge distances), but they have been used in isolated examples on the Interstate, often in instances where a freeway widening to the median is part of a corridor wide long-term improvement, but project limits and funding require an interim tie in.

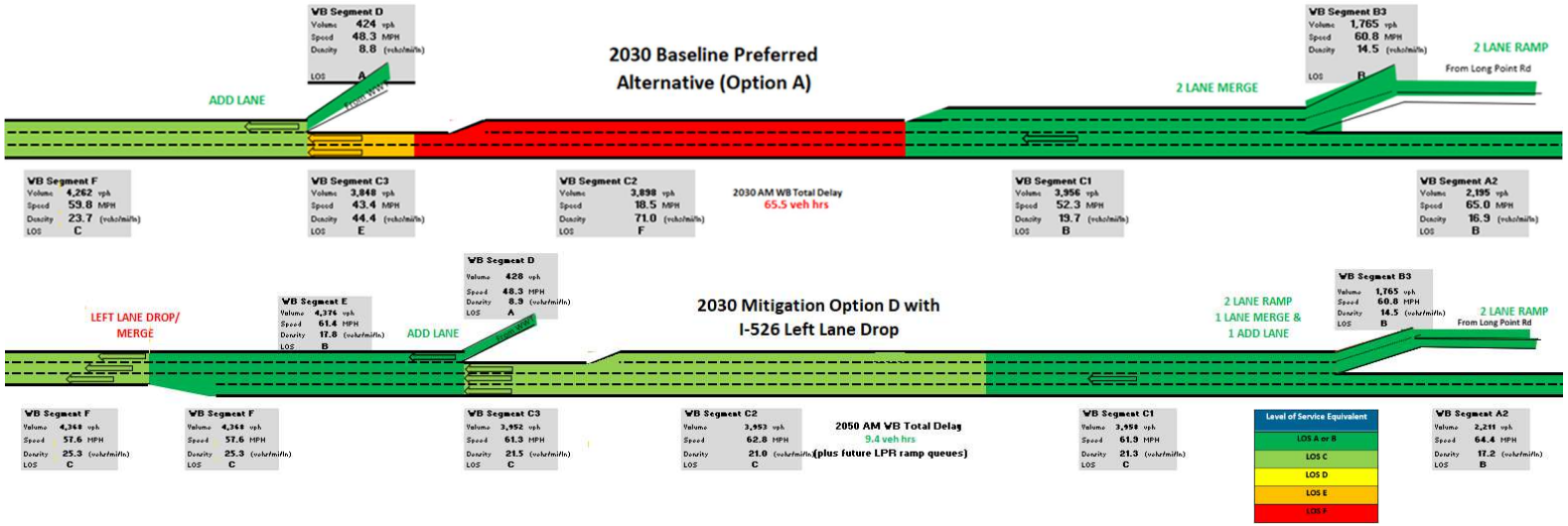
Since the 2030 operational issues with Option A are to be addressed at a future date as part of the widening program identified in the PEL, the 2030 congestion and operation issues similarly represent an interim condition that will be improved in the future. Therefore, a left lane drop/merge was examined as a potential interim layout for the 2030 year of opening. If pursued, this treatment would require SCDOT and FHWA approvals.

Recognizing those limitations, a Vissim analysis was conducted with a left side lane drop/merge from westbound I-526. The analysis was conducted to determine whether an interim lane layout could be developed that provided improved operations on I-526 westbound (similar to Option C) combined with an add lane treatment at the port access ramp.

Figure 8 provides a graphic comparison of operations with the Option A Preferred Alternative compared with a new Option D for the interim 2030 year of opening analysis.

As shown in Figure 8, Option D provides LOS C traffic operations (similar to Option C) combined with an add lane from the port access ramp without a truck merge (similar to Option A). To implement this solution, however, requires an extension of three I-526 lanes through the bottleneck (Segment C3).

Figure 8: Comparison of 2030 Preferred Alternative (Option A) with 2030 Option D (with I-526 Left Lane Drop)



Multiple issues need to be considered with Option D:

Traffic Operations

- Based on the Vissim analysis, I-526 westbound and ramps merging onto I-526 all operate at LOS C or better in the 2030 AM peak.
- Overall delay under Option B for the westbound merges is 9.4 vehicle hours, the least delay of the 4 options tested.

Driver Expectancy and Left Merge

- When reducing lanes on a freeway, the preferred treatment is to do this outside the limits of an interchange. In this case, it is necessary to begin the end of the lane within the interchange area in order to get back to a three-lane section of the Wando River Bridge.
- The preferred treatment for dropping a freeway lane is to merge traffic from the rightmost lane with merging occurring to the left.

Truck Conflicts

- Option D is effective in reducing truck conflicts at the connection between I-526 and the port access ramp since the heavy truck volumes are directed into their own lane without need to merge.

Design Issues

- The SCDOT Roadway Design Manual (Chapter 17, Figure 17.5-A) calls for 2,500-foot spacing from the end of the previous merge before starting an 840-foot drop lane taper.
- From the point where the port access ramp adds a lane to I-526, there is 1,500 feet to the tributary bridge (the western limit of the interim improvement). This is inadequate using the 3,340 feet cited in the SCDOT Roadway Design Manual. Options would be:
  - Begin signing the 2,500-foot approach to the left lane merge/ drop 1800 feet upstream of the port access ramp tie in point. After the tie in point there would be 660 feet of approach followed by the 840-foot merge dropping the leftmost lane.
  - Shift the port access tie in further east could be done in the interim to provide additional distance. It is not recommended, because it would need shifted back to the current location for the future I-526 widening in the future.
  - A design exception would need approved to allow for a reduced approach length to the final lane drop from I-526.
- From the point where the port access ramp adds a lane to I-526 there is 3,000 feet to the beginning of the Wando River Bridge. This would allow for a 2,160-foot approach (slightly less than the 2,500-foot standard) followed by the 840-foot merge to drop the lane.
  - This option introduces multiple additional issues including an extension of the western limits requiring additional analysis and impact reviews. In addition, construction costs would increase with an additional 1,500 feet of widening on I-526 westbound.

Signing Issues

- Signing is a key reason for the 2,500-foot requirement after the previous merge. That said, since Option D proposes closing off the left most lane, the previous ramp merge is on the right side, and there is no physical merge from the ramp (i.e., an add-lane), it may be possible to shift some of the signing for the left lane drop to before the add lane point from the port access road. This could effectively reduce the 2,500-foot requirement.
- If utilized, the signing plan in Section 9.2 of the IAR would need to be updated to account for the left lane drop. In this case, additional overhead signing would need to be integrated with interchange signing and require more detailed analysis.

Constructability

- Based on a conceptual review, Option D is the most challenging construction scheme for the initial construction. In addition, it will require the addition of more than one mile of widening into the median in the initial construction. Immediately after the two lane Long Point Road ramp connects with two I-526 mainline lanes, the four lanes (two I-526 mainline lanes and two Long Point Road ramp lanes) would be shifted 12 feet to the left while one lane from the Long Point Road ramp would be similarly shifted 12 feet to the left into the existing rightmost lane on I-26. The rightmost lane would be merged leaving a three-lane bottleneck section. Once the port access ramp is added to I-526, the left most lane will be tapered as a left lane drop.
- In the future widening, all widening would be to the median. In the area where an additional lane was already placed in the median, it likely will be necessary to reconstruct some or all of the widened pavement sections. At the west end near the Wando River Bridge, widening to the median lane is required from the interim I-526 left lane drop to a widened bridge section.

4.5 Summary Comparison of All Options for 2030 Westbound Merge Area

Sections 4.1 through 4.4 each provide a comparison of 2030 operations with the Option A Preferred Alternative opening year construction. For each Option a review of key issues including the geometric features, traffic operations, truck operations related to the reduction of truck conflicts, and constructability were reviewed. **Table 1** provides a colorized comparison of how well each Option meets each of these key criteria. **Figure 9** provides a comparison of traffic operations on all four of the Options examined.

The colorization follows a similar concept as included in Table 7.1 from Section 7.1.3 of the IAR document. Each criterion is color coded assuming red is Very Poor, Orange is Negative, Yellow is Positive with some issue, and Green is Good. In showing red, it is recognized that although not typically acceptable, more detailed consideration is needed.

Note that red has been identified for all four options for at least one category. Red is shown for traffic operations in both Option A and Mitigation Option B due to inadequate laneage on I-526. Red is also identified for Option C under Constructability and Option D under both Geometrics and Constructability.

Color coding is somewhat different than the 2050 analysis, particularly for LOS E and F operations. These are shown as Orange or Red depending upon the overall level of delay. This reflects the corridor wide issue that until I-526 is widened, poor operations on I-526 will continue to worsen. Recognizing this, LOS E or F may be acceptable (although certainly not preferred) for the interim 2030 year of opening analysis.

Based on this comparison, the following key items are noted:

- As expected, the **No Build** operates poorly and is not being pursued. It is critical to note that all Options considered provide improved traffic operations and reduce truck conflicts as compared with the No Build.
- Overall, **Option A** does well in all criteria except Traffic Operations. This Option is bottlenecked as a result of a two-lane section on I-526 resulting in LOS F at the two-lane merge of Long Point Road with 18 mph anticipated on I-526. The option does provide the preferred add-lane treatment at the merge area of I-526 and the port access ramp.
- **Option B** was an attempt to reduce flows into the critical merge area by physically metering traffic from the Long Point Road ramp into a single lane. In 2030, however, the one lane ramp was not congested enough to regulate flow and still resulted in the LOS bottleneck on I-526 westbound. This option is not recommended for consideration, but it may be possible that signalized ramp metering could more effectively meter flows and minimize congestion. At this stage, however, ramp metering is not pursued as part of the current Long Point Road interchange project.
- **Option C** stands out by providing LOS C operations in 2030 for I-526 and all westbound merges in the study area. The Option C lane layout improves operation by providing three I-526 lanes instead of two I-526 lanes at the Option A bottleneck. To implement this, both merge types for the Long Point Road ramp (changing from two lane merge to one lane merge/one add lane) and the port access ramp (change from add lane to one lane merge) are changed to focus on congestion reduction instead of reducing truck conflicts at the port access merge. As part of the discussion of all the options, however, serious concerns were raised as to constructability issues related to the ultimate widening of I-526 and required transitions at the eastern end of the study area.
- **Option D** employs a non-standard left lane drop requiring the left most lane of I-526 to be merged into the center lane and dropped. In this instance, the treatment (1) allows for three I-526 lanes through the bottleneck section at the Long Point Road merge resulting in LOS C operations and simultaneously allows (2) for the port access ramp to have an add lane section directly onto I-526 without a merge. Option D provides a balance in meeting both aspects of the purpose and need while avoiding LOS F operations on I-526. Nevertheless, Option D would also require design exceptions involved with ramp spacing. Unless a design exception is granted, the drop lane section would need to extend an additional 1,500 foot west beyond the study limits to the Wando River Bridge with widening in the median and increased impacts. Constructability would also pose a challenge for the ultimate widening of I-526 including removal of pavement added for the Option D interim scenario.

Note that all the Build options considered have less than optimal issues affecting their effectiveness. Options A (the Preferred Alternative) and B both have traffic congestion issues in 2030 due to demand on I-526 exceeding capacity. Option C and D both meet the traffic goals, but Option C does not meet Truck Operations goals associated with the port access ramp merge, and Option D requires design exceptions related to spacing needs for dropping an Interstate mainline lane.

Table 1. Comparison of Merge Options for 2030 AM Westbound Merge Section

Key Comparisons	2030 No Build	Option A 2030 Preferred Alternative	Option B with One lane LPR Ramp Merge to Meter Traffic (Option B)	Option C with 1 Merge/1 Add at LPR Ramp and Merge at Port Access Ramp	Option D with I 526 Left Lane Drop/Merge
Geometrics (excluding need to widen to I-526 at later date)	No improvements to I 526 or Long Point Road interchange. Design deficiencies include 2 low speed loop ramps.	Full range of improvements including new port access ramps.	Full range of improvements except that Long Point Road ramp purposely restricted to one lane to meter traffic.	Full range of improvements including new port access ramps. Does require future revisions to convert merge from port access road to add-lane in future.	This alternative includes a drop of the left most I 526 lane west of the Long Point Road merge. SCDOT standards calling for a 2,500 ft distance from the port access road tie in is not possible since the lane would require widening of the Wando River Bridge to meet the 2,500 ft standard distance.
Critical Traffic Operations	LOS F operations on I 526 and multiple ramps with over 200 veh hrs of delay.	LOS F operations on I 526 with 65 hours of vehicle delay.	LOS F operations on I 526 with 65 hours of vehicle delay.	LOS C operations on I-526 with 10.8 vehicle hours of delay.	LOS C operations on I-526 with 9.4 vehicle hours of delay. Mainline drops/merges the leftmost lane violating driver expectancy.
Truck Operations	Port related trucks are not separated from local traffic. Increased conflict points on Long Point Road, the interchange loop and merge and through the I 526 bottleneck. Trucks are forced to merge onto I 526.	Port access ramp traffic (primarily trucks) has an add lane section to directly feed onto I-526 with no merges in addition to bypassing the I-526 westbound bottleneck.bypass the I-526 westbound bottleneck.	Port access ramp traffic (primarily trucks) has an add lane section to directly feed onto I-526 with no merges in addition to bypassing the I-526 westbound bottleneck.bypass the I-526 westbound bottleneck.	Port access ramp traffic (primarily trucks) must merge onto I 526. The port access road still allows for reduced truck conflict as compared with the No Build since trucks are diverted from Long Point Road and the Long Point Road merge area.	Port access ramp traffic (primarily trucks) has an add lane section to directly feed onto I-526 with no merges in addition to bypassing the I-526 westbound bottleneck.bypass the I-526 westbound bottleneck. Drop-lane section of I-526 will overlap with left lane drop causing some additional friction.
Constructablity Issues	Future widening would require full reconstruction of the Long Point Road interchange to provide dual lane ramps and to replace existing loops with larger radii. As demonstrated in consideration of Alternatives, interchange would still have multiple capacity issues after widening of I 526.	Setup for I-526 widening. Additional I-526 lane assumed within existing median.	Additional I-526 lane assumed with existing median. Would require construction of Long Point Road ramp widening at a future date under higher MOT volumes.	A conceptual constructability review for the conversion from Option C to the Preferred Option A when the widening of I-526 was conducted. Based on the review, construction would be challenging, but could be completed by widening to the median and removing one lane of pavement associated with converting the Long Point Road ramp to a two-lane merge and removing an add lane treatment.	A conceptual constructability review for Option D requires revising the existing I 526 by transitioning westbound traffic 12 feet left to allow for the Long Point Road ramps add a lane directly to I 526. This linear shift would likely require initial construction of up to one mile of lane in the median. The Long Point Road on ramp would be constructed to merge only one lane which would need changed to a two lane merge in 2050. Constructability is most challenging with Option D in the original construction and likely requires shifts and reconstruction for the ultimate Preferred Alternative layout.

Figure 9: Traffic Comparison of Preferred Alternative (Option A) with Three Mitigation Options