Memo #6: Conceptual Toolbox Application for Priority Enhanced Transit Corridors

1/8/2018

Prepared by: CH2M

Prepared for: Portland Bureau of Transportation (PBOT) and Oregon Department of Transportation (ODOT)
[This page intentionally left blank]
Table of Contents

Introduction .................................................................................................................................................. 1

Closer Look Workshop Approach ........................................................................................................ 1
  Workshop Context and Limitations ........................................................................................................ 2
  Workshop Process: Problem Identification .......................................................................................... 3
  Workshop Process: Toolbox Application .............................................................................................. 4

Conceptual Design Case Studies ......................................................................................................... 5
  Closer Look Findings .......................................................................................................................... 7

Looking Ahead: Next Steps .................................................................................................................. 13
  TriMet ETC Toolbox Policy Development ......................................................................................... 13
  Recommended Future Studies ............................................................................................................. 13

Table of Figures
  Table 1. Closer Look Workshop Problem Identification Summary .................................................. 3
  Table 2. Closer Look Case Study Locations and Tools Tested ............................................................ 5
  Table 3. Line 72: 82nd Avenue Closer Look Findings ....................................................................... 7
  Table 4. Line 12: NE Sandy Boulevard Closer Look Findings ............................................................... 9
  Table 5. Line 6: Martin Luther King, Jr. Boulevard Closer Look Findings .......................................... 12
  Table 6. Recommended Future Studies ............................................................................................... 14
Introduction

The Portland Bureau of Transportation (PBOT) and TriMet have conceived Enhanced Transit to be a variety of moderate capital and operational treatments that improve transit capacity, reliability and travel time. Enhanced Transit improvements are intended to reduce transit delay on the TriMet planned Frequent Service Network, including both buses and streetcars. Improvements are flexible and context-sensitive; they can be deployed relatively quickly in comparison to larger High Capacity Transit (HCT) capital projects.

Enhanced Transit encompasses a range of investments. Treatments can be applied systematically across a transit network, or in a single corridor to improve a specific line. Enhanced Transit capital projects come in a variety of shapes and sizes. They can address “hot spot” bottlenecks, focus improvements along a portion of a transit line experiencing delay, or make improvements along the full length of a transit line.

As part of the Enhanced Transit Corridors (ETC) planning process, the project team developed an ETC Toolbox to help identify effective Enhanced Transit improvements. (See Memo #4: Capital and Operational Toolbox). The toolbox contains potential capital and operational treatments that can be applied to improve transit performance or create safer, more predictable interactions with other travel modes.

This memorandum documents a conceptual application of ETC toolbox treatments in three Enhanced Transit segments and hot spots that could result in improved transit performance and considerations for further study. This memorandum also describes overarching operational improvements that could result in corridor, network, or system-wide reliability and travel time benefits.

The main goal of this step in the planning process is to test and learn from applying the ETC Capital/Operational Toolbox to corridor segments and hot spots.

Objectives

- Learn general lessons that can be applied to other places within Portland’s transit system
- Learn information specific to these segments

This memorandum does not include final recommendations on specific applications of the toolbox or investments in the study corridors.

Closer Look Workshop Approach

After developing the ETC toolbox, the ETC Plan project team held three ETC “Closer Look” workshops in Fall 2017 to test the application of ETC tools to three selected segments of the transit network. The Closer Look process matched ETC tools to locations where delay is harming transit performance within the ETC segments. The purpose of this conceptual application of ETC tools was to explore design possibilities in context, identify potential tradeoffs and considerations for future study, and learn from the overall process.

Each workshop was attended by multiple agency partners, and experts, including representatives from ODOT, PBOT, Portland Streetcar, and TriMet. The workshops were informed by data and analysis prepared in advance by TriMet about types and sources of transit delay. At the beginning of each
workshop, participants discussed corridor characteristics and specific transit delay issues. Participants worked collaboratively to narrow the number of study locations, and to assess which tools were most appropriate at given locations. This approach enabled the project team to explore different problem/solution sets and achieve a better understanding of the level of effort and investment necessary to implement specific ETC toolbox treatments in the future.

Workshop Context and Limitations

Selection of Corridor Segments

Given the time and resource limitations of the ETC Plan, only three (3) segments of bus lines could be analyzed in the Closer Look process. PBOT and TriMet staff worked collaboratively to identify a set of ETC corridor segments that illustrated a range of corridor types and transit delay. Community stakeholders had the opportunity to provide input on which segments to look at during the public engagement May through July 2017 and July 13 City Council hearing. The selected segments included:

- Line 72 – 82nd Avenue between I-84 and SE Powell Boulevard
- Line 12 – Sandy Boulevard between NE 47th and Parkrose Transit Center
- Line 6 – Martin Luther King, Jr. Boulevard from NE Killingsworth to NE Holladay Street

Corridor segments were selected based on two main criteria. First, corridor segments with higher transit performance deficiency scores and greater need based on the initial criteria (as documented in Memo #3: Existing Conditions/Methodology) were identified as having a high potential for improvement. The initial technical evaluation revealed both Lines 72 and 6 as having substantial transit delay issues, high ridership, and considerable implications for future growth and equity populations.

The second criterion was that study locations represent a broad range of street conditions and contexts to allow a typological approach. Locations were selected for their broad applicability to other corridors across the City, and to inform the future application of ETC tools on streets experiencing similar transit performance issues.

For example, Sandy Boulevard (Line 12) is a diagonal four-lane arterial road with on-street parking, resulting in complex intersection geometries and irregular street fragments. While Sandy itself is unique, this type of intersection irregularity is not uncommon in SE and SW Portland - so taking a typological approach enabled the project team to understand how ETC tools would function in similar contexts.

In the coming year, PBOT identified additional opportunities to focus on portions of other Enhanced Transit Corridors through other planning and projects. For example, the 122nd Avenue portion of Line 73 will be analyzed as part of the 122nd Avenue Plan, Line 20 will be analyzed as part of the Outer SE Stark Safety and Access planning process and various locations in the Central City will be looked at through the Central City in Motion project. These efforts provide an opportunity to apply the ETC toolbox and develop recommendations for transit and the multi-modal safety and access needs together.

Selection of ETC Tools for Application

In any given location, several different ETC capital/operational tools could address transit delay. For purposes of the Closer Look, the project team tested the civil design tools most likely to yield benefits to transit at relatively low cost, given the information available.

Resource constraints limited the number of geometric design exercises, so the team focused on the tools best applied at a corridor segment scale. A number of tools were not tested because they apply more appropriately at a network or regional scale. For example, traffic signal priority (TSP) was
identified as a feasible way to achieve transit priority along several bus lines; however, next generation TSP technology systems are more appropriately analyzed and applied as a corridor-wide or regional solution. Additional studies and policy guidance are needed before making a recommendation on using these tools.

**Limitations of Benefit/Trade-off Analysis**

The Closer Look process represents the first steps toward understanding the transit need and potential solutions at a corridor segment level. However, additional project development and analysis is needed to understand the potential benefits and trade-offs resulting from ETC tool application in the Closer Look segments and form project recommendations. These would be important considerations for informing future recommendations. Due to resource constraints, the ETC Closer Look process did not include traffic modeling and safety analysis. As a result, these conceptual toolbox applications give only limited information about the potential benefits and trade-offs associated with selected ETC improvements in specific locations. Still, the results provide valuable information about the conceptual application of ETC tools, the closer look workshop process and what specific additional analysis is needed. This information will inform and shape future efforts. The types of additional analysis needed:

- Transit performance benefits
- Multi-modal safety
- Traffic impact and diversion
- Right-of-way and property impacts
- On-street parking impacts

There is an opportunity to potentially advance project development and analysis in these three study corridors and others through the newly emerging Enhanced Transit Concept Regional Pilot Program. This program is described in the Looking Ahead Chapter at the end of this memo.

**Workshop Process: Problem Identification**

Each workshop began with a detailed review of TriMet transit performance data for a particular bus line. This process built on previous work to develop Memo #3: Existing Conditions/Methodology, which assessed corridor-level performance for all ETC lines. The workshop approach expanded on this earlier work in two important ways. First, specific transit performance problems (such as transit delay during PM peak hours in a given direction) and their potential sources (e.g. bottlenecks at intersections and a high rate of intermodal transfers) were identified using more fine grain analysis of TriMet’s CAD/AVL performance data, also known as “breadcrumb” data. Next, the team shared performance data to identify the time and place of particularly severe transit performance problems. The location, length, and duration of transit delay at specific locations were assessed using maps and charts displaying TriMet “breadcrumb” data. Then attendees agreed on a set of specific locations to focus on during the remainder of the workshop. The resulting study locations are summarized in Table 1 below.

**Table 1. Closer Look Workshop Problem Identification Summary**

<table>
<thead>
<tr>
<th>Line 72: 82nd Avenue Problem Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound</td>
</tr>
<tr>
<td>Approach to Division</td>
</tr>
</tbody>
</table>

3 Enhanced Transit Corridors Plan

JANUARY 2018
### Line 72: 82nd Avenue Problem Spots

<table>
<thead>
<tr>
<th>Northbound</th>
<th>Problem Extent</th>
<th>Southbound</th>
<th>Problem Extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach to Glisan</td>
<td>2 blocks</td>
<td>Approach to Glisan</td>
<td>1 block</td>
</tr>
<tr>
<td>Approach to I-84</td>
<td>2 blocks</td>
<td>Approach to Burnside</td>
<td>1 block</td>
</tr>
<tr>
<td>Approach to Woodward</td>
<td>1 block</td>
<td>Approach to Stark</td>
<td>1 block</td>
</tr>
<tr>
<td>Approach to Stark and Washington</td>
<td>1 block</td>
<td>Division to Powell – North of Woodward</td>
<td>8 blocks</td>
</tr>
</tbody>
</table>

### Line 12: Sandy Boulevard Problem Spots

<table>
<thead>
<tr>
<th>Northbound</th>
<th>Problem Extent</th>
<th>Southbound</th>
<th>Problem Extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach to 82nd</td>
<td>1 block</td>
<td>Approach to 82nd</td>
<td>1 block</td>
</tr>
<tr>
<td>Approach to 72nd/Fremont</td>
<td>4 blocks</td>
<td>Approach to 72nd/Fremont</td>
<td>2 blocks</td>
</tr>
<tr>
<td>Approach to 57th</td>
<td>5 blocks to 52nd</td>
<td>Approach to 57th</td>
<td>8 blocks</td>
</tr>
</tbody>
</table>

### Line 6: Martin Luther King, Jr. Boulevard Problem Spots

<table>
<thead>
<tr>
<th>Northbound</th>
<th>Problem Extent</th>
<th>Southbound</th>
<th>Problem Extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta to Killingsworth</td>
<td>9 blocks, PM peak</td>
<td>Approach to Alberta</td>
<td>1 block, all day</td>
</tr>
<tr>
<td>Fremont to Morris</td>
<td>4 blocks, PM peak</td>
<td>Approach to Fremont</td>
<td>1 block, all day</td>
</tr>
<tr>
<td>Tillamook to Holladay</td>
<td>5 blocks, all day</td>
<td>Holladay to Tillamook</td>
<td>5 blocks, all day</td>
</tr>
<tr>
<td>Approach to Knott</td>
<td>1 block, PM peak</td>
<td>Fremont to Alberta</td>
<td>8 blocks, AM peak</td>
</tr>
</tbody>
</table>

### Workshop Process: Toolbox Application

After workshop attendees agreed on problem locations, the group proceeded through a systematic review of the relevant ETC Capital and Operational Tools that could be deployed to reduce transit delay in each of the identified problem locations. The purpose was to leverage the expertise in the room to assess the applicability and feasibility of various ETC tools in a specific context, faced with a specific transit performance problem. The workshop participants also discussed agency perspectives on the challenges and opportunities associated with implementing specific tools in each context. At the end of this process, the project design team identified nine (9) specific toolbox applications for preliminary geometric design to determine the “on-the-ground” feasibility. These conceptual design exercises set the stage for further investigation to identify potential impacts and tradeoffs of ETC toolbox treatments at different location types.

A complete record of workshop proceedings for the toolbox application process (organized by line and ETC tool) is documented in Appendix A: Closer Look Workshops Summary.
Conceptual Design Case Studies

The nine Closer Look study locations serve as “case studies” to test the geometric feasibility of a range of ETC tools. The selected locations and tools are listed in Table 2. These case studies were developed to help the project team understand potential trade-offs, constraints, and implementation considerations related to the deployment of particular ETC treatments in the physical street environment.

These preliminary design exercises acknowledge that in each case, more analysis is needed to determine transit performance, potential traffic and bike/ped impacts, and impacts to specific properties. The case studies serve as a starting point to learn what it takes to implement Enhanced Transit tools in physically constrained locations. In addition, they highlight the local and regional policy issues that will ultimately guide development of a conceptual Enhanced Transit investment framework.

<table>
<thead>
<tr>
<th>Case Study Location</th>
<th>Tools Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line 72: 82nd Avenue</td>
<td>Bus and Turn Lanes, Curb Extensions, Far-side Bus Stops, Street/Traffic Modifications, Transit Signal Priority</td>
</tr>
<tr>
<td>I-84 Overpass to Multnomah</td>
<td>Queue Jump, Far-side Bus Stops, Street/Traffic Modifications, Transit Signal Priority</td>
</tr>
<tr>
<td>E Burnside Intersection</td>
<td>Bus and Turn Lanes, Far-side Bus Stops, Transit Signal Priority</td>
</tr>
<tr>
<td>Stark/Washington Couplet</td>
<td>Bus and Turn Lanes, Far-side Bus Stops, Street/Traffic Modifications, Transit Signal Priority</td>
</tr>
<tr>
<td>Line 12: Sandy Boulevard</td>
<td>Bus and Turn Lanes, Far-side Bus Stops, Transit Signal Priority</td>
</tr>
<tr>
<td>NE 57th Avenue Intersection</td>
<td>Pro Time Lane, Queue Jump, Far-side Bus Stops, Transit Signal Priority</td>
</tr>
<tr>
<td>NE 72nd/Fremont Street Intersection</td>
<td>Far-side Bus Stops, Transit Signal Priority</td>
</tr>
<tr>
<td>NE 82nd Avenue Intersection</td>
<td>Bus and Turn Lanes, Queue Jump, Far-side Bus Stops, Street/Traffic Modifications, Transit Signal Priority</td>
</tr>
<tr>
<td>Line 6: Martin Luther King, Jr. Boulevard (Toolbox application on both MLK and Grand Avenue)</td>
<td>Bus and Turn Lanes, Curb Extensions, Far-side Bus Stops, Street/Traffic Modifications, Transit Signal Priority</td>
</tr>
</tbody>
</table>
Closer Look Findings

Tables 3 through 5 summarize high-level findings from the conceptual application of ETC capital and operational tools to address specific hot spots and corridor segments. These findings are not recommendations at this stage. The findings describe implementation considerations and an early assessment of potential benefits and trade-offs gleaned from the Closer Look workshops and case studies. Since traffic modeling, right-of-way safety analysis were not performed as part of the Closer Look process, most findings relate to the geometric and policy considerations associated with deploying ETC tools in each case study location.

Each case study considered multiple tools. Corridor wide or regionally-applicable tools – such as Transit Signal Priority – are visually represented as ETC toolbox icons on the case study maps. Tables 3 through 5 organize findings by case study location.

The graphical conceptual design case studies are provided in Appendix B: Closer Look Conceptual Toolbox Application Maps.

Line 72: 82nd Avenue

Table 3. Line 72: 82nd Avenue Closer Look Findings

<table>
<thead>
<tr>
<th>General Considerations (Corridor-wide)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 82nd Avenue is a state highway facility owned by ODOT, which presents unique jurisdictional challenges for implementing ETC solutions</td>
</tr>
<tr>
<td>• Full-length dedicated transit lanes are not feasible for the length of 82nd Avenue due to the need for (and impacts of) taking general purpose and turn/travel lanes or acquiring property</td>
</tr>
<tr>
<td>• Improvements that move curbs on 82nd will trigger bike, pedestrian, ADA, stormwater management improvements and more, increasing project cost and complexity</td>
</tr>
<tr>
<td>• Strategic queue jumps may be feasible in some places; further analysis is needed to determine optimal locations</td>
</tr>
</tbody>
</table>

I-84 Overpass to Multnomah

ETC Tool: Bus and Turn Lane, Far-side Bus Stops

Potential Transit Operations Benefits

• Northbound Bus and Turn Lane would provide separated roadway space for buses to travel across NE Wasco Street, allowing for more efficient through movement
• Bus and Turn Lane would lessen the impact of dedicated bus lanes by maintaining business and residence access
• Bus priority could be achieved while preserving general traffic circulation for right turns into driveways or intersecting streets
• Southbound Bus and Turn Lane design would preserve local bus pull-out and stop
• Far-side stops included as part of design could enable the bus to move more efficiently through signalized intersections at NE Jonesmore Street and NE Wasco Street. Far-side stops
would allow the bus to clear the intersection before stopping, minimizing delay at traffic signals

Considerations

- Implementation of Bus and Turn Lanes on would require elimination of north and southbound left turns from 82nd Avenue to connecting streets, resulting in the need for a traffic flow diversion strategy and further analysis of neighborhood circulation
- Implementation of Bus and Turn Lane in northbound direction requires the removal of existing curb extensions at NE Jonesmore Street and at NE Wasco signalized intersection, increasing the crossing distance for pedestrians
- Implementation of Bus and Turn Lane in proximity to the I-84 overpass would require the removal of the center median and art sculpture installed by ODOT
- Potential roadway and public right-of-way widening south of NE Wasco Street would likely be required; further study is needed to determine specific property, effect on project cost, and other impacts. Widening the roadway generally raises safety concerns, particularly along a High Crash Corridor.

<table>
<thead>
<tr>
<th>E Burnside Intersection</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETC Tool: Queue Jump, Far-side Bus Stops</td>
</tr>
</tbody>
</table>

Potential Transit Operations Benefits

- Southbound queue jump could provide a short section of exclusive transit lane approaching E Burnside Street, allowing the bus to “jump the queue” of traffic waiting at a red light
- Queue jump would allow for quicker, more reliable transit movement through the E Burnside intersection
- If queue jump is paired with a Right Turn Except Bus lane, dedicated signal phasing is not required
- Far-side stops could enable the bus to move more efficiently through signalized intersection at E Burnside and SE 82nd Avenue. Far-side stops allow the bus to clear the intersection before stopping, minimizing delay at traffic signals

Considerations

- The current roadway width can only fit a single (northbound) queue jump on 82nd Avenue without resorting to roadway widening and potential property acquisition
- Queue jump implementation requires the elimination of north and southbound left turn movements onto E Burnside Street; further analysis of northbound and southbound larger vehicle turning movement onto SE 82nd and diversion analysis to understand impacts to circulation is required
- North and southbound far-side bus stop placement is feasible in this reach
- Queue jump implementation would eliminate left turn access to Walgreen on NE Couch Street and NE 82nd Avenue, as well as left turn access to strip mall south of E Burnside; further
analysis is needed to understand the full suite of access management impacts and neighborhood circulation modifications

<table>
<thead>
<tr>
<th>Stark/Washington Intersections</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETC Tool: Bus and Turn Lane, Far-side Bus Stops</td>
</tr>
</tbody>
</table>

**Potential Transit Operations Benefits**

- Northbound Bus and Turn Lane would provide separated roadway space for buses to travel across SE Stark and Washington Streets, allowing for more efficient through movement
- Bus and Turn Lane would lessen the impact of dedicated bus lanes by maintaining business and residence access
- Bus priority could be achieved while preserving general traffic circulation for right turns into driveways or intersecting streets
- Far-side stops could enable the bus to move more efficiently through signalized intersections at SE Stark Street and SE Washington Street. Far-side stops allow the bus to clear the intersection before stopping, minimizing delay at traffic signals

**Considerations**

- Implementation of north and southbound Bus and Turn lanes would require roadway widening on east and west sides of 82nd Avenue; further analysis is needed to determine specific property impacts, effects on project cost, and other impacts
- Implementation of Bus and Turn lanes would result in a wider roadway. Widening the roadway generally raises safety concerns, particularly along a High Crash Corridor
- A northbound far-side bus stop is feasible north of SE Stark Street, and a southbound far-side bus stop is feasible south of SE Washington Street; further analysis is required to determine the efficacy of queue jumps to the far side station placement vs. near side station placement and the assumed bus merge movement or full-cycle wait time
- Tapered medians are recommended to preserve sightlines and left-turn movements from 82nd onto Washington and Stark Streets; there is an opportunity to extend medians to created pedestrian refuge islands
## Table 4. Line 12: NE Sandy Boulevard Closer Look Findings

### General Considerations (Corridor-wide)

- The diagonal orientation of NE Sandy Boulevard results in complex intersection geometry and street fragments that require special design consideration and treatments
- Future investments in Enhanced Transit must acknowledge funded safety improvements on NE Sandy Boulevard.
- Any future improvements on NE Sandy Boulevard that move the curbs to widen the roadway, will trigger bike, pedestrian, ADA, stormwater management improvements and more and ADA improvements. This may potentially include reserving space for future protected bikeways.
- Laneway solutions are feasible on the corridor, including bus and turn lanes, dedicated transit lanes, and intersection queue jumps. Stop consolidation and far-side stop placement is also feasible in the corridor.

<table>
<thead>
<tr>
<th>NE 57th Avenue Intersection</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETC Tool: Bus and Turn Lane, Far-side Bus Stops</td>
</tr>
</tbody>
</table>

### Potential Transit Operations Benefits

- Bus and Turn Lanes could provide separated roadway space for buses to travel across NE 57th Avenue, allowing for more efficient through movement
- Bus and Turn Lane would lessen the impact of dedicated bus lanes by maintaining business and residence access
- Bus priority could be achieved while preserving general traffic circulation for right turns into driveways or intersecting streets
- Far-side stops included as part of design would enable the bus to move more efficiently through signalized intersection at NE 57th Avenue. Far-side stops allow the bus to clear the intersection before stopping, minimizing delay at traffic signals

### Considerations

- Implementation of southbound Bus and Turn Lane to NE 57th Avenue intersection could be accomplished with widening of the north side of NE Sandy Boulevard; further analysis is needed to determine specific property impacts, effects on project cost, and other impacts.
- Implementation of southbound Bus and Turn Lane would result in a wider roadway. Widening the roadway generally raises safety concerns, particularly along a High Crash Corridor.
- This intersection has six legs and is very complex; further study required to determine traffic flow scenarios and impacts. It is recommended that traffic signal phasing is studied to determine how to optimize travel times while preserving turning movements from NE Sandy Boulevard
- Implementation of northeast-bound Bus and Turn Lane would require shifting of laneway markings south to take advantage of existing parking lanes/right-of-way to establish a 10-foot
ENHANCED TRANSIT CORRIDORS PLAN

JANUARY 2018

Potential Transit Operations Benefits

- North and southbound pro-time bus lanes would provide bus priority during peak travel times, allowing for more efficient movement through complex intersection geometry at NE Fremont/NE 72nd/NE Sandy
- Pro-time bus lanes would preserve off-peak parking spaces
- Temporary separation from general purpose traffic during congested peak periods would improve bus travel time and reliability, while lessening the impact of dedicated bus lanes
- Off-peak parking and travel on pro-time bus lanes would lessen the impact of separation on adjacent land uses
- Far-side stops included as part of design would enable the bus to move more efficiently through signalized intersection at NE Fremont/NE 72nd/NE Sandy. Far-side stops would allow the bus to clear the intersection before stopping, minimizing delay at traffic signals

Considerations

- Complex intersection geometry requires further study to determine traffic flow scenarios and impacts
- North and southbound pro-time lanes are feasible with roadway widening west of NE 72nd Avenue; further study is needed to determine parking impacts, impacts to specific properties and other impacts. Widening the roadway generally raises safety concerns, particularly along a High Crash Corridor.
- Bus stop consolidation and far-side placement in front of Safeway is feasible; project team recommends further study to determine specific location and expected benefits
- Pro-time bus lanes could require restriction of left-turn movements from NE Sandy Boulevard onto connecting streets; further study is needed to determine other possible left-turn restrictions
- Roadway widening would effectively increase pedestrian crossing distance at the intersection of NE Sandy Boulevard and NE Fremont Street. Implementation of eastbound pro-time lane and far-side bus stop placement would also require the removal of curb extension at NE Sandy Boulevard/NE Fremont Street intersection. Further analysis is needed to determine specific impacts to pedestrian and bicyclist safety, and potential mitigation measures. Widening the roadway generally raises safety concerns, particularly along a High Crash Corridor.
### Potential Transit Operations Benefits

- North/eastbound Bus and Turn Lane could provide 10-foot of separated roadway space for buses to travel across NE 82nd Avenue, allowing for more efficient through movement.
- Bus and Turn Lane would lessen the impact of dedicated bus lanes by maintaining business and residence access.
- Bus priority could be achieved while preserving general traffic circulation for right turns into driveways or intersecting streets.
- Near-side bus stop and Bus and Turn Lane at NE 82nd Avenue would allow the bus to “jump the queue” of north/eastbound traffic waiting at a red light.

### Considerations

- Roadway width only supports deployment of a single eastbound Bus and Turn/Queue Jump lane.
- Implementation of eastbound Bus and Turn Lane/Queue Jump would require near-side bus stop placement at 82nd Avenue intersection; there is no space to build a receiving lane on far-side of intersection. Bus would need to dwell at stop and use queue jump to safely jump ahead of traffic.
- East and westbound left turn movements at 82nd Intersection could be preserved.
- Implementation of eastbound Bus and Turn Lane/Queue Jump would restrict westbound left-turn movements onto NE 81st Avenue.
- Deployment of laneway solutions would require widening of roadway, effectively increasing the pedestrian crossing distance; further analysis is needed to determine specific property impacts, other impacts and effect on project cost. Widening the roadway generally raises safety concerns, particularly along a High Crash Corridor.
- Laneway solutions would likely restrict right-turn accesses to businesses located along the south side of NE Sandy Boulevard; further analysis is needed to determine full suite of access management impacts.
- Design recommends closure of NE Mason Street at NE Sandy Boulevard to allow far-side bus placement north of 81st and development of a potential pedestrian plaza.
Line 6: Martin Luther King, Jr. Boulevard

Table 5. Line 6: Martin Luther King, Jr. Boulevard Closer Look Findings

<table>
<thead>
<tr>
<th>General Considerations (Corridor-wide)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The corridor is characterized by constrained right-of-way, a high frequency of mid-block crossings, and the presence of landscaped medians.</td>
</tr>
<tr>
<td>• Planned improvements as part of the MLK Pedestrian Improvement Project include median modifications and refuge installations at Graham, Sumner, Failing, and Beech. The project also includes tree removal in some locations, lighting improvements, and an unfunded signal improvement at Going.</td>
</tr>
<tr>
<td>• There is a need to coordinate HAWK signals and stops to achieve better movement for vehicles through the corridor while providing safe and accessible crossings for pedestrians.</td>
</tr>
<tr>
<td>• Given high frequency of crossings and recent improvements in the corridor, there is a desire to create a “slow, but steady” travel environment for all users.</td>
</tr>
<tr>
<td>• Constrained ROW and improved streetscape existing conditions north of NE Hancock Street influenced the selection of the study area to be consolidated south of Hancock on MLK and Grand couplet</td>
</tr>
</tbody>
</table>

Reach 1-3: NE Schuyler Street to NE Holladay Street

ETC Tool: Bus and Turn Lane

Potential Transit Operations Benefits

• Bus and Turn Lanes in the north and southbound directions are geometrically feasible without roadway widening, allowing for more efficient through movement for buses and minimizing potential project cost
• Bus and Turn Lanes would lessen the impact of dedicated bus lanes by preserving right turns onto driveways or intersecting streets
• Design could provide 11-foot southbound Bus and Turn Lane on NE Martin Luther King, Jr. Boulevard
• Southbound Bus and Turn Lane could preserve on-street parking in space and in time
• Southbound Bus and Turn Lane design could include curb extension at NE Halsey Street intersection, effectively reducing the pedestrian crossing distance
• Northbound Bus and Turn Lane could leverage existing Portland Streetcar alignment to create Enhanced Transit environment

Considerations

• Implementation of southbound Bus and Turn lane on NE Martin Luther King, Jr. Boulevard would require repurposing of a general traffic lane to accommodate 11-foot transit priority lane.
• Bus stop consolidation is feasible in this reach
• On NE Grand Avenue, existing Streetcar lane would be converted to a shared lane for bus, Streetcar, and right-turns only
• Further study is needed to determine relationship of streetcar stops to bus performance and how to facilitate bus stop transfers to Line 6 and Streetcar

Looking Ahead: Next Steps

The Enhanced Transit concept is being introduced into Metro’s Regional Transit Strategy as part of the current Metro Regional Transportation Plan (RTP) update. Concurrently, Metro and TriMet are initiating a year-long pilot program to build understanding around where enhanced transit tools may be applicable throughout the greater Portland region as of the writing on this memorandum. JPACT and Metro Council have allocated up to $5M of Regional Flexible Funds to support the pilot workplan. The pilot intends to undertake a deeper analysis of benefits, costs, and trade-offs associated with the application of ETC tools by enabling project development and design up to 15% for a pipeline of projects within high priority locations. A smaller subset of projects found to offer significant transit benefits at an acceptable cost during the initial stage of project development will be recommended for additional design work. Additional funding is available to advance this smaller subset of ETC projects to 100% design. Final design will also be contingent upon the willingness of facility owners to indicate they are prepared to fund and advance construction of ETC projects in their respective jurisdictions.

TriMet ETC Toolbox Policy Development

Implementation of several ETC Toolbox elements – such as stop spacing, near-level/all-door boarding, and rolling stock modification – rests primarily within the responsibility and control of the transit agency. In many cases, these tools are best applied at a route level or even system-wide. Recognizing this, TriMet is embarking on a six-month effort to develop the policy support necessary to clearly determine when, where, and how TriMet is prepared to implement ETC toolbox elements.

Recommended Future Studies

As discussed earlier in this memorandum, additional analysis and policy guidance will be needed to determine the feasibility of several ETC tools – including headway management and Transit Signal Priority. Further study will help guide the application of these tools, whether they are part of a City-led project or a regional investment strategy for Enhanced Transit. Table 6 briefly summarizes issues requiring additional analysis (beyond the scope of the ETC Plan). The future studies listed below only reflect those that were identified within the scope of the Closer Look process.
### General Studies

- Transit Signal Priority is applicable, but needs to be universally applied with a new regional architecture and technology backbone to be applied at the corridor and/or intersection level. Further study needs to consider TSP upgrades as a regional approach to developing an Enhanced Transit program. It is also important to consider that signal upgrades trigger ADA improvements, so future studies to identify deficient signals also need to understand cost implications of corridor-wide TSP upgrades. Potential signal upgrades also need to coordinate intelligent transportation system (ITS) projects previously identified in the City’s Transportation System Plan (TSP), Oregon Statewide Transportation Improvement Program (STIP), and other relevant plans and programs.

- Headway management is potentially applicable as part of a regional approach, but it is currently difficult to document at a stop/corridor level. Further studies to implement an active headway management program are recommended.

- Strategic modification of traffic operations is implicit in all ETC Closer Look Case Studies, and will be a part of all future detailed designs for Enhanced Transit. Traffic modeling, safety, and transit performance studies are recommended to understand and manage trade-offs.

### 82nd Avenue Future Design Studies

- Additional safety studies are recommended to determine impacts associated with ETC toolbox deployments along 82nd Ave.

- **82nd Avenue at Burnside:** Perform traffic modeling and detailed design analysis to determine the impacts of removing left-turn movements in lieu of queue jump implementation. Test application with fewer stops and far-side bus stop placement.

- **82nd Avenue MAX Station/Bridge SB (77 and 72):** Perform traffic modeling and detailed design analysis to determine the impacts resulting from the deployment of a northbound Bus and Turn Lane, with restricted left-turn movements southbound to Wasco. Explore southbound benefits and show fewer stops and far-side bus stop placement.

- **82nd Avenue from Powell to Division:** Perform a detailed design analysis to test Enhanced Transit solutions in this span. Implement bus stop consolidation and far-side bus stop placement.

### NE Sandy Boulevard Future Design Studies

- Additional studies are needed to determine where bike/bus lanes are feasible along NE Sandy Boulevard based on street conditions, speeds, and volumes.

- Additional safety studies are recommended to determine impacts associated with ETC toolbox deployments along NE Sandy Boulevard

### NE Martin Luther King, Jr. Boulevard Future Design Studies
Traffic modeling and detailed design analysis is recommended to assess the feasibility of continuous Bus and Turn Lanes along NE Martin Luther King, Jr. Boulevard and NE Grand Avenue. The study will need to acknowledge potential benefits or impacts to Streetcar performance along NE Grand Avenue.
MEMO #6: CONCEPTUAL TOOLBOX APPLICATION FOR PRIORITY ENHANCED TRANSIT CORRIDORS

Appendix B: Closer Look Conceptual Toolbox Application Maps

Updated 1/8/2018
[This page is intentionally left blank.]
Enhanced Transit Corridors Plan
January 2018 DRAFT

LINE 82ND AVENUE CORRIDOR STUDY AREA Overview Map of Potential ETC Tools

*This design is preliminary, future study is required.
Overview Map of Potential ETC Tools

**NE SANDY BOULEVARD**

**CORRIDOR STUDY AREA**

**Potential Corridor Wide Tools**

- Protimelanes
- Bus & Turn Lanes
- Queue Jump
- Near Level Boarding
- All Door Boarding
- Rolling Stock
- Curb Extensions
- Stop Consolidation
- Street/Traffic Modifications
- Transit Signal Priority

*This design is preliminary, future study is required.*

**Enhanced Transit Corridors Plan**

January 2018  DRAFT

**NE 57th Ave. Intersection**

**NE 82nd St. Intersection**

**NE Fremont St. Intersection**

**NE Sandy Blvd.**
Enhanced Transit Corridors Plan
January 2018 DRAFT

LINE 6
NE MARTIN LUTHER KING, JR. BOULEVARD CORRIDOR STUDY AREA
Overview Map of Potential ETC Tools

*This design is preliminary, future study is required.*