MEMORANDUM

Date: October 8, 2014

To: Steve Szigethy
   Washington County

From: Susan Wright, PE and Karla Kingsley

Project: SW 170th Avenue / SW Merlo Road Conceptual Design Plan

Subject: Existing Conditions, Opportunities, and Constraints

INTRODUCTION AND PROJECT OBJECTIVES

As Washington County’s urban area continues to develop and urbanize, the County has continually sought to serve the transportation needs of its residents, workers, and visitors. Washington County has identified the SW 170th Avenue / SW Merlo Road corridor as an area of needed improvement in order to better serve its diversity of users. The SW 170th Avenue / SW Merlo Road Conceptual Design Plan project will develop a conceptual design for these two connecting arterial roadways, based on an analysis of existing conditions, opportunities and constraints; a broader look at surrounding neighborhood context; an evaluation of best practices and innovative designs; and an inclusive public involvement process. The conceptual design will provide Washington County and corridor stakeholders with a higher level of certainty as to how the corridor will look and function in the future and will better prepare the County for designing, engineering and constructing improvements in the corridor.

Project Objectives

The overarching goal of this Project is to develop a conceptual plan for street design treatments along 170th Avenue between Baseline Road and SW Tualatin Valley Highway (OR8) and along Merlo Road between Jenkins Road and 170th Avenue to incorporate multimodal circulation, to support adjacent land use and development, and to conceptually address a number of environmental constraints including riparian, floodplain, wetland, forest and wildlife habitat resources.

Specific objectives are to:

• Create a corridor that will encourage and support the use of active transportation modes and reduce reliance on the automobile.
Create a corridor that better links Aloha neighborhoods with nearby destinations including two schools, two Metropolitan Area Express (MAX) light rail stations, Tualatin Hills Nature Park, and a major employment hub anchored by Nike to the northeast of the study area.

Identify at a planning level means to address potential environmental impacts including stormwater runoff from additional impervious surfaces, construction within floodplain, wetland and/or riparian areas, and impacts on mature trees, considering green street treatments and more conventional measures.

Address right-of-way and access management needs.

For the purpose of bicycle and pedestrian mobility, examine the local street and trail network to address safety and connectivity, including connections necessary to link adjacent development to any alternative parallel bicycle or pedestrian facilities.

Explore the application of innovative bikeway treatments for 170th Avenue and Merlo Road, potentially including a two-way cycle track, one-way cycle tracks, or buffered bike lanes.

Explore opportunities to accommodate bus stops, including improved pedestrian access, along 170th Avenue and Merlo Road in anticipation of a TriMet-proposed bus line.

Provide safe routes and crossings for bicyclists and pedestrians to area destinations such as Beaver Acres Elementary School, Merlo Station High School and Tualatin Hills Nature Park.

Explore project phasing options that could deliver pedestrian/bicycle facilities in advance of planned roadway widening.

Engage a broad range of public and stakeholders in designing concepts for 170th Avenue and Merlo Road, ensuring compliance with Title VI regulations regarding outreach to disadvantaged and minority citizens.

This memorandum, the Existing Conditions, Opportunities, and Constraints Memorandum, documents the existing land use, natural features, utilities, and transportation-related conditions in the study corridor; provides a discussion of the standards and improvement guidelines relevant to this corridor; and identifies key opportunities and constraints. Figure 1 shows the extents of the study corridor and breaks the corridor into three distinct segments.
CORRIDOR BACKGROUND AND EXISTING CONTEXT

The 170th Avenue/Merlo Road corridor is a critical north-south connection between residential neighborhoods, major employment hubs, transit lines, schools and park facilities; however, it currently faces major challenges for various modes of travel. The corridor is in a high-growth area of Washington County that is experiencing major development and redevelopment activity in both commercial and residential sectors. Neighborhoods to the west and south have concentrations of “environmental justice” populations, including lower income, minority and limited English proficiency (LEP) residents. The corridor currently does not serve the needs of people walking, bicycling and accessing transit, and vehicular congestion will likely remain in the future.

Figure 1 shows the study area of the corridor. For the purposes of the existing conditions and solution alternatives documentation, the corridor is broken into three distinct segments:

- Segment 1 is SW 170th Avenue north of SW Merlo Road to W Baseline Road;
- Segment 2 is SW 170th Avenue south of SW Merlo Road to SW Tualatin Valley Highway, and
- Segment 3 is SW Merlo Road between SW 170th Avenue and SW Jenkins Road.

170th Avenue north of Merlo Road (Segment 1) is designated as an arterial with two to three vehicle travel lanes. Merlo Road and the southern section of 170th Avenue (Segments 2 and 3) are designated as arterials in the Washington County Transportation System Plan with future configurations of four to five vehicle travel lanes. The same segments are also planned for future bus service in TriMet’s Westside Service Enhancement Plan and identified as top-level gaps in the pedestrian and bicycle system through the County’s Bicycle and Pedestrian Improvement Prioritization Project and the Aloha-Reedville Study and Livable Community Plan. The following sections detail the existing conditions in the study area.
Zoning and Land Use

The area of 170th Avenue in the study area lies on the border between the City of Beaverton and unincorporated Washington County. Zoning designations on land to the west are from Washington County and to the east are from the City of Beaverton. Figure 2 shows the zoning designations. Both the City of Beaverton and Washington County zoning designations include zones specifically designed for the station areas - Station Community and Transit Oriented, respectively, and these are found in the north end of the corridor.

In Washington County, the community development code states that the intent of the Transit Oriented Districts is to “direct and encourage development that is transit supportive and pedestrian oriented” in areas proximate to transit. To do this, the Transit Oriented zones specify development with densities that are supportive of transit, uses that generate trips serviceable by transit, a complementary mix of land uses, and design that facilitates pedestrian, bicycle, or transit trips. The north end of the corridor is bounded by Transit Oriented business (TO: BUS) and moderate density residential (TO:R24-40, TO:R18-24) zones. The Transit Oriented zones also carry minimum density requirements.

The City of Beaverton code describes the Station Community zone designations in a similar way. Adjacent to the corridor are Station Community multiple use (SC-MU) and employment (SC-E) zones, with high density residential (SC-HDR) on the north side of Baseline Road. The SC-MU and SC-HDR zones have no maximums (but do have minimums) on residential densities and the SC-E zone is designed to have an intensity of 40 employees per acre.

West of 170th, in an area of unincorporated Washington County, the corridor is abutted by a range of moderate density residential zones, which is resulting in gradual increases in densities as infill development occurs in these areas.

At the south end of the corridor, a Central Business District (CBD) zoning designation covers the area between Alexander Street and Tualatin Valley Highway on the west side of the corridor. This CBD zone is one of the highest density zones in unincorporated Washington County, with a 100 foot height limit and a mix of allowed uses; however, it is not currently built out to the level of intensity allowed within the CBD zone.

The study corridor currently serves a mix of land uses, with residential neighborhoods to the west ranging from single-family housing at a density of approximately three units per acre to higher-density multifamily housing. At the north end of the corridor, the Steed Creek and Merlo Village developments next to the Elmonica MAX station provide 555 new multi-family units. Towards the south end of the corridor, there are other multi-family developments clustered at Heritage Court, and across 170th, the Arbor Creek Apartments provide 440 units of multi-family housing. The corridor also has some commercial uses at the north and south ends of the corridor, with some live/work units at 170th Ave/Baseline Rd, and at the intersection of 170th Avenue/Merlo Road. The Nike World Headquarters are located just to the northeast of the corridor and is undergoing an expansion. At 158th Ave/Jenkins Rd, there is a Costco in the northwest corner of the intersection and Reser’s Fine Foods distribution
center at the southeast corner; however, the Reser’s distribution center will be relocating. The corridor also features two MAX stations – a park-and-ride facility at the north end of 170th Avenue (Elmonica/170th Ave MAX) and a station with a bus drop-off area on Merlo Road (Merlo/158th Ave MAX). Near these two stations are the Merlo bus garage and the Elmonica Light Rail Vehicle yard. The corridor also has significant natural and recreational land uses, with a large regional park (Tualatin Hills Nature Park) at the southern end of 170th Avenue and the Merlo Station Athletic Fields at the north end. Finally, the corridor serves two schools – Beaver Acres Elementary School and Merlo Station High School – as well as both the Beaverton School District offices and the Tualatin Valley Water District offices. Figure 3 shows the existing land uses in the corridor.

Figure 4 shows areas of potential development and redevelopment, based on Metro’s buildable land inventory data. For the residential land, the methodology considers a property’s capacity to add housing units based on the existing zoning and other constraints. In the case of commercial land, development potential is calculated based on existing land and building values to assess the likelihood of redevelopment. Ultimately, private property owners have the authority on whether or not they redevelop their properties, when they would do so, and how the future land uses and streets would be arranged on their sites to meet the applicable development codes.

Significant residential capacity is available in some of the areas on the west side of the corridor, where original development occurred in the 1960s. This additional density could be accomplished through incremental infill and redevelopment. There are also a number of vacant employment sites in the vicinity of the corridor, including areas at the western edge of the Nike Campus north of Jenkins Rd and several properties along Merlo Road.
Natural Features

There are two main areas with natural features to consider on this project. The Beaverton Creek area within Segment 2 is the most significant area, and will require the most attention when considering improvements. The bridge is substandard and would require replacement with any improvement to the roadway. The Tualatin Hills Nature Park is adjacent to this creek, and could also be impacted by improvements. The stream corridor of Beaverton Creek within and near the project area is dominated by palustrine forested wetlands with lesser components of palustrine emergent wetlands. The wetland resources and adjoining upland habitats are of high habitat value for both terrestrial and aquatic species.

The Segment 2 project activities affecting Beaverton Creek will require compliance with a number of state, federal, and local environmental regulations. While the distribution of Endangered Species Act listed salmon and steelhead is anticipated to be limited within Beaverton Creek, compliance with regulations associated with these listed resources is expected. Two expected regulations and process items include Fish Passage Approval from the Oregon Department of Fish and Wildlife and either consultation with the National Marine Fisheries Service (NMFS) or adherence to design standards set forth by this agency. As bridge replacement and roadway development activities would likely encroach on the creek and adjoining wetlands, permits from the Army Corps of Engineers (Corps) and the Oregon Department of State Lands (DSL) are likely. In addition, infringement or impacts to Vegetated Corridors (buffers) around Beaverton Creek and wetlands may require permitting, mitigation/restoration, and approval through Clean Water Services. Minimum anticipated Vegetated Corridor extent along Beaverton Creek is 50 feet from the ordinary high water line on either side of the creek. Corridors extend further depending on local topography and the presence/size of adjoining wetlands.

The second area is located within Segment 1 along the light rail track corridor and can be characterized as palustrine emergent wetland swale with additional flow through (riverine) components. This feature is surrounded by herbaceous buffer of low function and quality, but the swale and corridor habitats are wholly within the Beaverton Creek watershed. This segment of the project area has been recently widened to a three lane cross section with bicycles and vehicles sharing the travel lane for a short portion. Any further widening would have impacts on this wetland area and is also likely to impact degraded Vegetated Corridors. As with the potential impacts to Beaverton Creek and adjacent wetlands, any impacts to wetlands in Segment 1 are likely to require approval and permitting through Clean Water Services, the Corps, DSL, and potentially NMFS.

Figure 5 shows the natural features in the corridor including, floodplains, wetlands, and 5-foot contours.

Appendix A includes larger scale figures of the corridor by segments. They include 2-foot contours throughout the corridor overlaid on an aerial photo base.
Transportation Facilities

The corridor currently serves automobiles, freight vehicles, transit riders using LIFT services or accessing the MAX light-rail stations, bicyclists, and pedestrians; however, the existing facilities do not provide a high quality of service for these various modes, and in some cases there are no facilities for some modes. Facilities for each mode are described herein.

Auto/Freight mode

Figure 6 shows the existing characteristics of the roadways in the study area, including 85th percentile speeds and daily traffic. Segment 1 is currently three lanes and is designated as such in the 2035 Transportation System Plan (TSP). Segments 2 and 3 are both designated as five-lane arterials in the 2035 TSP, though currently they are 2 and 3 lanes, respectively. Though the corridor does serve freight movements, with truck percentages shown on Figure 6, none of the segments is designated as a freight route in the Washington County TSP. All three segments in the corridor have 40 mph posted speed limits.

At the southern end of the corridor, 170th Avenue connects with Tualatin Valley Highway, the primary east/west route between Hillsboro and Beaverton. The June 2013 TV Highway Corridor Plan recommends adding dual left-turn lanes for all directions of travel at the 170th Ave/TV Highway intersection in order to maintain mobility and meet the existing mobility standards for the auto mode.

North/south connectivity is also limited in the vicinity of the corridor with 185th Avenue 0.75 miles to the west and Murray Boulevard 1.25 miles to the east providing the nearest continuous north/south routes.

Pedestrian Mode

The study corridor, with nearby schools, dense housing, two MAX light-rail stations, and a regional park, has the potential to serve increased pedestrian use; however, currently the pedestrian facilities are discontinuous in portions of the corridor. Figure 7 shows the existing facilities currently serving pedestrians as well as planned facilities. The majority of sidewalks present in the corridor are built to Washington County’s minimum 5-foot standard, with the exception of a portion of Segment 1 in front of the Tualatin Valley Water District. Also in Segment 1, there are portions of 5-foot curb-tight sidewalk near the Elmonica/170th Ave MAX station. In segment 3, the sidewalk is curb-tight on both sides, with the south side meandering around utility poles. In addition to facilities shown on the map, there is a 3-foot wide worn asphalt path on the west side of 170th south of Augusta Lane; however, there are no facilities on the east side of the corridor along the Tualatin Hills Nature Park Frontage and no crosswalks allowing pedestrians to access the park. Though not shown on the map, any sidewalk gaps on arterials or collectors would be filled as development or roadway improvements occur.

In the Transportation System Plan, Segment 1 and the southernmost block of Segment 2 are designated as Pedestrian Oriented Street Overlay areas, defined as “a segment of urban roadway in which
enhanced pedestrian features and/or expanded pedestrian facility dimensions are encouraged to facilitate a safe, comfortable, attractive walking environment and to leverage community and economic development.” Appropriate features and dimensions vary by context and shall be determined through the project development and/or land development review process, with consideration of other modal classifications including freight. Features may include (but are not limited to): sidewalks with widths greater than those shown in the Washington County Road Design and Construction Standards, medians, narrower travel lanes and/or narrower pavement widths, curb extensions, on-street parking, pedestrian-scale lighting, enhanced crosswalks, traffic calming, street trees, landscaping, street furniture and public art.”

Finally, 170th Avenue between Merlo Road and Alexander Street was identified as one of the top 30 bicycle/pedestrian needs in the 2012 Washington County Bicycle and Pedestrian Improvement Prioritization Project.

**Bicycle Mode**

Though the corridor has potential to serve regional bicycle travel for various users, currently it lacks bicycle facilities on much of its length and therefore serves only bicyclists willing to operate on a shared roadway with other vehicles. Figure 8 shows the existing bicycle facilities in the study area, along with the route designations from the TSP – Enhanced Major Street Bikeways and Major Street Bikeways. All three segments of the study corridor are designated as Enhanced Major Street Bikeways, which is defined as “an urban arterial or collector roadway that has or is planned to have buffered bike lanes or cycle tracks on one or both sides of the road as illustrated in the Washington County Bicycle Facility Design Toolkit. Enhanced Major Street Bikeways typically have higher traffic volumes, higher speeds, more lanes, and users with diverse skills such that additional separation between the bikeway and vehicular traffic is desired. Bikeway facility types and dimensions shall be context-sensitive and determined on a case-by-case basis through engineering review.” Also, Alexander Street, Johnson Street, and Augusta Lane are proposed neighborhood bikeways.

As shown in Figure 8, the very southern end of the corridor currently has bike lanes – these lanes extend to the south as far as Rigert Road.

Figures 7 and 8 also show the existing and planned multi-use trails in the corridor vicinity. These facilities serve both pedestrians and bicyclists, and include:

- The existing Waterhouse Trail, which was recently completed north of the Merlo/158th Ave MAX Station;
- The Westside Trail, running north/south just to the east of the Tualatin Hills Nature Park, which is planned to be routed along Merlo Road / 158th Avenue to go around the Nike World Campus;
- The Beaverton Creek Trail, which has been funded east of Merlo Road parallel to the MAX tracks and is planned to be a natural surface west of 170th Avenue; and
• The TV Highway Trail, which is envisioned as part of a future Turf to Surf Trail and is a Regional Trail Refinement Area in the TSP.

**Transit Mode**

The study area is currently served by both bus and rail transit in the vicinity, though there is not existing transit service running along 170th Avenue or the majority of Merlo Road. The MAX Blue Line crosses both 170th Avenue and Merlo Road, with stations at each of these points – Elmonica/170th Ave, which has a 430-space park-and-ride and bicycle racks, and Merlo/158th Ave. The Blue line provides service every 5-10 minutes during the morning and evening commute hours, with roughly trains arriving roughly every 15 minutes in off-peak hours between 3:30 a.m. and 1:00 a.m. Currently there is bus service connecting the Merlo Rd/158th Ave station to the north along 158th Ave (route #67), and future bus service is planned in the TriMet Westside Service Enhancement Plan along Segments 2 and 3 of the study corridor, as well as along Jenkins Road. The #67 bus currently travels between Bethany and the Merlo/170th Ave MAX station at approximately 15 minute headways during the commute hours, and its future expansion would create a major north/south transit connection between Bethany, the Nike Campus, Aloha, South Beaverton/Progress Ridge, and Tigard.

Figure 9 shows the existing and planned transit in the study corridor.

**Safety**

Washington County maintains a Safety Priority Index System (SPIS) to help identify and rank potentially hazardous intersections based on three years of crash data. Intersections included in the list have three or more crashes or one or more severe injury or fatal crashes. The 2010-2012 SPIS identified several intersections in the corridor based on their crash history, summarized in Table 1.

**Table 1: Corridor intersections on SPIS list**

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Rank</th>
<th>Total Crashes</th>
<th>SPIS Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>170th Ave / Alexander Street</td>
<td>147</td>
<td>9</td>
<td>40.0</td>
</tr>
<tr>
<td>170th Ave / Baseline Road</td>
<td>127</td>
<td>22</td>
<td>44.4</td>
</tr>
<tr>
<td>170th Ave / Tualatin Valley Hwy</td>
<td>21</td>
<td>47</td>
<td>76.4</td>
</tr>
<tr>
<td>158th Ave / Jenkins Road</td>
<td>9</td>
<td>47</td>
<td>80.0</td>
</tr>
</tbody>
</table>
Available Right-of-Way (ROW) and Existing Cross Sections

Appendix A includes larger scale figures of the corridor by segments. They identify the existing right-of-way and parcel lines throughout the corridor overlaid on an aerial photo base. As shown, the existing right-of-way varies throughout the corridor. Table 2 provides a summary of the minimum, maximum, and predominant (a typical range) right-of-way for each of the three study area segments.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Minimum ROW (ft)</th>
<th>Maximum ROW (ft)</th>
<th>Predominant ROW (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment 1 (SW 170th Ave. North)</td>
<td>52’</td>
<td>90’</td>
<td>75’-90’</td>
</tr>
<tr>
<td>Segment 2 (SW 170th Ave. South)</td>
<td>55’</td>
<td>140’</td>
<td>65’-75’</td>
</tr>
<tr>
<td>Segment 3 (SW Merlo Rd)</td>
<td>75’</td>
<td>95’</td>
<td>85’</td>
</tr>
</tbody>
</table>

The following cross-sections provide estimated facility widths and a view of the corridor in Google Streetview for several locations throughout the corridor. As shown, there are several locations throughout the corridor where there is available right-of-way for improvements; however, it may not be sufficient to accommodate the ultimate future cross-section.
Segment 1: 170th Avenue at Berkeley Lane (90 feet ROW)

Segment 2: 170th Avenue at Augusta Lane (70 feet ROW)
Segment 2: 170th Avenue at Nyssen Street (90 feet ROW)

Segment 3: Merlo Road (75 feet ROW)
Utilities

Utilities within the study area are overhead and underground. Overhead power runs along the east side of 170th Avenue from Baseline Road to Merlo Road/Marty Lane then heads toward the east. The overhead power starts again from just north of 170th Avenue/Berkeley Lane intersection and runs along the east side toward Alexander Street, then diverges to the northeast and continues past Tualatin Valley Highway. Overhead telephone/cable runs along the power poles. Other utilities in the corridor include underground fiber optics cables, telephone, water, gas, sanitary sewer, and storm drains. Street lighting is limited throughout the corridor. There are existing traffic signals on 170th Avenue at the Baseline road, Merlo Road, Alexander Street, and Tualatin Valley Highway intersections. There is also a traffic signal at Merlo Road and Jenkins Road. Figure 10 shows the existing utility lines in the corridor.

In reviewing the pole locations, Google images, right-of-way, and tax lots maps have been utilized to assess whether these poles have a direct impact to the safety of the corridor due to their locations. All of the poles along the 170th Avenue have been placed at least 2 feet from the edge of curb and/or pavement except for the pole at the southwest corner of the Johnson Street/170th Avenue intersection. This pole is at the edge of pavement return and appears to be less than two feet from the pavement. The majority of the poles along this corridor appear to have been placed within the right-of-way except for a few locations. Between Heritage Court and Johnson Street, there are two poles that appear to have been placed outside of the street right-of-way. Approximately 300 feet north of Johnson Street, there is an existing pole that appears to have been placed outside of the right-of-way. Between Vendla Park Lane and Augusta Lane, there are two poles that appear to have been placed outside of the right-of-way. There is no available record of utility easement for these poles. Along the Merlo Road corridor, the existing utility poles appear to have been placed within the right-of-way and at least 2 feet from the edge of curb. A phone inquiry to Portland General Electric indicates that there is no plan for scheduled maintenance or upgrades for the 170th Avenue and Merlo Road corridors.
Existing utility poles on Merlo Road (left) and utilities adjacent to the bridge crossing on 170th (right)
APPLICABLE STANDARDS AND GUIDELINES

This section reviews a variety of standards and guidelines from different sources that apply to the study corridor, including local, regional, and national level guidance. This section includes reviews of the following:

- Washington County Bicycle Facility Design Toolkit
- Washington County Roadway Design and Construction Standards
- American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Street (Green Book)
- National Association of City Transportation Officials (NACTO) Guidelines
- Metro Regional Active Transportation Plan
- Americans with Disabilities Act (ADA)
- Federal Highway Administration (FHWA) Cycle Track Report
- Roundabouts: An Informational Guide (NCHRP Report 672)

Washington County Bicycle Facility Design Toolkit

The Washington County Bicycle Facility Design Toolkit supplements the Washington County Road Design Standards by offering design guidance on innovative bikeway facilities that are not currently addressed in the road standards and is consistent with national standards and references developed by AASHTO, FHWA, the United States Access Board, and NACTO. It identifies appropriate bicycle facilities according to the user type that is desired to be accommodated or attracted to.
the facility as well as the characteristics of the roadway.

Table 3 identifies some of the roadway characteristics relevant to selecting a bicycle facility type. Based on the characteristics of the study area roadway segments and the desire to incorporate a wide range of users, including those defined as **Interested, but Concerned** or **Type C (Concerned)**, the study area segments are recommended to be designed to Protection Level 2 or 3 per the Washington County Bicycle Facility Design Toolkit. Within the urban context, Level 2 protection includes bike lanes or buffered bike lanes and Level 3 protection includes bike lanes, buffered bike lanes, or cycle tracks.

These Level 2 and Level 3 designations are consistent with each of the study area segments designations in the County’s Transportation System Plan as **Major Street Enhanced Bikeways**. **Major Street Enhanced Bikeways** are urban Arterial or Collector roadways that have, or are planned to have, buffered bike lanes or cycle tracks on one or both sides of the road.

**Table 3: Bicycle Toolkit Recommendations for Study Corridor Segments**

<table>
<thead>
<tr>
<th></th>
<th>Segment 1</th>
<th>Segment 2</th>
<th>Segment 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roadway</strong></td>
<td>170th Avenue (Baseline Road to Merlo Road)</td>
<td>170th Avenue (Merlo Road to Tualatin Valley Highway)</td>
<td>Merlo Road (170th Avenue to Jenkins Road)</td>
</tr>
<tr>
<td><strong>Characteristics</strong></td>
<td><strong>Roadway Functional Classification</strong></td>
<td><strong>Arterial</strong></td>
<td><strong>Arterial</strong></td>
</tr>
<tr>
<td>Average Daily Traffic (2013)</td>
<td>11,700</td>
<td>16,200</td>
<td>8,600</td>
</tr>
<tr>
<td>85th Percentile Speed</td>
<td>39 mph</td>
<td>45 mph</td>
<td>39 mph</td>
</tr>
<tr>
<td>Desired User Groups</td>
<td>Advanced, Basic, &amp; Concerned</td>
<td>Advanced, Basic, &amp; Concerned</td>
<td>Advanced, Basic, &amp; Concerned</td>
</tr>
<tr>
<td>Connect to School?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Recommended Protection Level</strong></td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Design Considerations/Constraints</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freight, Transit, or Emergency Route?</td>
<td>Transit/Freight</td>
<td>Transit/Freight</td>
<td>Transit/Freight</td>
</tr>
<tr>
<td>Frequent Driveways?</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>On-street Parking?</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Challenging Geometry?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROW Constraints?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Structures?</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

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1 These types include people of all ages, such as school children, who enjoy bicycling but may only ride on shared use paths, protected on-street facilities, or low traffic local streets.

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Kittelson & Associates, Inc.  
Portland, Oregon
Table 3 also identifies some of the design considerations and constraints that should be considered when selecting a bicycle facility type. The range of facility types that would be appropriate on an urban arterial include:

- Conventional Bike Lane
- Buffered Bike Lane
- Protected Cycle Track
- Raised Cycle Track
- Two-Way Cycle Track
- Multi-use Off-Street Path

The desire for Level 2 or Level 3 protection needs to be considered in the context of the design considerations and constraints identified above and with the design guidance provided in the Washington County Bicycle Facility Design Toolkit for each of the facility types above. This guidance is included in Appendix B.

The Washington County Bicycle Facility Design Toolkit also includes design guidance on treatments for bicyclists at intersections and driveways. The range of treatment types that would be appropriate in the study area include:

- Colored Pavement in Conflict Zone
- Bicycle Signal
- Intersection Crossing Markings
- Bike Box
- Two-Stage Left-Turn Queue Boxes
- Wayfinding
- Lighting

Applicability and design guidance on these treatments as well as intersection striping for bike lanes, buffered bike lanes, and cycle tracks is provided in the Washington County Bicycle Facility Design Toolkit for each of the treatment types above. This guidance is also included in Appendix B.

Providing Level 2 and Level 3 treatment types on Arterials will require one of three modifications to existing plans and/or standards:

- Additional right-of-way and pavement width beyond what is identified in the Washington County Road Design Standards for Arterials;
- A reduction in the number of planned lanes;
- A reduction from the standard width for travel lanes on arterials.

Table 4 identifies the amount of additional right-of-way and pavement width beyond a typical arterial that is necessary to accommodate an Enhanced Bikeway if no modifications are made to the typical street section. Kittelson & Associates, Inc. prepared a white paper to accompany the Washington
County Bicycle Facility Design Toolkit summarizing the research on lane width design modifications, included in Appendix C. Additional guidance on reduced lane widths is provided in NACTO’s Urban Streets Design Guide, including considerations for transit and freight. Future transit planned along Segment 2 and 3 will need to be considered in the evaluation.

Table 4: Right-of-way and pavement needs for Enhanced Bikeways

<table>
<thead>
<tr>
<th>Segment 1</th>
<th>TSP Planned Facility (ft)</th>
<th>Required ROW (ft)</th>
<th>Required pavement width (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(170th Ave. North)</td>
<td>Three-lane arterial w/ Enhanced Bikeway</td>
<td>90’ (sufficient for enhanced bikeway)</td>
<td>50’ + (3’ to 9’ for Enhanced Bikeway)</td>
</tr>
<tr>
<td>Segment 2</td>
<td>Five-lane arterial w/ Enhanced Bikeway</td>
<td>98’ + (3’ to 9’ for Enhanced Bikeway)</td>
<td>74’ + (3’ to 9’ for Enhanced Bikeway)</td>
</tr>
<tr>
<td>(170th Ave. South)</td>
<td>Five-lane arterial w/ Enhanced Bikeway</td>
<td>98’ + (3’ to 9’ for Enhanced Bikeway)</td>
<td>74’ + (3’ to 9’ for Enhanced Bikeway)</td>
</tr>
</tbody>
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Washington County Roadway Design and Construction Standards

The provisions of the Washington County Roadway Design and Construction Standards are “intended to provide a safe and reliable transportation system and to preserve, protect, and improve the public transportation infrastructure.” The standards are in place to “ensure long-term viability of the transportation system and avoid unnecessary and excessive maintenance and replacement costs,” however, they are flexible, providing a process for exceptions to the standards in situations where any of the following occurs:

1. The specification or standard does not apply in the particular application;
2. Topography, right-of-way or other geographic conditions impose an economic hardship on the applicant and an equivalent alternative is available which can accomplish the same design objective;
3. A minor change to a specification or standard is required to address a specific design or construction problem which if not allowed will result in an undue economic hardship.

Design exceptions must be approved by the County Engineer.

The Standards were reviewed to identify applicable standards for the 170th Avenue / Merlo Road corridor. The remainder of this section summarizes the most applicable standards. In addition to the sections highlighted in detail, the Standards also provide guidance on landscaping, retaining walls, driveways, traffic management devices, roadway illumination, and other roadway design topics along with standard drawings, which would be consulted in the design phase of the project.
Cross Sections

- For rural and interim urban roads, 6-foot wide shoulders are required.
- Arterials have 45-mph design speed and collectors have 35-mph design speed.
- For A-2 (Five-lane arterial), standards require 98-foot ROW, 74 foot paved width, four 12-foot travel lanes, a 14-foot center turn lane, 6-foot bike lanes, a 4.5-foot buffer between roadway and sidewalk, and a 5-foot sidewalk (Exhibit #1 in document, included in Appendix D).
- For A-4 (three-lane arterial), standards require 90-foot ROW, 50 foot paved width, two 12-foot travel lanes, a 14-foot center turn lane, 6-foot bike lanes, a 4.5-foot buffer between roadway and sidewalk, and a 5-foot sidewalk (Exhibit #1 in document, included in Appendix D).
- For C-1 (three lane collector), standards require 74-foot ROW, 50 foot paved width, two 12-foot travel lanes, a 14-foot center turn lane, 6-foot bike lanes, a 4.5-foot buffer between roadway and sidewalk, and a 5-foot sidewalk (Exhibit #2 in document, included in Appendix D).

Roadway Design Elements

- Design controls for crest vertical curves for 45-mph design speed require a minimum K-value of 61 feet (the minimum length of curve per one percent difference in grade). For sag vertical curves, the minimum K value is 79 feet for a 45-mph design speed. Exhibits #7 and #8 (included in Appendix D) in the Standards provide values for other design speeds.
- Sag vertical curves may use shorter curves with the installation of additional road lighting.
- The minimum radius for a horizontal curve on a zero slope roadway is 930 feet for 45-mph arterial design speed. Exhibit #9 (included below) provides additional details for other design speeds and roadway slopes.
• Also provides guidance on transitions into dedicated turn lanes.
• Clear zones must meet AASHTO guidelines; and for curbed roadways, “in no case shall the horizontal clearance from face-of-curb to the face of non-breakaway obstacles be less than 2 feet.”
• Intersection design:
  o Sidewalks and crosswalks must meet ADA guidelines.
  o Curb ramps must be provided at all corners of all intersections.
  o Minimum curb radius for an Arterial to Arterial is 55 feet; Arterial to Collector is 40 feet.
    In areas where bike lanes or on-street parking exist, the radii may be reduced by five feet.

Ancillary Facilities

• Bikeways shall be required in accordance with Community Development Code and Transportation System Plan.
• Urban arterial and collector roads shall include curbs on both sides except in situations of interim width improvements. Interim width urban roads shall have six foot wide shoulders with a minimum two-foot paved width adjacent to the road at the road cross-slope.

Drainage Design

The roadway improvements to the study corridor will add a significant impervious area which will result in the increase in stormwater runoff. This will trigger water quality treatment, conveyance design, and may require stormwater detention. Applicable design standards include Washington County Roadway Design and Construction Standards, Cleanwater Services Design and Constructions Standards, Cleanwater Services Low Impact Development Approaches (LIDA) handbook, and City of Beaverton Engineering Design Manual. Other standards may apply to the project through the SLOPES V requirements (SLOPES for Stormwater, Transportation or Utilities) by National Marine Fisheries Service (NMFS) and Army Corps of Engineers due to wetland and potential impact within the corridor.

• Water Quality:
  o Runoff treatment from 0.36 inches of precipitation falling in 4 hours with 96 hours storm event (CWS Standards)
  o Runoff treatment from 50% 2-year, 24-hour storm event (SLOPES V Standards if applicable)

• Conveyance:
  o 25-year, 24-hour storm event

• Detention:
  o 42% of 2-year, 24-hour storm event (SLOPES V Standards if applicable)
  o 2-year, 24-hour storm event (CWS Standards)
  o 10-year, 24-hour storm event (CWS and SLOPES V Standards)
25-year, 24-hour storm event (CWS Standards)

Utilities

The corridor improvements will affect both overhead and underground facilities and may require relocations, utility system expansion, or relocation due to conflicts with the new drainage system. The extent of utility impacts or relocations is not known and cannot be discussed extensively until a conceptual roadway layout has been developed. Early coordination and meetings with affected utility companies are necessary since these works can affect project schedule and/or right of way acquisition process.

American Association of State Highway and Transportation Officials guidelines

The Washington County Roadway Design and Construction Standards provide the primary source of guidance for roadway design and construction in the County, and draw on the same principles and guidance found in the AASHTO Green Book, the AASHTO Roadside Design Guide, and the AASHTO Guide for the Development of Bicycle Facilities. Therefore, this document does not provide a thorough review of these documents, except in the case of the clear zone, specifically referenced by the Washington County Roadway Design and Construction Standards. The Standards state that the engineer is responsible for meeting AASHTO guidelines. In the case of uncurbed roadways, the Standards directly apply guidance from the AASHTO Roadside Design Guide. However, AASHTO guidance notes that clear roadsides are not practical on urban arterials with curbs. “In such areas, a clearance between the curb face and object of 1.5 feet should be provided. A 3-foot clearance to roadside objects should be provided particularly near turning radii at intersections and driveways.” The County’s Standard of two feet between the curb face and any non-breakaway obstacles meets the minimum of 1.5 feet in the AASHTO guidance. The 4.5 foot buffer between the sidewalk and roadway in the County’s design standards allows enough space for street trees and utility poles to be located in this space while still meeting the two-foot clearance standard.

National Association of City Transportation Officials Guidelines

The FHWA has officially endorsed use of the guidance from NACTO, both in its Urban Bikeway Design Guide (2012) and its Urban Street Design Guide (2013). Washington County’s own bicycle facility toolkit drew on the guidance from the Urban Bikeway Design Guide, with specific guidelines customized for Washington County. Because of this, the Urban Bikeway Design Guide was not reviewed further. However, the Urban Street Design Guide was reviewed for certain aspects that may be applicable to the 170th Avenue/Merlo Road corridor.

Urban Street Design Guide

NACTO’s Urban Street Design Guide (USDG) was developed in response to a growing need from cities for design guidance that better meets their complex needs and moves away from a bias towards
highway designs. The Urban Street Design Guide focuses guidance on “making streets safe and inviting for people walking, shopping, parking, and driving in an urban context. These principles are about creating real spaces for people on city streets. Economic development is integrally tied into this transformation, since great streets support city businesses.” The 170th Avenue/Merlo Road study area is in transition from a more rural/suburban character to being a more urban area. 170th Avenue forms the eastern edge of the adopted Aloha Town Center and corresponding Pedestrian/Bicycle District. However, it is not a fully urban area and some principles that would apply in a dense city core may not apply. The following provides a summary of the Urban Street Design Guide recommendations potentially applicable to the study area.

**Lane Widths**

- NACTO recommends lane widths of 10 feet, with 11 feet on truck or transit routes, in order to discourage speeding and positively impact safety by reducing crash severity. Studies have shown that reductions of lane widths do not impact operations (the measured saturation flow rates are similar for lane widths between 10 feet and 12 feet).
- NACTO USDG states, “Lane widths greater than 11 feet should not be used as they may cause unintended speeding and assume valuable right-of-way at the expense of other modes...Restrictive policies that favor the use of wider travel lanes have no place in constrained urban settings, where every foot counts.”

**Sidewalk Zones**

- NACTO recommends including extra sidewalk width for a *frontage zone* between walking space and adjacent land use (to accommodate street furniture, trash receptacles, bus stops, or signage).
- The *pedestrian through zone* should be 5-7 feet in residential areas, and 8-12 feet in commercial areas.
- The *street furniture/curb zone* may include utility poles, lighting, benches, bicycle parking, etc.
- The *enhancement BUFFER zone* is between the sidewalk and the street, and may include stormwater management, parking, cycle tracks, etc.
Diagram from the *Urban Streets Design Guide* showing four sidewalk zones

**Sidewalk Design**

- An absolute minimum is 5 feet, but in an urban context, sidewalks should go beyond the minimum width.  
- At intersections with driveways, sidewalks should be maintained at-grade through the conflict zone.
- Location of fixed objects (utility poles, light fixtures) should not impinge on or restrict the walkway.
- On urban arterials, sidewalks of minimum dimensions directly adjacent to the traveled way should be avoided.

**Bus Stops**

- NACTO USDG states, “Bus stops must have safe access via sidewalks and appropriate street crossing locations. Where possible, pedestrian crossings should be accommodated behind the departing transit vehicle.”
- Include adequate lighting around bus stops to ensure security.

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2 The Oregon Department of Transportation standards designate a 6-foot minimum sidewalk width.
Intersections

- Minimize unused space.
- Use leading pedestrian intervals on signalized intersections.
- Accommodate bicyclists through full signalization or mixing zones.
- Delineate guide markings through intersections to guide vehicles and reduce conflicts.
- Reduce vehicle speeds to match sight distance, rather than enlarging the intersection or removing obstructions.
- Use raised crossings and curb extensions to limit turning speeds where possible.
- Minimize curb radii – 10-15 feet in urban areas, with radii exceeding 15 feet the exception.
- Shorten signal cycles and keep number of phases to a minimum.

Design Speed

- Speeds play a critical role in the cause and severity of crashes.
- Conventional highway design selects a design speed based on how fast vehicles are going (85th percentile speeds). NACTO recommends a proactive urban street design approach, designing streets using a target speed, the speed you would like drivers to go. Maximum target speed for urban arterial streets is 35 mph.

Metro Regional Active Transportation Plan

The Metro Regional Active Transportation Plan identifies a vision, policies and actions to complete a seamless green network of on- and off-street pathways and districts connecting the Metro region and integrating walking, biking and public transit. The following provides a summary of the plan within the study area.

- The plan designates all three study area segments as on-street regional pedestrian corridors. This is the second highest functional classification in the plan. Regional pedestrian corridors are any major or minor arterial street or regional trail that is not designated as a pedestrian parkway.
- Much of the corridor, including the Elmonica/170th Ave and Merlo/158th Ave station areas and the area west of the southern part of Segment 2, is included in the Regional Pedestrian District designation, areas that “correspond with 2040 Growth Concept Design Types - the Central City, Regional and Town Centers and Station Communities; bicycle and pedestrian districts are the same. All streets and trails within a district are part of the regional pedestrian network. A pedestrian district is an area with a concentration of transit, commercial, cultural, educational, institutional and/or recreational destinations where pedestrian travel is attractive, comfortable and safe. Pedestrian districts are areas where high levels of walking exist or are planned.”
- Includes the Vine Maple Trail, the Westside Trail, and the Beaverton Creek Trail.
- Designates all three segments of the study area as on-street regional bikeways. This is “the second highest functional classification and, like bicycle parkways, can be on any type of facility.
Regional bikeways connect to bicycle parkways and complete the regional network of bicycle routes.

- Tualatin Valley Highway is designated as both a bicycle parkway and a pedestrian parkway (the highest functional classification for each), with the potential for off-street facilities, on-street facilities, or both.

Pedestrian map from Regional Active Transportation Plan

Americans with Disabilities Act

The Public Rights-of-Way Proposed Guidelines specify design details to ensure accessibility by all users, including geometric design of sidewalks, pedestrian signals, crosswalks, and other right-of-way characteristics. These guidelines will be followed in the development of the actual design for the 170th
Avenue/Merlo Road corridor and are not outlined extensively here. However, design of roundabouts is an area that is currently evolving with respect to designing for visually impaired pedestrians.

To date, the United States Access Board, which publishes the ADA Standards, has not put forth requirements for single-lane roundabouts to have additional design features for visually impaired pedestrians. However, guidelines currently suggest that multi-lane roundabouts should have a pedestrian activated signal, pedestrian hybrid beacon, or other feature that provides equivalent facilitation at pedestrian crossings of all legs.

NCHRP 03-78B is an ongoing research effort looking into other types of treatments that may provide equivalent facilitation and the different situations in which they work best; however, the US Access Board has not yet made a determination of a performance measure or threshold that will determine equivalent facilitation. Currently, the responsibility for demonstrating equivalent facilitation in the event of a challenge rests with the covered entity.

FHWA Cycle Track Report

The FHWA recently sponsored research into planning, safety, and design of cycle tracks. The draft document will be released by late 2014 and provides information about various design considerations related to cycle tracks, including one-way and two-way designs; interactions with ADA parking spaces, bus stops, and loading zones; intersection treatments; and connections to other types of bicycle facilities, including bike lanes and off-street paths. Kittelson & Associates, Inc. is part of the consultant team that performed the research and developed the report and will be able to draw on the recommendations of the report in the Solution Alternatives memorandum.

Roundabouts: An Informational Guide (NCHRP Report 672)

Roundabouts: An Informational Guide provides guidance on all aspects of implementing roundabouts. In particular, Chapters 6 through 10 offer guidance on geometric design, traffic control devices, illumination, landscaping, and construction and maintenance. Of primary relevance to the 170th Avenue/Merlo Road concept design is understanding the spatial needs for a potential roundabout at the 170th Avenue/Merlo Road intersection. Roundabouts: An Informational Guide provides typical ranges for the inscribed diameters of various roundabout types, shown below in Exhibit 6-9 from the guide. The likely design vehicle for a roundabout would be a WB-67 tractor-trailer combination. Considering the addition of pedestrian facilities, a landscape buffer and potential bicycle facilities, the circle diameter for the full right-of-way needed could be 20-40 feet wider than the ranges in Exhibit 6-9 from Roundabouts: An Informational Guide, included below.
### Exhibit 6-9

Typical Inscribed Circle Diameter Ranges

<table>
<thead>
<tr>
<th>Roundabout Configuration</th>
<th>Typical Design Vehicle</th>
<th>Common Inscribed Circle Diameter Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-Roundabout</td>
<td>SU-30 (SU-9)</td>
<td>45 to 90 ft (14 to 27 m)</td>
</tr>
<tr>
<td>Single-Lane Roundabout</td>
<td>B-40 (B-12)</td>
<td>90 to 150 ft (27 to 46 m)</td>
</tr>
<tr>
<td></td>
<td>WB-50 (WB-15)</td>
<td>105 to 150 ft (32 to 46 m)</td>
</tr>
<tr>
<td></td>
<td>WB-67 (WB-20)</td>
<td>130 to 180 ft (40 to 55 m)</td>
</tr>
<tr>
<td>Multilane Roundabout (2 lanes)</td>
<td>WB-50 (WB-15)</td>
<td>150 to 220 ft (46 to 67 m)</td>
</tr>
<tr>
<td></td>
<td>WB-67 (WB-20)</td>
<td>165 to 220 ft (50 to 67 m)</td>
</tr>
<tr>
<td>Multilane Roundabout (3 lanes)</td>
<td>WB-50 (WB-15)</td>
<td>200 to 250 ft (61 to 76 m)</td>
</tr>
<tr>
<td></td>
<td>WB-67 (WB-20)</td>
<td>220 to 300 ft (67 to 91 m)</td>
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* Assumes 90° angles between entries and no more than four legs. List of possible design vehicles is not all-inclusive.
OPPORTUNITIES AND CONSTRAINTS

Implementation of the facilities outlined in the recent update to the Transportation System Plan will face some challenges in the study corridor, due to physical and, to some extent, policy constraints. However, improvements in the corridor present a significant opportunity to improve connections for various modes in the study area. This section outlines the opportunities and constraints that will need to be considered in the development of a conceptual design:

**Urban / suburban tension:** The corridor lies in an area in transition from a rural/suburban character to a more urban one. There is a tension between creating more urban-type facilities in the station areas, residential areas, and near schools on one hand and providing a high-capacity arterial for vehicles and freight on the other. This tension is also apparent in the different sources of roadway design guidance, including AASHTO’s Green Book, NACTO’s Urban Streets Design Guide, and Washington County’s Roadway Design & Construction Standards. However, this tension and transitioning character of the study corridor can provide an opportunity to build on the County’s growing multi-modal system and provide an example of designing facilities that need to fulfill multiple purposes.

**Transportation System Plan designations and the design standards:** The transportation system plan designates all three segments of the corridor as enhanced major street bikeways, requiring a buffered bike lane or cycle track on each. For segments 2 and 3, the TSP also designates the facilities as 4-5 lane arterials. In order to fulfill both of these items, the roadways would either require additional right-of-way beyond the 98 feet indicated in the Standards, or they would need to consider using narrower travel lane widths than those shown in the standards. However, the design standards currently offer flexibility in design with the design exception process, as described in the preceding section.

**Narrow available right-of-way:** One of the primary challenges in the 170th/Merlo corridor is related to the available right-of-way, which ranges throughout the corridor and the three segments as shown in Table 3 above and in Figure 11. None of the three segments has sufficient right-of-way to implement the designation of the transportation system plan, and obtaining additional right-of-way poses a challenge in terms of cost and property impacts. Minimizing the overall footprint of the roadway may also be desirable in the context of sensitive natural features and parkland. The corridor may have the potential to narrow the center median in areas where no turn lanes are needed to as low as four feet, a design exception that has been implemented in other areas in the County. However, as noted in the Washington County Bicycle Facility Toolkit, in order to implement the enhanced facilities as indicated in the TSP, one of three options will need to be selected:

- Increase the overall width of the right-of-way beyond the current cross sections in the Washington County Roadway Design & Construction Standards.
- Decrease automobile travel lane widths.
- Reduce the number of automobile travel lanes.
Figure 11. Areas with the minimum right-of-way in each segment

Natural water features: Segment 2 currently has a two-lane bridge crossing Beaverton Creek that runs through Tualatin Hills Nature Park, with a number of utility pipes also crossing alongside the bridge. In order to make any improvements to Segment 2, including widening or adding bicycle or pedestrian facilities, the bridge will need to be replaced and utilities relocated. Segment 1 also has a wetland area abutting the corridor near the MAX crossing that may complicate the addition of right-of-way at this pinch-point. Improving the bridge in Segment 2, however, will provide the opportunity to enhance the riparian corridor connection of Beaverton Creek between the Tualatin Hills Nature Park and the greenway to the west.
Utilities adjacent to the bridge (left) and Beaverton Creek bridge (right)

Rail crossings: The MAX line crosses the corridor in two places – on Segment 1 and Segment 3. On Segment 1, this crossing represents the narrowest point in the right-of-way for Segment 1, and currently has no bicycle facilities, though a midblock crossing with an RRFB was recently constructed to the south of the light rail tracks. However, the presence of the MAX line and the stations within the study area provide an immense opportunity to increase multi-modal movement in the study corridor. People traveling to and from the MAX stations can already do so via bike or on foot; with enhanced multi-modal facilities, even more will be encouraged to do so. In addition, bus service is ultimately planned to run on Segments 2 and 3, and this will expand transit service coverage in the neighborhood to further enable residents to make non-single-occupant-vehicle mode choices.

MAX Crossing on Merlo Road (left) MAX Crossing on 170th Avenue (right)
Tualatin Hills Nature Park: Currently the park has many old trees growing adjacent to the property line, with branches overhanging the side of the road (on Segment 2), creating an appealing aesthetic, which may make it difficult to widen the roadway to include the facilities designated in the Transportation System Plan. Also, the park is bounded by a tall fence, with two entrances on the western side of the park, and no marked crossing areas to access the park from neighborhoods to the west, decreasing its accessibility to the residents. However, a redesign of the walking and biking facilities along the study corridor has the potential to substantially enhance community access to the park, already an immense asset in the community.

On-street bicycle and pedestrian facility connections with regional trail network: The study area is surrounded by Washington County’s existing and planned network of paved multi-use trails, including the Waterhouse Trail, Vine Maple Trail, Beaverton Creek Trail, and Westside Trail. The redesign of the study corridor presents an opportunity to provide added connectivity to these trails and enhance access to adjacent land uses through protected on-street bicycle and pedestrian facilities.

170th Avenue/Merlo Road Intersection: The 170th Ave/Merlo Road intersection represents a future challenge and an opportunity. Existing and forecast vehicular traffic patterns and plans indicate that the Segment 2 and Segment 3 portions of the study corridor will carry much of the north/south demand. In addition, pedestrian and bicyclist demand is likely to increase moving through the intersection in all directions, especially considering the increasing levels of development in the vicinity. The intersection of 170th Avenue/Merlo Road will need to be thoughtfully designed to provide enhanced safety and comfortable movement of all modes through the intersection. The area presents the opportunity to consider innovative bicycle crossing treatments, a roundabout, or other potential design ideas.

Phased implementation: Because of the difficulty and high costs of obtaining sufficient right-of-way to meet the TSP designations, there is an opportunity to phase implementation of improvements along the study corridor. An initial phase improvement could include three-lane cross sections throughout
the corridor with improvements to bicycle and pedestrian facilities. This type of facility could be accommodated within the existing right-of-way for the majority of the corridor (with some exceptions). A future phase could then complete the roadway widening to five lanes, requiring ROW acquisition along all of Segment 2 and 3. A phased implementation would distribute the costs of the project over time and would allow for pedestrian and bicycle access sooner rather than later.

**Stormwater/drainage/infrastructure:** The corridor improvements present an opportunity to collect and treat stormwater runoff where none exists today. Additionally, there is an opportunity to repair and upgrade existing damaged or undersized conveyance system. The narrow right of way poses a major challenge to finding opportunities to treat stormwater runoff using Low Impact Development Approach (LIDA) facilities. A phased approach to constructing the roadway would distribute the cost over time, and project phasing would be a consideration in designing a conveyance system and treatment facility for the ultimate build out condition. A phased system could be designed for future modification when the road is widened to its full cross-section.

**APPENDICES**

Appendix A: Large-scale figures of study corridor

Appendix B: Washington County Bicycle Facility Design Toolkit selected pages

Appendix C: White Paper to Support Bicycle Facility Design Toolkit on Lane Width Design Modifications

Appendix D: Washington County Road Design and Construction Standards selected exhibits
Appendix A    Large-scale figures of Corridor