



Sellwood Bridge Existing Roadway Deficiencies

Executive Summary

Purpose

Roadway design standards are developed to support safety and mobility goals. Roadway deficiencies have a critical impact on the safe and efficient use of the road by all travelers. Sight distance, for example, has a standard for minimum stopping distance depending on the classification, speed, and location of a road. Insufficient sight distance can be a safety concern because drivers may not have enough time to avoid hitting an object in the road, or might result in a rear-end collision.

This memorandum highlights the existing roadway deficiencies in the vicinity of the Sellwood Bridge. The deficiencies identified in this memo will be used to:

- Inform the project's purpose and need statement, and
- Lay the groundwork for the development of project alternatives.

The deficiencies listed here are limited to those in the immediate project area. Roadway deficiencies outside of the project area could be addressed by other agencies in relation to this project.

Methodology

This analysis surveyed the geometric, access, and bicycle/pedestrian conditions in the vicinity of the Sellwood Bridge. These current conditions were compared with relevant federal, state, and local standards.

Study Area

The study area includes the Sellwood Bridge and the intersection of the bridge with Highway 43/Macadam Avenue. The analysis has been organized into six segments, which are listed below and illustrated in Figure ES-1:

- Segment 1 – Highway 43 mainline
- Segment 2 – Highway 43 northbound bypass ramp
- Segment 3 – Highway 43 southbound loop ramp
- Segment 4 – Sellwood Bridge
- Segment 5 – Westside bicycle/pedestrian connection to Willamette Greenway Trail
- Segment 6 – Tacoma Street

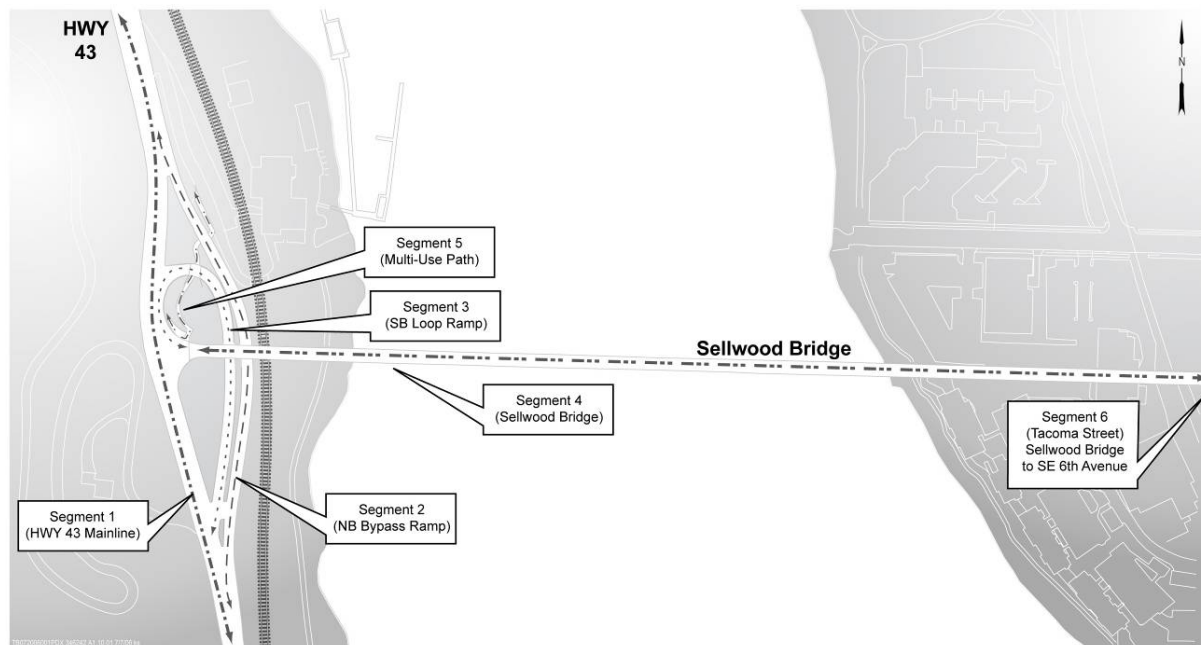


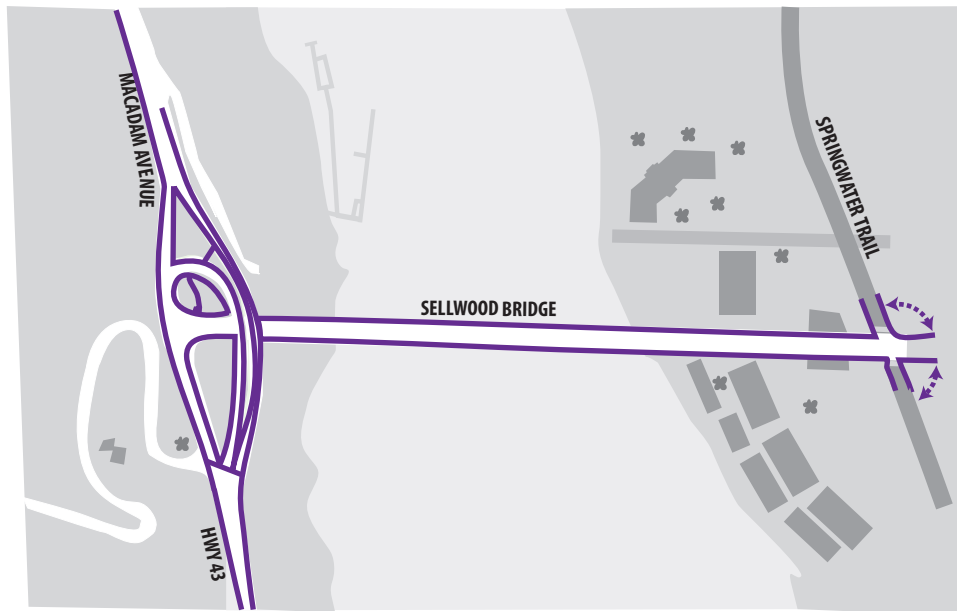
Figure ES-1: Study Area for Roadway Deficiencies Analysis

Summary of Findings

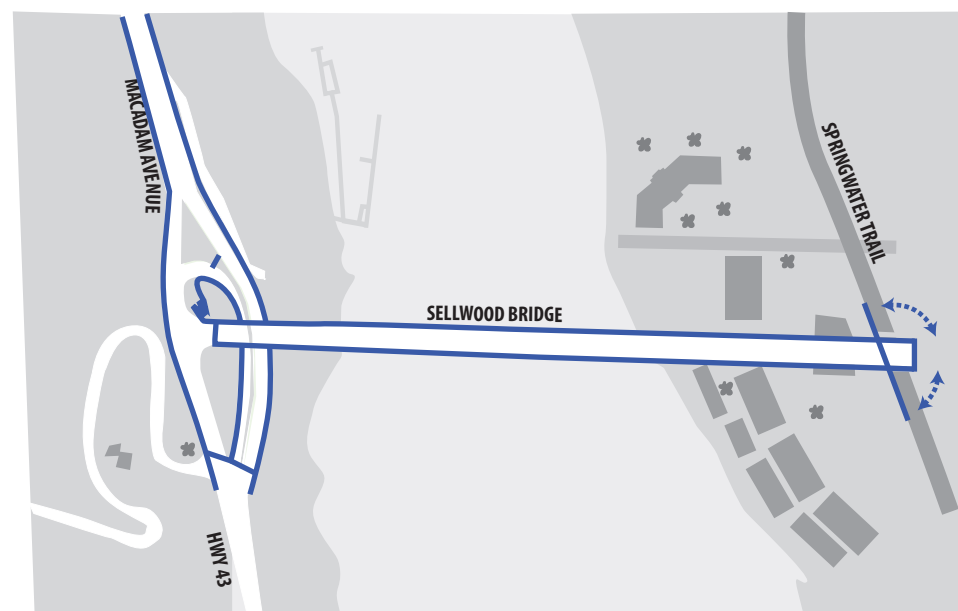
Although numerous roadway deficiencies were identified and summarized in the background technical memorandum, those listed below and illustrated in Figures ES-2 and ES-3 are most critical. These deficiencies should be included in the project purpose and need statement, and should be resolved or otherwise addressed through the alternatives development process.

- 1** **2** • **Bicycle and Pedestrian Facilities**—There are no bicycle lanes and narrow or nonexistent sidewalks on both the Sellwood Bridge and on Highway 43, Macadam Avenue. Bicycle and pedestrians are forced to share common space, which is too narrow to be shared safely. This lack of adequate bicycle and pedestrian facilities creates a safety concern and is a barrier between elements of the local and regional bicycle and pedestrian network. Furthermore, bicycle lanes, sidewalks, crosswalks, and access routes throughout the study area are not compliant with the Americans with Disabilities Act (ADA).
- 5** • **Stopping Sight Distance**—There are segments of Highway 43, Macadam Avenue where safe stopping sight distance is not provided due to the horizontal or vertical curvature of the roadway. Adequate stopping sight distance (the distance for a vehicle traveling at normal speeds to stop) is needed to give drivers enough time to safely stop their vehicles once a road obstruction has become visible. Obstacles such as retaining walls and steep hillsides block the line of sight around corners when they are located too close to the travel lane. If the “hump” of a vertical curve is too extreme, it will block the line of sight to the other side of the hill.
- 3** • **Lane, Shoulder, and Median Widths**—There are narrow travel lanes and narrow or nonexistent shoulders and medians throughout the study area. These deficiencies increase the potential for collisions between vehicles. Lane and median widths have an impact on driver comfort, safety, and crash potential. There is no shoulder area to accommodate emergency parking, disabled vehicles, and emergency response vehicles.

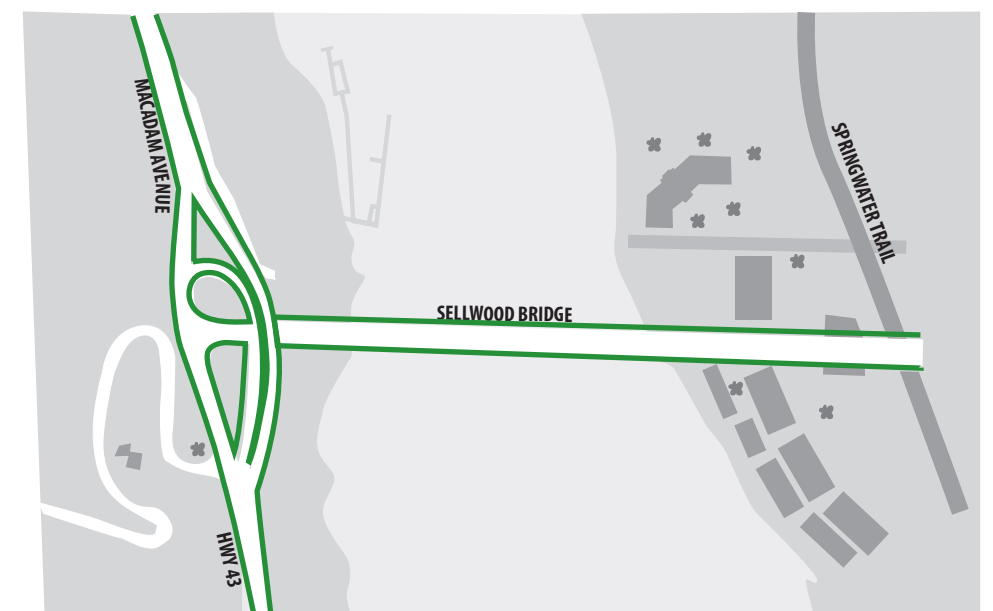
- **Horizontal Curvature (Segment 3)**—The radius of the southbound loop ramp curve (Segment 3) is substantially tighter than what is allowed under the state standard. This has led to a restriction in the size of vehicle that can use the loop ramp. Horizontal curves that are too tight also lower vehicle speeds, lower capacity, and decrease sight distance.



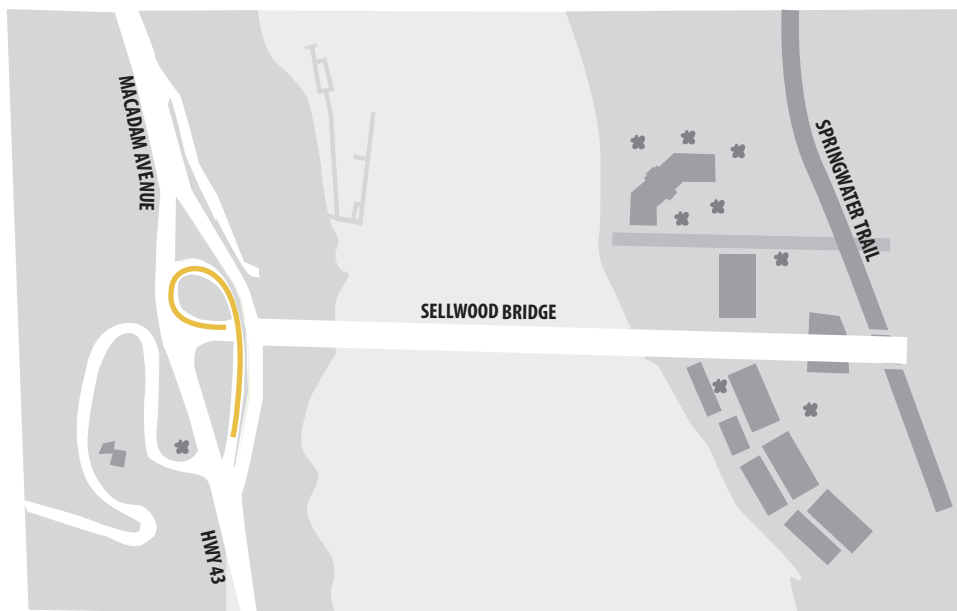
1 Bicycle Deficiencies



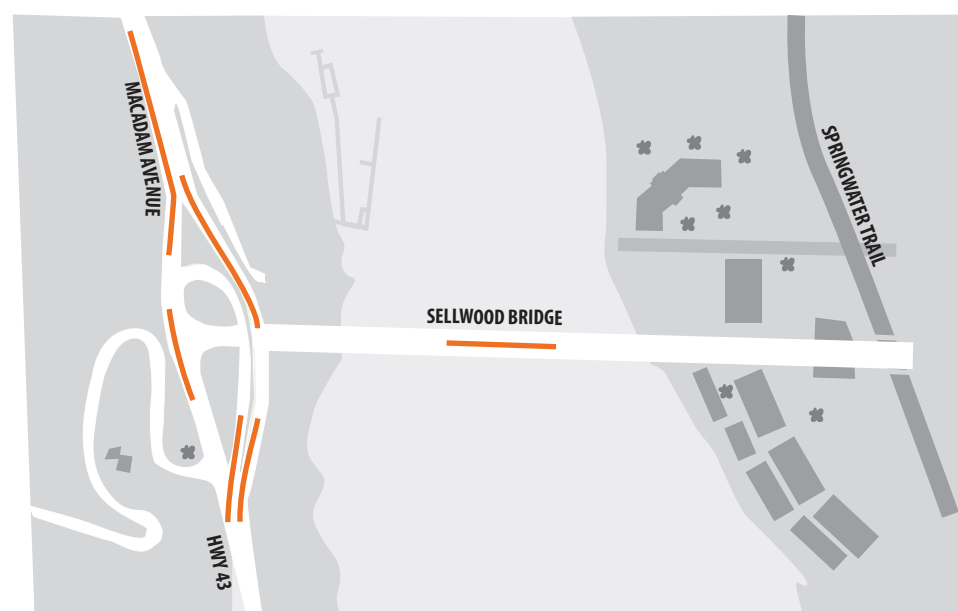
2 Pedestrian Deficiencies



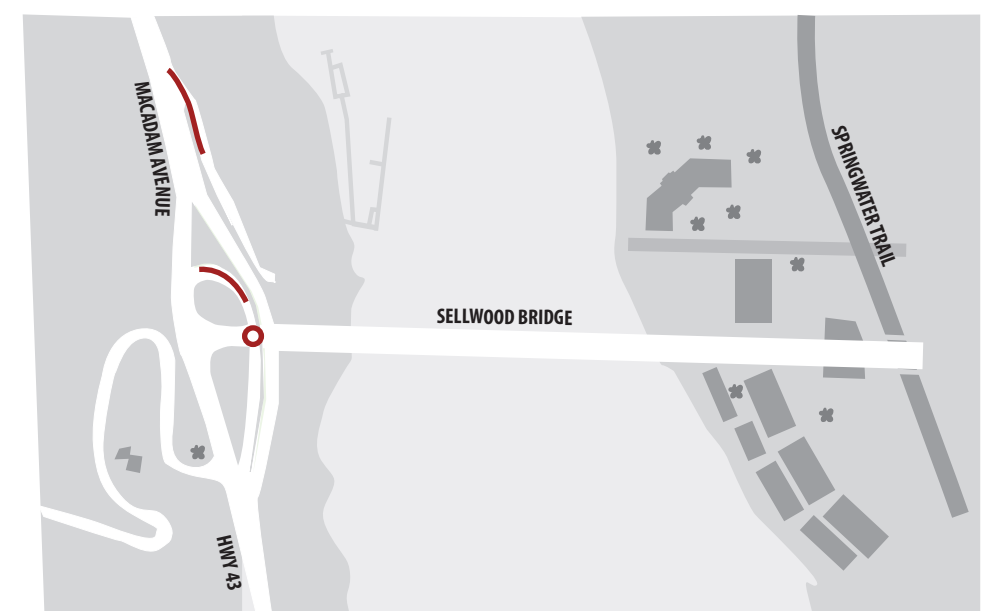
3 Lane/Shoulder/Median Deficiencies



4 Horizontal Curvature Deficiency



5 Horizontal and Vertical Stopping Sight Distance Deficiencies



6 Miscellaneous Deficiencies
(Access Spacing Deficiencies, Grade Deficiencies,
and Vertical Clearance Deficiencies)

Background Report

Introduction

The purpose of this memorandum is to highlight the existing roadway deficiencies in the vicinity of the Sellwood Bridge. It is important to identify these geometric, access and other deficiencies at the outset of the project because they have a critical impact on the safe and efficient use of the facility by all travelers: motorists, bicyclists, pedestrians, and transit riders. The deficiencies identified in this memo, as well as those outlined in the safety, operational, and structural analyses, will inform the project's purpose and need statement and will lay the groundwork for the development of project alternatives.

The deficiencies listed here are limited to those in the immediate project area. Roadway deficiencies outside of the project area could be addressed by other agencies in relation to this project.

Methodology

The standard manuals referenced in this memorandum include the *Oregon Department of Transportation (ODOT) Highway Design Manual (HDM)*; the *City of Portland Design Guide for Public Street Improvements*; the *City of Portland Transportation System Plan*; the *American Association of State Highway and Transportation Officials' (AASHTO) A Policy on Geometric Design of Highways and Streets – 2001*; *Guide for the Development of Bicycle Facilities (1999)*; and *Guide for the Planning, Design, and Operation of Pedestrian Facilities (2004)*; the *Portland Pedestrian Design Guide*; *Portland Bikeway Design and Engineering Guidelines*; *Americans with Disabilities Act Accessibility Guidelines*; *Manual on Uniform Traffic Control Devices (MUTCD)*, and the *Oregon Bicycle and Pedestrian Plan*.

The design elements analyzed are listed in Table 1 below.

TABLE 1
Design Elements Analyzed for Existing Roadways Deficiencies

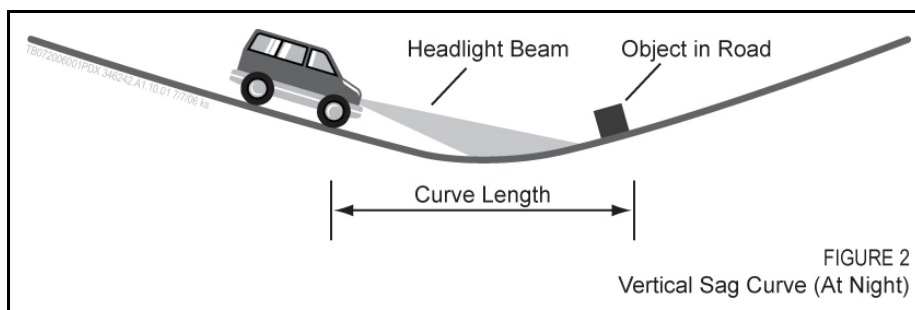
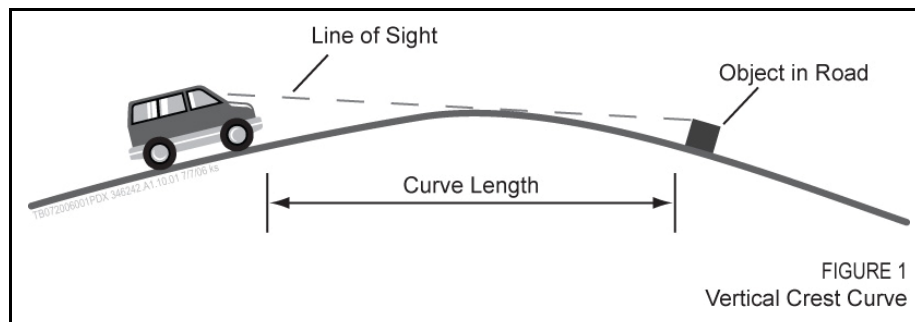
Design Element	Description	Measurement	Why It's Important
Horizontal Alignment	The curvature of a road with respect to the horizontal plane (straight vs. curved)	Radius of curve, length of horizontal curves	Affects safe vehicle operating speeds, sight distance, and capacity.
Vertical Alignment	The curvature of a road with respect to the vertical plane (flat vs. mountainous)	Length of vertical crest (inclining) curves, length of vertical sag (declining) curves	Shorter crest curves can create sight problems if drivers cannot see sufficient distance ahead of their vehicles (See Figure 1). Shorter sag curves are less of a concern during daylight hours because drivers can see ahead of them while going uphill. At night, however, visibility is of concern because headlights on sag curves are pointed downward and do not provide visibility for sufficient distance ahead (See Figure 2). Provision of adequate illumination can often alleviate this concern; however, the length of curve should still meet the criteria for passenger comfort due to change in vertical direction.

TABLE 1
Design Elements Analyzed for Existing Roadways Deficiencies

Design Element	Description	Measurement	Why It's Important
Grade	The change in height for a given length of road	Grade is expressed as the change in elevation per 100 feet of horizontal distance	Steeper grades than standard are more difficult for vehicles (especially larger vehicles such as RVs and commercial trucks) to navigate. There is greater difficulty for vehicles (especially larger vehicles) to maintain control on steeper downgrades.
Stopping Sight Distance	Distance for a vehicle traveling at design speed to stop	The length (feet) of the roadway ahead that is visible to the driver	Insufficient stopping sight distance increases potential for rear-end crashes due to inadequate distance for vehicles to stop when encountering an obstruction in the roadway.
Superelevation	Inclined roadway cross-section that employs the weight of a vehicle in the generation of the necessary centripetal force for curve negotiation	The slope of the roadway cross-section	Inadequate superelevation increases the potential for drivers to lose control on a curve and slide off the roadway.
Vertical Clearance	The clear distance between the surface of a road and the lowest object hanging over the road	Height (number of feet) between overhead structure and element (roadway, bicycle path, sidewalk, river) underneath	Lower than standard vertical clearance can restrict the use of roadways to a subset of smaller or shorter vehicles, and restrict the use of waterways to a subset of shorter boats.
ADA Standards	Accessibility guidelines for places of public accommodation and commercial facilities by individuals with disabilities, established under the Americans with Disabilities Act (ADA)	Presence of, width, and grade of sidewalks; placement of curb ramps and crosswalks designed to ADA standards	One of the most pertinent ADA guidelines for this project is the requirement that sidewalks and curb ramps be built to accommodate wheelchairs, and that signalized pedestrian crossings accommodate wheelchairs and persons with limited sight and hearing.
Bike Lane/ Multi-Use Path Width	Width of bicycle lane or bicycle/pedestrian multi-use lane	Presence and width of bicycle and/or bicycle and pedestrian multi-use lane	<p>On-street bicycle lanes are one-way facilities that carry bicycle traffic in the same direction as adjacent motor-vehicle traffic. They should be sufficiently wide to enable cyclists to ride far enough from the curb to avoid debris and drainage grates, yet far enough from passing vehicles to avoid conflicts.</p> <p>Multi-use paths are typically two-way (although they can be designed for one direction of travel) off-street facilities used by pedestrians, joggers, bicyclists, and other non-motorized users. Multi-use paths need to be sufficiently wide to safely accommodate the two-way travel and passing of pedestrians by bicyclists and joggers.</p>
Sidewalk	Width of curbed sidewalk	Presence of and unobstructed width (number of feet) devoted to raised sidewalk feature	City sidewalk width standards will vary by the number of pedestrians who use them. Sidewalks provide a buffer between pedestrians and vehicles, should accommodate wheelchairs and strollers, and allow sufficient room for pedestrians to pass each other.

TABLE 1
Design Elements Analyzed for Existing Roadways Deficiencies

Design Element	Description	Measurement	Why It's Important
Median	Width between directional travel lanes	Presence of and width (number of feet) between travel lanes of different directions	Medians minimize head-on collisions by providing a buffer between vehicles traveling in opposite directions. Medians are of greater importance for higher-speed roadways.
Travel Lane	Width of travel lane	Width (number of feet) between striping for vehicles' use for traveling	Adequate lane widths provide a buffer between vehicles moving in the same direction in different travel lanes, reducing potential for sideswipe crashes (especially between wider vehicles).
Shoulder	Width of roadway shoulder	Presence of and width (number of feet) between stripe of outer travel lane and edge of pavement	Shoulders provide an area for disabled vehicles, bicyclists, and pedestrians (if bicycle lanes and sidewalks are not present), and for emergency vehicles. Where shoulders are not present, bicycles and pedestrians are forced to use a travel lane, causing a safety concern. Disabled vehicles cause safety and mobility concerns because they obstruct or impede the travel lane.
Spirals	Transition between straight and curved horizontal alignment elements	Length of spiral	Spirals provide a smooth transition between straight segments of road and curves by mimicking the natural path of a vehicle entering a curve. They minimize abrupt steering corrections and provide a location for developing superelevation.



The design elements reviewed for deficiencies were limited to the Federal Highway Administration (FHWA) list of design elements that must be considered for conformance to geometric standards. Parking was not analyzed because on-street parking (angle or parallel) is not allowed within the study area. Data for analysis were collected from as-built drawings and field measurements.

Study Area

The study area includes the Sellwood Bridge and the intersection of the bridge with Highway 43, Macadam Avenue. Due to the complexity of the roadways in the study area, the remainder of the memorandum has been organized into six segments. These are listed below and illustrated in Figure 3:

- Segment 1 – Highway 43 mainline
- Segment 2 – Highway 43 northbound bypass ramp
- Segment 3 – Highway 43 southbound loop ramp
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- Segment 5 – Westside bicycle/pedestrian connection to Willamette Greenway Trail
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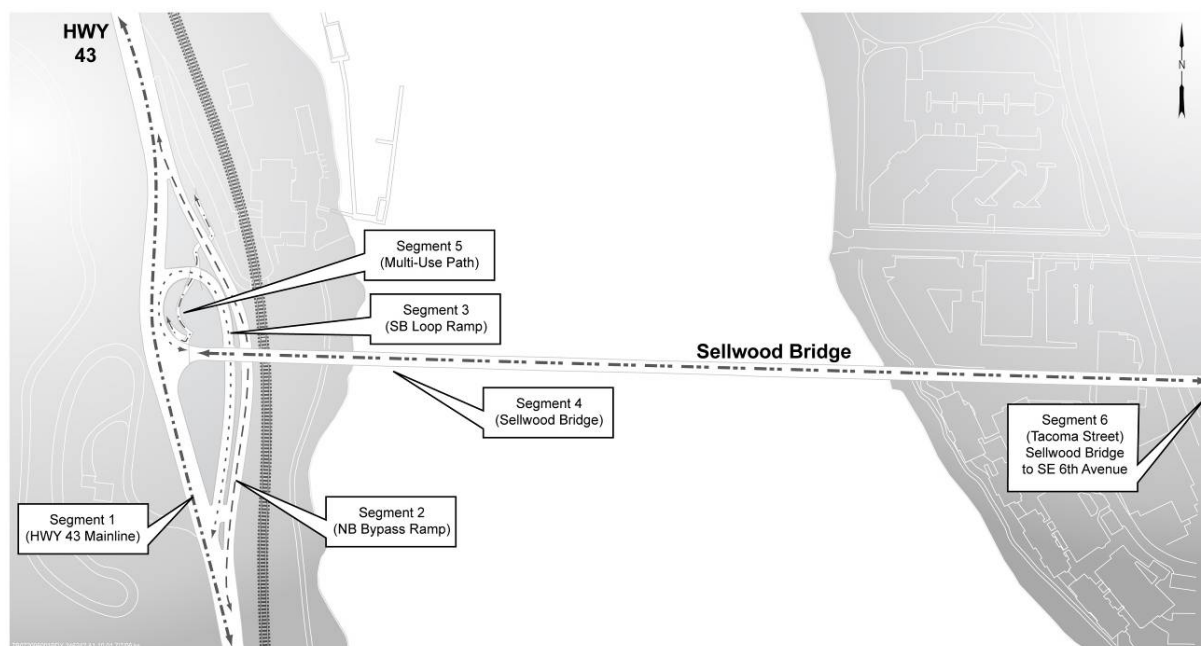


Figure 3: Study Area

Segment 1: Highway 43, Macadam Avenue

Description

Highway 43 is owned and maintained by the Oregon Department of Transportation (ODOT). The highway runs north south between the cities of Portland and Oregon City, Lake Oswego, and West Linn. The highway is referred to as Macadam Avenue within the study area. The segment of Macadam Avenue within the study area is classified as a District Highway. The average annual daily traffic (AADT) immediately north of the Sellwood Bridge is 38,900 vehicles¹. In the study area, the highway has two lanes (one lane in each direction) with no shoulders, bicycle lanes, or sidewalks. There is a southbound left turn lane at the Sellwood Bridge, as illustrated in Figure 4. Vehicles traveling on Macadam Avenue in the northbound direction either turn right (east) onto the Sellwood Bridge, or use the northbound bypass ramp to continue northbound towards downtown Portland. This bypass ramp, considered Segment 2 for this analysis, is described in the next section. There are no sidewalks, crosswalks, or on-street bicycle lanes on Highway 43 through the interchange.



Figure 4: View of southbound left-turn lane from Highway 43 onto Sellwood Bridge.

Review of Deficiencies

Methodology

The relevant roadway design standards for Highway 43 are the ODOT HDM, Section 8.0, Urban Highway Design (Section 8.7.1 Non-Designated Urban Highways, Urban Fringe/Suburban):

- Posted Speed: 35 miles per hour (mph)
- Standard Design Speed Range: 35 mph to 55 mph
- Design Speed for Deficiency Review: 40 mph²

Summary of Deficiencies

The following bullets summarize the geometric deficiencies identified for Segment 1. Design elements that meet standards are not discussed.

- **Horizontal Alignment** – The radius of the horizontal curve through the intersection of Highway 43 and the bridge approach is approximately 510 feet, which is less than the standard of 573 feet. The turning radii at the intersection can handle no larger than an intermediate semi-trailer (designated as a “WB-40” vehicle) without the vehicle sweeping out of its lane. WB-40 vehicles typically have characteristics similar to fire trucks.

¹ From ODOT 2004 Transportation Volume Tables for State Highway 003 MP 2.58. Available at <http://www.oregon.gov/ODOT/TD/TDATA/tsm/docs/TVTPages/2004vt34-38.pdf> (last accessed 6/19/06).

² 5 mph above posted, Section 5.1 HDM

- **Vertical Alignment** – The length of the vertical sag curve leading into the intersection from the north of Highway 43 and the bridge approach is less than the standard of 333 feet. Field measurements indicate the length of sag to be approximately 100 feet. Because the roadway is illuminated, vertical sight distance is not an issue. However, the curve length is still below the standard for what is considered driver comfort. In this case, 180 feet would be required to meet that measurement (80 feet longer than exists).



Figure 5: No sidewalks, crosswalks, or bicycle lanes exist on the mainline of Highway 43 in the vicinity of the Sellwood Bridge.

The length of the vertical crest curve at the intersection of Highway 43 and the bridge approach is approximately 230 feet. Based on existing grade, it should be a minimum of 455 feet.

- **Stopping Sight Distance** – The stopping sight distance for the southbound Highway 43 traffic approaching the interchange is 250 feet. It should be a minimum of 305 feet. The line of sight is blocked by the hillside immediately west of the highway.
- **Bicycle/Pedestrian Facilities** – As shown in Figure 5, there are no sidewalks, crosswalks, or bicycle lanes on Highway 43 through the study segment, with the exception of a pedestrian way that connects the bridge to a sidewalk on the eastside of Highway 43, north of the interchange (described as Segment 5). This roadway has been highlighted by the BTA as “one of the most dangerous and challenging gaps in the (Portland) region.”

The ODOT HDM requires sidewalks at least 6 feet wide with 6-foot-wide landscape buffers. In physically constrained locations, 8-foot-wide sidewalks could be constructed in lieu of a buffer. The HDM also requires 8-foot-wide shoulders on 4-lane highways with ADT greater than 28,000 vehicles. The shoulders may or may not be striped as a bicycle lane. A shoulder width of 6 feet is required on the 2-lane access ramp between the Sellwood Bridge and River View Cemetery entrance. The Oregon Bicycle and Pedestrian Plan also recommends that bicycle lanes and sidewalks be at least 6 feet wide.

Bicycle travel between Highway 43 and the Sellwood Bridge is problematic in several locations. Unless they walk their bicycles along the adjacent narrow multi-use path, cyclists traveling from the Sellwood Bridge to Highway 43 northbound conflict with motorists turning onto Southbound Loop Ramp. Cyclists then must cross the Northbound Bypass Ramp where it merges with Highway 43 in order to maneuver to the right side of the road.

A similar problem faces cyclists traveling from Highway 43 northbound to the Sellwood Bridge. In this area, cyclists approaching the bridge must cross the Northbound Bypass Ramp entrance near the River View Cemetery. Specific problems include lack of pavement markings, striping, or physical treatments that encourage cyclists to cross as close to a 90 degree angle as possible; poor sight distance; and lack of advance warning signs to alert motorists and cyclists of these conflict areas.

Highway 43, the Northbound Bypass Ramp, Southbound Loop Ramp, and the River View Cemetery entrance intersect at a signalized intersection just south of the Sellwood Bridge. Pedestrian signals and a crosswalk are located on the intersection's west side to facilitate north-south pedestrian crossings, however curb ramps do not currently exist. The HDM requires intersections on state highways to include ADA-compliant facilities such as curb ramps. Curb ramps must include a 3-foot-wide landing with a maximum 2 percent slope. The intersection also lacks crosswalks spanning Highway 43. Although the HDM allows restrictions of some pedestrian crossings at "T" intersections, some pedestrian crossing treatments on Highway 43 should be provided.

North of the Sellwood Bridge, Highway 43 intersects with a local street providing access to Staff Jennings. The Staff Jennings access street consists of a wide cross-section where it intersects with Highway 43 to accommodate vehicle turning movements. The wide cross-section increases the potential for bicycle/pedestrian conflicts with turning vehicles. The street also lacks designated bicycle/pedestrian facilities, forcing walkers and cyclists to mix with vehicle traffic when traveling between the multi-use path and the Highway 43 sidewalk. Additionally, northbound walkers and cyclists generally use the southbound side of the street, increasing the potential for conflicts with oncoming vehicles.

The sidewalk on the east side of Highway 43 is approximately 6 feet wide with about 1 foot of shy distance to the east and no shy distance to the west. The HDM and Oregon Bicycle and Pedestrian Plan recommend a minimum 2-foot shy distance.

- **Lane and Shoulder Width**—As shown in Table 2 below, the two travel lanes meet ODOT standards. The southbound left turn lane is 1 foot more narrow than the standard. No shoulders exist.

TABLE 2
Travel Lane Widths for Segment 1: Comparison of Existing to Standard

	Travel Lanes	Left-Turn Lanes	Median	Shoulder
Standard	12 feet	16 feet	2 feet (striped)	6 feet (8 feet with barrier)*
Existing Condition	12' (inside lane) 13' (outside lane)	15 feet	1 foot	0

*Where concrete barrier or guardrail is used, an additional 2 feet of offset is required on the shoulder.

- **Superelevation**—To accommodate the design speed and curvature of Highway 43, a superelevation of 4 percent is the standard through the curves in this segment. While the cross slope is warped at the intersection of the bridge approach, a non-superelevated (normal crown) section exists on either sides of the intersection.
- **Spirals**—To accommodate the design speed and curvature of Highway 43, spiral lengths of 360 feet entering and exiting each horizontal curve would be required. The existing horizontal alignment has no spirals.

- **Access Spacing** – The access spacing standards between a ramp terminal and a public or private access point where left turns are allowed is 1,320 feet.³ The approximate distance between the northbound bypass ramp merge point with Highway 43 and the driveway to Stafford Jennings is 200 feet. Sight distance is also a concern for vehicles exiting the driveway onto Highway 43.

³ Oregon Administrative Rule (OAR) 734-051 (Division 51) Highway Approaches, Access Control, Spacing Standards and Medians. Table 7 Minimum Spacing Standards Applicable to Non-Freeway Interchanges with Two-Lane Crossroads.

Segment 2: Northbound Bypass Ramp

Description

Vehicles traveling northbound on Macadam Avenue towards downtown Portland must use the northbound bypass ramp because the highway mainline mandates a right-hand turn onto the Sellwood Bridge. The northbound bypass ramp is a 1-lane structure, as shown in Figure 6. It branches off of the mainline south of the bridge intersection, and travels under the bridge structure. Local access to Staff Jennings is provided north of the bypass ramp; no local access is provided via the bypass ramp.

Review of Deficiencies

Methodology

The relevant roadway design standards for the bypass ramp are found in the ODOT HDM, Section 9 Intersection and Interchange Design (Section 9.6.2 Non-Freeway Interchange Design).

- Posted Speed: 35 mph
- Standard Design Speed Range: 35 to 55 mph
- Design Speed for Deficiency Review: 40 mph

Summary of Deficiencies

The list below summarizes geometric deficiencies for Segment 2. Design elements that meet standards are not discussed.

- **Horizontal Alignment**—The radius of the horizontal curve as it splits from the main alignment of Highway 43 at the signaled intersection is 478 feet. It should be no less than 573 feet. The radius of the horizontal curve just north of the Sellwood Bridge is 300 feet. It should be no less than 573 feet.
- **Vertical Alignment**—The profile of the northbound bypass has a series of deficient vertical curves. Starting south to north, the first crest vertical curve is 100 feet. Based on existing grade, it should be no less than 385 feet. The following sag vertical curve is 300 feet. Based on existing grade, it should be at least 704 feet. However, because the roadway is illuminated, vertical sight distance is not an issue. This sag should still meet a minimum of 378 feet in length for driver comfort. The final crest curve is 150 feet. Based on existing grade, it should be at least 336 feet.
- **Stopping Sight Distance**—The stopping sight distance for the northbound bypass is approximately 200 feet. It should be a minimum of 305 feet. The line of sight is blocked by the retaining walls supporting the loop ramp.



Figure 6: Northbound bypass ramp (to the right) as seen from the Sellwood Bridge.

- **Bicycle or Pedestrian Facilities** – There are no sidewalks or bicycle lanes on the Northbound Bypass Ramp. The right-side shoulder (where bicycle travel would normally occur) is currently 2 feet wide. The HDM requires a right shoulder width of 6 feet (8 feet when directly adjacent to a barrier or guard rail).
- **Lane and Shoulder Width** – As shown in Table 3 below, the ramp travel lane and left shoulder meets current standard. The ramp right shoulder does not meet standard.

TABLE 3
Travel Lane Widths for Segment 2: Comparison of Existing to Standard

	Ramp Travel Lane	Ramp Left Shoulder	Ramp Right Shoulder
Standard	14 feet	2 feet	6 feet (8 feet with barrier)*
Existing Condition	16 feet	2 feet	2 feet

*Where concrete barrier or guardrail is used, an additional 2 feet of offset is required on the shoulder.

Segment 3: Southbound Loop Ramp

Description

The southbound loop ramp, as illustrated in Figure 7, is a one-way, one-lane ramp to connect vehicles coming from the Sellwood Bridge with Macadam Avenue southbound (traveling toward Lake Oswego). The ramp splits off to the right from Highway 43 and loops under the Sellwood Bridge structure immediately west of the northbound bypass ramp. The ramp reconnects with Highway 43 at the same location that the northbound bypass ramp begins. There is a traffic signal at this location to help facilitate vehicle movement.



Figure 7: Southbound loop ramp (to left) as seen from Sellwood Bridge.

Review of Deficiencies

Methodology

The relevant roadway design standards for the bypass ramp are found in the ODOT HDM, Section 9.6.2 (Non-Freeway Interchange Design).

- Posted Speed: 15 mph
- Standard Design Speed: 25 mph (minimum for ramps)
- Design Speed for Deficiencies: 25 mph

Summary of Deficiencies

The list below summarizes geometric deficiencies for Segment 3. Design elements that meet standards are not discussed.

- **Horizontal Alignment**—The loop ramp is composed of three consecutive horizontal curves. The loop curve radii, beginning at the end of the Sellwood Bridge, are 87 feet, 57 feet, and 181 feet. No one curve should be less than 159 feet. Consequently, the posted speed is less than the design speed standard for ramps. Additionally, because of the tightness of the loop, the largest vehicle that can safely travel the loop is an intermediate semi-trailer (designated as a “WB-40” vehicle). WB-40 vehicles typically have characteristics similar to a fire truck.
- **Vertical Alignment**—The profile of the southbound loop ramp has a series of deficient vertical curves. The length of the first vertical crest curve is 120 feet. Based on existing grade, it should be at least 140 feet. The length of the middle vertical sag curve is 250 feet. Based on



Figure 8: Worn pedestrian path along west side of southbound loop ramp.

existing grade, it should be at least 365 feet. However, because the roadway is illuminated, vertical sight distance is not an issue. This sag does meet the minimum of 190 feet in length for driver comfort.

- **Grade**—The existing ramp contains a profile descending grade of 8.5 percent. A maximum grade of the ramp should not exceed 8.0 percent.
- **Vertical Clearance**—The vertical clearance under the Sellwood Bridge overpass is 16.25 feet. The minimum allowable clearance is 17 feet.
- **Bicycle or Pedestrian Facilities**—There are no sidewalks or bicycle lanes on the Southbound Loop Ramp. Pedestrians and some cyclists appear to use the grassy area west of the ramp as a path, as shown in Figure 8. The ramp also lacks a right-side shoulder (where bicycle travel would normally occur). The HDM requires a right shoulder width of 6 feet (8 feet when directly adjacent to a barrier or guard rail).
- **Lane and Shoulder Width**—As illustrated in Table 4 below, the ramp travel lane and left shoulder meets current standard. The ramp right shoulder does not meet standard.

TABLE 4
Travel Lane Widths for Segment 3: Comparison of Existing to Standard

	Ramp Travel Lane	Ramp Left Shoulder	Ramp Right Shoulder
Standard	14 feet	2 feet	6 feet (8 feet with barrier)*
Existing Condition	Varies (16 to 18 feet)	4 feet	0

*Where concrete barrier or guardrail is used, an additional 2 feet of offset is required on the shoulder.

Segment 4: Sellwood Bridge

Description

The Sellwood Bridge, shown in Figure 9, is a four-span continuous deck truss bridge that connects Highway 43 on the west with SR 99E on the east via SE Tacoma Street. It is owned and maintained by Multnomah County, and is classified by the City of Portland as a District Collector. With an ADT of approximately 35,000 vehicles/day, the Sellwood Bridge is the busiest two-lane bridge in the State of Oregon. The Sellwood Bridge opened in 1925 as the first fixed span bridge along the Willamette River in Portland. The Bridge has no on-street bicycle facilities and a 4-foot sidewalk on the north side.



Figure 9: Looking eastward onto the Sellwood Bridge.

Review of Deficiencies

Methodology

The relevant roadway design standards for the roadway on the bridge are found in the *City of Portland Design Guide for Public Street Improvements* (District Collector), the City of Portland TSP, Bikeway Design and Engineering Guidelines (Portland Bicycle Master Plan, Appendix A), MUTCD, and AASHTO. However, the application of standards can vary from project to project as determined through individual studies, reports, or policy decisions by the City of Portland.

- Posted Speed: 30 mph
- Design Speed for Deficiency Review: 35 mph

Summary of Deficiencies

The list below summarizes geometric deficiencies for Segment 4. Design elements that meet standards are not discussed.

- **Vertical Alignment**—None of the crest points on Sellwood Bridge are vertically curved. For City of Portland, a vertical curve is required only when there is a more than a 2.5 percent algebraic difference between two adjacent grades. The algebraic differences between grades at Piers 18 and 19 (the two centermost piers) both have 2.67 percent differences and would require vertical crest curves. The lack of curves at these locations leads to limited sight distance.
- **Pedestrian Facilities**—The sidewalk on the bridge's north side is 4 feet 4 inches wide, with 3 feet of pedestrian space around light poles. There is no sidewalk on the south side. Sidewalks should be at least 6 feet wide on both sides of the bridge to meet minimum City standards for sidewalks. On the bridge's west end, there are no pedestrian connections between the bridge sidewalk and Highway 43 southbound. On the bridge's east end, there is no delineated crossing to connect pedestrians with the south side of Tacoma Street.

- **Bicycle Facilities**—There are no designated bicycle facilities on the Sellwood Bridge. Cyclists must either use vehicle travel lanes or walk their bikes on the narrow sidewalk. The BTA listed the Sellwood Bridge as “nearly uncrossable” and “the biggest barrier identified in the Portland area.” The crossing is listed by the BTA as one of the top 10 needed bicycle projects in the region. The Portland Bikeway Design and Engineering Guidelines generally recommend 5-foot-wide bicycle lanes. Six-foot-wide lanes are preferred on roadways with high posted speeds and/or high vehicle and bicycle volumes.
- Although signage exists directing cyclists to dismount when using the Sellwood Bridge sidewalk, the sidewalk still serves as a “sidewalk bikeway” because cyclists generally do not feel comfortable using the adjacent vehicle travel lanes. Sidewalk bikeways can create potential bicyclist conflicts with pedestrians and utility poles, and the sidewalk width is insufficient to be designated as a multi-use path.

At the bridge’s east end, the location of existing bridge columns creates a “pinch point” on the Springwater Trail below. The trail is approximately 10 feet wide below the bridge with shy distances less than 1 foot wide. The standard for multi-use paths in the City of Portland is 12 feet wide, with 3 feet of shy distance on each side.

- **Lane and Shoulder Width**—As shown in Table 5 below, the bridge travel lane meets current standard.

TABLE 5
Travel Lane Widths for Segment 4: Comparison of Existing to Standard

	Travel Lanes	Shoulder/Bike Lanes	Median
Standard	Varies (11 to 12 feet)	5 to 6 feet	Varies (2 to 4 feet)
Existing Condition	11 feet, 4 inches	0	1 foot

Segment 5: Westside Bicycle/Pedestrian Connection to Willamette Greenway Trail

Description

The Springwater Corridor/Willamette Greenway Trail is a premier element of Portland's Willamette River Renaissance effort, and a treasure and transportation facility used daily by thousands of bicyclists and pedestrians. A multi-use path connects bicyclists and pedestrians between the Sellwood Bridge's west end and the Willamette Greenway Trail. See Figure 10. Built in 1980, this path starts at the west end of the bridge, winds down under the southbound loop ramp and the northbound bypass ramp, and connects with a sidewalk on the east side of Macadam Avenue.



Figure 10: View of multi-use pathway, from Sellwood Bridge.

Review of Deficiencies

Methodology

The relevant design standards for the multi-use path are found in the *City of Portland Pedestrian Design Guide*, the Oregon Bicycle and Pedestrian Plan, ADA Standards for Accessible Design, and AASHTO.

Summary of Deficiencies

The list below summarizes geometric deficiencies for Segment 5. Design elements that meet standards are not discussed.

- **Pathway Width**—The southern half of the multi-use path (within the loop ramp) is 5 feet wide, and the northern half widens to 8 feet. The standard for multi-use paths in the City of Portland is 12 feet, with 3 feet of shy distance on each side. ADA requires a minimum access width of 5 feet. This can be reduced to 3 feet if 5-foot passing spaces are provided every 200 feet.
- **ADA**—The profile of the path does not meet ADA requirements. The path has segments with grades varying between 7.2 and 8.3 percent, with level landings separated by more than 30 feet. The ADA requires all pedestrian pathways to have a maximum grade of 5 percent. Grades can be increased to 8.3 percent, but require level landings every 30 feet.

ADA requires handrails to be placed on both sides of stairways, but the stairway at the Sellwood Bridge's west end only includes a handrail on one side. ADA also requires a minimum 6-foot level landing at the top and bottom of stairways, with a maximum 2 percent slope in any direction. The upper landing consists of a curb ramp sloping away from the stairway with a greater slope.

- **Horizontal Curvature**—The multi-use path is characterized by tight turns and limited sight distance. For multi-use paths, AASHTO recommends a minimum turning radius of 36 feet (assuming a bicyclist operating speed of 12 miles per hour with a 15 degree bicyclist “lean angle”). The path also does not meet AASHTO bicycle stopping sight distance standards due to the presence of multiple tight turns and relatively steep grades.
- **Signage**—The multi-use path lacks signage warning users of limited sight distance and tight turns.
- **Vertical Clearance**—The vertical clearance □ beneath the Southbound Loop Ramp is as low as 7 feet 4 inches. This is illustrated in Figure 11. The vertical clearance beneath the Northbound Bypass Ramp is as low as 7 feet 1 inch. a 10-foot minimum vertical clearance is required for undercrossings.



Figure 11: Vertical clearance of multi-use pathway beneath northbound bypass ramp is almost 3 feet lower than standard.

Segment 6: Tacoma Street

Description

Southeast Tacoma Street runs in an east/west direction between the Sellwood Bridge and the Clackamas County border. The segment of Tacoma Street within the study area is from the eastern terminus of the Sellwood Bridge to southeast 6th Avenue. Tacoma Street is owned and maintained by the City of Portland, and is classified in the City of Portland Transportation System Plan (TSP) as both a District Collector and a Community Main Street. The average daily traffic (ADT) along Tacoma Street between the bridge and 13th Street is 31,000 vehicles/day⁴. Within the study area, Tacoma Street has two lanes (one lane in each direction) with an easterly left-turn lane onto southeast 6th Avenue. There is a sidewalk on the north side of the road. There are no bicycle lanes on Tacoma Street.



Figure 12: SE Tacoma Street immediately east of the Sellwood Bridge has one travel lane in each direction.

Review of Deficiencies

Methodology

The relevant roadway design standards for the roadway on the bridge are found in the *City of Portland Design Guide for Public Street Improvements* (District Collector), the City of Portland TSP, Bikeway Design and Engineering Guidelines (Portland Bicycle Master Plan, Appendix A), MUTCD, and AASHTO. However, the application of standards can vary from project to project as determined through individual studies, reports, or policy decisions by the City of Portland.

- Posted Speed: 30 mph
- Design Speed for Deficiency Review: 35 mph

Summary of Deficiencies

The list below summarizes geometric deficiencies for Segment 6. Design elements that meet standards are not discussed.

- **Sight Distance**—There are trees, utility poles, and fences that are blocking the line of sight of vehicles attempting to turn onto Tacoma Street from southeast 6th Avenue. A passenger vehicle on southeast 6th Ave., sitting back a safe distance from Tacoma Street (6.5 feet), would need to see 412 feet down Tacoma Street in both directions to safely make a left turn. Vehicles must creep closer to Tacoma Street in order to be able to have an unobstructed view.
- **Pedestrian Facilities**—Bicycles and pedestrians share the narrow 6-foot-wide sidewalk on the north side of Tacoma Street. No crosswalks or curb ramps exist for pedestrians at the Tacoma Street and 6th Avenue intersection. The stairway at the bridge's east end provides a

⁴ From the Tacoma Main Street Plan, City of Portland Office of Transportation, October 2001.

direct pedestrian connection to the Springwater Trail. Some segments of the stairway have handrails on one side only. The ADA requires handrails on both sides. The Portland Pedestrian Design Guide also states that landings should be provided for every 12 feet rise. The stairway's existing landings currently do not meet this standard. The short path connecting the stairway with the Springwater Trail crosses an active railroad, but lacks appropriate safety signage, as required by the MUTCD.

Signage to direct pedestrians between the Sellwood Bridge, Springwater Trail and Willamette Greenway Trail is unclear. Although "Willamette Greenway Trail" signs are posted at the east and west bridgeheads and other nearby locations, some signs lack directional information or are placed at inconspicuous locations.

- **Bicycle Facilities**—There is no continuous bicycle lane for westbound bikes to transition from Tacoma Street to the Sellwood Bridge. The stairway at the bridge's east end does not accommodate bicyclists. Portland's Bikeway Design and Engineering Guidelines recommend including a "wheel gutter" to allow cyclists to roll their bicycles up and down the stairs. The gutter should have dimensions of no less than 3 inches x 3 inches x ½ inch. The gutter should be flush with all landings.

Signage to direct bicyclists between the Sellwood Bridge, Springwater Trail, and Willamette Greenway Trail is unclear. Although "Willamette Greenway Trail" signs are posted at the east and west bridgeheads and other nearby locations, some signs lack directional information or are placed at inconspicuous locations.

- **Lane and Shoulder Width**—As shown in Table 6 below, the travel lanes meet current standard. The eastbound bicycle lane meets standard though the westbound bicycle lane does not consistently meet standard. The median width is more narrow than standard on the west end of Tacoma Street.

TABLE 6
Travel Lane Widths for Segment 6: Comparison of Existing to Standard

	Travel Lanes	Shoulder/Bike Lanes	Median
Standard	Varies (11 to 12 feet)	5 to 6 feet	Varies (2 to 4 feet)
Existing Condition	11 feet, 6 inches	Eastbound—7 feet Westbound—Varies 0 to 7 feet	1 foot, widens to left turn lane at 6th Avenue