

US 97 Parkway Plan Phase 2

Alternative Mobility Targets Memorandum - Draft

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Draft

Prepared for:



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1.0 EXECUTIVE SUMMARY

The purpose of this memorandum is to describe the recommended alternative mobility targets for Oregon Department of Transportation (ODOT) intersections in the US 97 Parkway corridor. This builds on a previous evaluation of potential alternative mobility targets completed for the Bend Transportation System Plan (TSP)¹ and follows the process outlined in the ODOT Planning Business Line Team Operational Notice PB-02.²

THE PURPOSE OF ALTERNATIVE MOBILITY TARGETS

The Oregon Highway Plan (OHP) identifies highway mobility targets for maintaining acceptable and reliable levels of mobility on the state highway system, consistent with expectations for each facility type, location, and functional objectives.³ The adopted mobility targets are the initial tool for identifying deficiencies and considering solutions for vehicular mobility on the state system. However, consistent with OHP Policy 1F, the ability to meet OHP mobility targets may not be compatible with a community's adopted land use plan or goals. In these cases, alternative mobility targets can be explored for a facility to adjust long-term roadway performance expectations.

THE NEED FOR ALTERNATIVE MOBILITY TARGETS IN THE US 97 PARKWAY CORRIDOR

In Bend there is a significant amount of population and employment growth projected over the 20-year planning horizon. Even with the transportation improvements identified as reasonably likely to be funded in the US 97 Parkway Plan and the City's TSP (approximately \$1 billion of projects and programs), transportation analysis forecasts many intersections along the US 97/Bend Parkway corridor will not comply with ODOT's current mobility targets by the end of the 20-year planning horizon. An evaluation of the disparity between the current targets (typically measured as a volume-to-capacity (v/c) ratio of 0.85 during the peak summer conditions) and forecasted traffic operations confirmed the need for assessing the potential to mitigate conditions through other means, while balancing the goals established as part of the US 97 Parkway Plan and Bend TSP. Therefore, the need to adopt alternative mobility targets for several intersections under ODOT jurisdiction was identified through the US 97 Parkway planning process and is one of the plan recommendations.

THE PROCESS FOR DEVELOPING ALTERNATIVE MOBILITY TARGETS

ODOT's methodology for determining alternative mobility targets involves five steps, with each allowing for increasing amounts of congestion until an attainable target is reached. This begins with gradually increasing the allowed v/c ratio as long as the demand does not exceed the capacity (i.e., the v/c ratio would be less than 1.0), then changing the analysis methodology to consider average weekday

¹ City of Bend Transportation System Plan, Volume 2, Appendix I: Alternative Mobility Target Memorandum, May 26, 2020

² Planning Business Line Team Operational Notice PB-02, Oregon Department of Transportation, effective May 2, 2013.

³ 1999 Oregon Highway Plan, as amended May 2015, Policy 1F: Highway Mobility Policy, Oregon Department of Transportation



conditions instead of peak summer conditions (30th highest annual hour), and lastly could allow unrestricted congestion for a specified number of hours per day.

RECOMMENDED ALTERNATIVE MOBILITY TARGETS FOR THE US 97 PARKWAY CORRIDOR

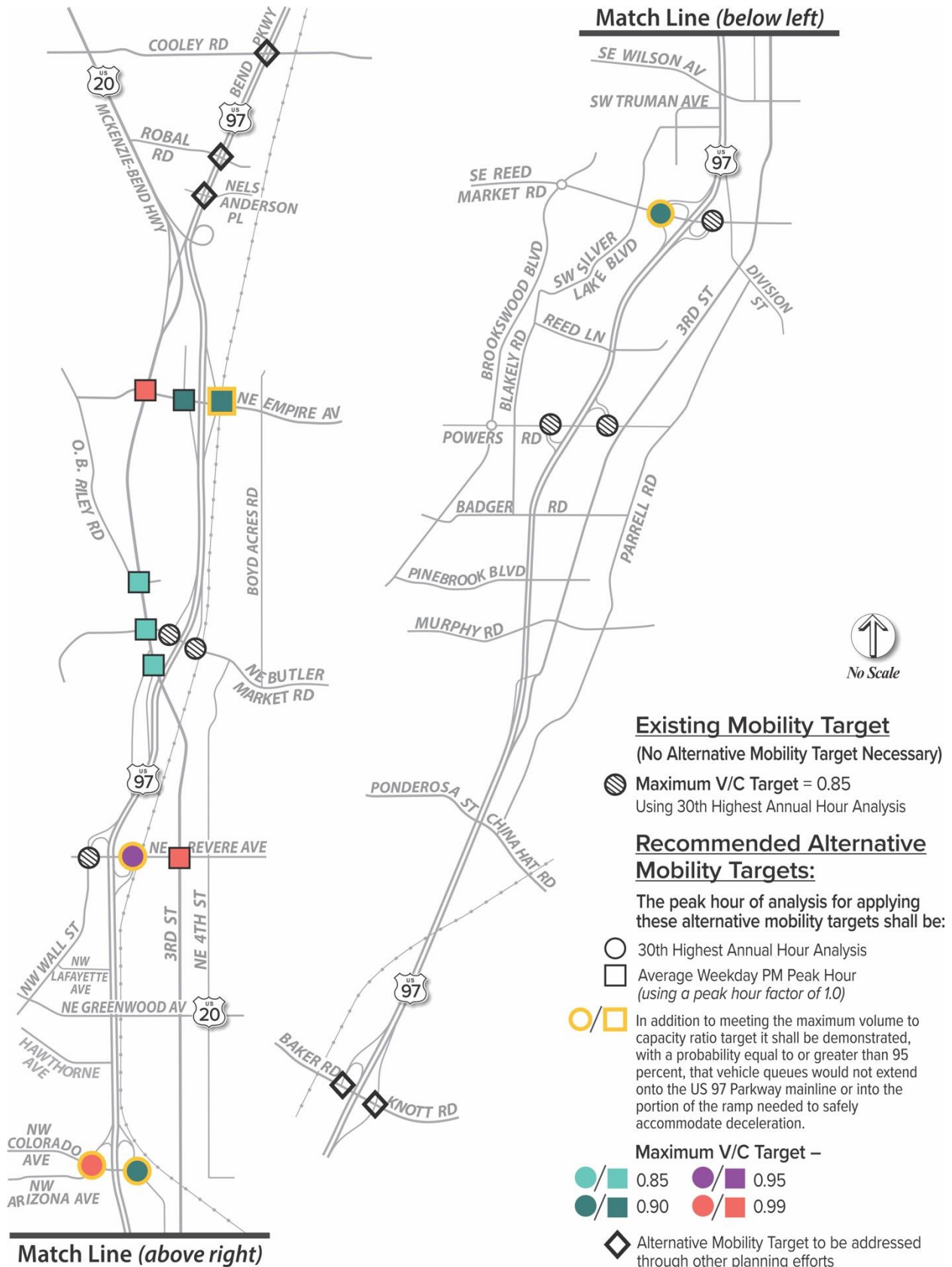
Alternative mobility targets were considered for all US 97 interchange ramp terminals and intersections along US 20 paralleling the Parkway that were analyzed as part of the US 97 Parkway Plan. However, the intersections on US 97 at Cooley Road, Robal Road, and Nels Anderson Place were excluded because the ongoing North Corridor project will change performance expectations at those locations. Similarly, the US 97 ramp terminals with Baker Road and Knott Road were excluded because the ongoing US 97 Baker Road Interchange Area Management Plan project will be developing long-range solutions with new performance expectations for those locations. In conclusion, alternative mobility targets are recommended for 11 intersections.

The recommended alternative mobility targets are shown on the attached map (Figure 1). The recommended targets can be summarized in the following three categories:

1. **US 97 interchange ramp terminals** – v/c ratios ranging from 0.90 to 0.99 under peak summer conditions, with additional queueing analysis necessary to ensure safe off-ramp operations.
2. **US 20 (3rd Street) intersections** – v/c ratios ranging from 0.85 to 0.99 under average weekday conditions (with a peak hour factor of 1.0).
3. **Empire Boulevard corridor** – v/c ratio ranging from 0.90 to 0.99 under average weekday conditions (with a peak hour factor of 1.0), with additional queueing analysis necessary to ensure safe off-ramp operations.



Figure 1: US 97 Parkway Corridor Recommended Alternative Mobility Targets





The purpose of this memorandum is to describe the recommended alternative mobility targets for Oregon Department of Transportation (ODOT) intersections within the US 97 Parkway corridor. This builds off a previous evaluation of potential alternative mobility targets completed for the Bend Transportation System Plan (TSP)⁴ and follows the process outlined in the ODOT Planning Business Line Team Operational Notice PB-02.

2.0 INTRODUCTION

The Oregon Highway Plan (OHP) identifies highway mobility targets for maintaining acceptable and reliable levels of mobility on the state highway system, consistent with expectations for each facility type, location, and functional objectives⁵. The adopted mobility targets are the initial tool for identifying deficiencies and considering solutions for vehicular mobility on the state system. However, consistent with OHP Policy 1F, the ability to meet OHP mobility targets may not be compatible with a community's adopted land use plan, financial capacity, or goals. In these cases, alternative mobility targets can be explored for a facility to adjust long-term roadway performance expectations.

It is important for a highway facility plan to identify a broad range of transportation system projects and services to address the deficiencies that would exist at the end of a 20-year planning horizon if the community grows in accordance with its adopted land use plan. However, it is also important to realistically identify which transportation projects and services are reasonably likely to be implemented over the 20-year planning horizon, based on financial or other constraints. This exercise enables the community and the state to establish realistic expectations for how that transportation system will likely operate at the end of the 20-year planning horizon.

Because of the financial constraints that have been faced by state and local governments over the last 20 years and which are expected to continue into the foreseeable future, it is often the case that the local and/or state roadways will not be able to meet local level-of-service (LOS) standards or, in the case of ODOT, roadway volume-to-capacity (v/c) ratio-based mobility targets, at the end of the 20-year planning horizon if the community grows in accordance with its land use plan. This is particularly common in larger communities or in those with roadways that experience higher travel demands. In these cases, it is appropriate to adjust roadway performance expectations, as expressed through local LOS standards or state mobility targets, to match the performance that is actually forecasted to exist at the end of the 20-year planning horizon, through the adoption of alternative standards or mobility targets.

In these situations, adopting alternative standards or mobility targets means adjusting roadway performance expectations to match realistic expectations for how the roadways are forecasted to operate, taking into account financial and other constraints. In addition to establishing realistic expectations for future system performance, this process will help reduce the need to list state and local investment needs that both parties acknowledge are unlikely to be achieved.

⁴ City of Bend Transportation System Plan, Volume 2, Appendix I: Alternative Mobility Target Memorandum, May 26, 2020

⁵ 1999 Oregon Highway Plan, as amended May 2015, Policy 1F: Highway Mobility Policy, Oregon Department of Transportation



3.0 ALTERNATIVE MOBILITY TARGET NEED

Continued growth in regional travel along US 97 coupled with a significant amount of population and employment growth projected in Bend will increase daily trips on the US 97 Parkway from about 50,000 today to about 80,000 by 2040. Even with the transportation improvements identified as reasonably likely to be funded in the US 97 Parkway Plan and the City's TSP (approximately \$1 billion of projects and programs), transportation analysis forecasts many intersections along the US 97/Bend Parkway corridor will not comply with ODOT's current mobility targets by the end of the 20-year planning horizon.

An evaluation of the differences between the current targets and forecasted traffic operations (discussed in more detail below) confirmed the need for assessing the potential to mitigate conditions through other means, while balancing the goals established as part of the US 97 Parkway Plan and Bend TSP. The findings of that evaluation are described below.

3.1 CURRENT MOBILITY TARGETS

Currently, all ODOT intersections within the Bend MPO area must comply with the volume to capacity (v/c) ratio-based mobility targets in Table 6 of the OHP. ODOT v/c ratio mobility targets are based on highway classification and area type. Within Bend, US 97 is classified as a Statewide Highway and Expressway within an MPO. Therefore, the v/c target is a maximum of 0.85 for intersections on US 97 and its ramp terminals.

The mobility targets in the OHP are based on conditions present during the 30th highest annual hour of traffic (30 HV). Within Bend, the 30 HV typically occurs during the summer months, when traffic volumes increase due to an influx of vacationers and visitors, leading to a significant increase in traffic over average weekday conditions (from an 11 percent to 31 percent increase in some areas).

3.2 PROJECTED 2040 OPERATIONS IN THE US 97 CORRIDOR

During the development of Bend's TSP, an alternative mobility targets technical memorandum was prepared that analyzed the need for alternative mobility targets on state highways (attached in the appendix). This analysis assumed all of the reasonably likely to be funded projects in the Bend MPO area would be constructed in the 20-year planning horizon, including many projects from the US 97 Parkway Plan. Based on this analysis, Table 1 lists the future year 2040 peak hour (30 HV) intersection operations without and with the reasonably likely to be funded projects (referred to as the "No Build"⁶ and "Mitigated" scenarios, respectively). Given the increased growth in Bend over the 20-year planning horizon, traffic demand is forecast to exceed capacity at many intersections by 2040. As shown in Table 1, 13 study intersections would continue to fail to comply with existing mobility targets even under the mitigated scenario.

⁶ For more details on the No Build scenario results, see the US 97 Parkway Plan Phase 2, Technical Memorandum #4 – Future Conditions, November 2018



Table 1: Intersection Operations in the US 97 Parkway Corridor without and with Reasonably Likely to be Funded Improvements (2040 PM Peak Hour, 30 HV)

Int. No.	Intersection	Control ^A	Existing OHP Mobility Target	No Build V/C ^C	Mitigated V/C	US 97 Parkway Plan/TSP Project
1	US 97 & Tumalo Pl	<i>(removed from study area after existing conditions analysis was completed)</i>				
2	US 97 & Cooley Rd	Signalized	< 0.85	1.07	0.89	US 97 North Corridor Project
3	US 97 & Robal Rd	Signalized	< 0.85	1.41	0.73	US 97 North Corridor Project
4	US 97 & Nels Anderson Pl/Cascade Village	TWSC	< 0.85 (major) < 0.95 (minor)	>2.00 / >2.00	- ^D	US 97 North Corridor Project
5	US 97 Bend Pkwy SB On-Ramp & Empire Blvd	Signalized ^B	< 0.85	1.28	0.99	Empire Blvd widening (C-13)
6	US 97 Bend Pkwy NB Ramps & Empire Blvd	Signalized	< 0.85	1.33	1.10	Empire Blvd widening (C-13)
7	US 20 & Empire Blvd	Signalized	< 0.85	1.32	1.25	US 97 North Parkway Extension Phase 2 (C-40)
8	US 20 & Butler Market Rd	Signalized	< 0.85	1.27	1.04	Butler Market Rd/US 20/US 97 improvement (C-21)
9	US 97 Bend Pkwy SB Off-Ramp & Butler Market Rd	TWSC/RAB ^B	< 0.85	NA ^E / 1.30	0.55	Butler Market Rd/US 20/US 97 improvement (C-21)
10	US 97 Bend Pkwy NB On-Ramp & Butler Market Rd	TWSC	< 0.85 (ramp) < 0.95 (Butler Market Rd)	0.11 / 0.04	0.11 / 0.13	-
11	US 97 Bend Pkwy SB On-Ramp/Division St & 3rd St	Signalized	< 0.85	1.37	0.88	Butler Market Rd/US 20/US 97 improvement (C-21)
12	US 97 Bend Pkwy SB Ramps & Revere Ave	Signalized	< 0.85	0.99	0.84	Revere Ave interchange improvements (C-9)
13	US 97 Bend Pkwy NB Ramps & Revere Ave	Signalized	< 0.85	0.94	0.92	Revere Ave interchange improvements (C-9)
14	US 97 Bend Pkwy & Lafayette Ave	TWSC/Free ^B	NA	NA ^E / >2.00	NA	US 97 right-off only (C-42)
15	US 97 Bend Pkwy & Hawthorne Ave	TWSC/Free ^B	NA	NA ^E / >2.00	NA	US 97 right-off only (C-42)
16	US 97 Bend Pkwy SB Ramps & Colorado Ave	Signalized	< 0.85	1.17	0.98	-
17	US 97 Bend Pkwy NB Ramps & Colorado Ave	TWSC/Signalized ^B	< 0.85	0.52 / 1.29	0.90	US 97/Colorado Ave NB ramp capacity improvement (C-7)
18	US 97 Bend Pkwy & Truman Ave	TWSC/Closed ^B	-	NA ^E / >2.00	-	US 97 right-on, right-off closure (C-42)
19	US 97 Bend Pkwy SB Ramps & Reed Market Rd	Signalized	< 0.85	1.29	0.89	US 97/Reed Market Rd interchange (C-19,C-20)
20	US 97 Bend Pkwy NB Ramps & Reed Market Rd	TWSC/Signalized ^B	< 0.85	NA ^E / >2.00	0.80	US 97/Reed Market Rd interchange (C-19,C-20)
21	US 97 Bend Pkwy & Reed Ln	TWSC/Closed ^B	-	NA ^E / 1.05	-	US 97 right-on, right-off closure (C-42)
22	US 97 Bend Pkwy SB Ramps & Powers Rd	Signalized ^B	< 0.85	0.08 / 1.24	0.81	Powers Rd interchange (C-41)



Int. No.	Intersection	Control ^A	Existing OHP Mobility Target	No Build V/C ^C	Mitigated V/C	US 97 Parkway Plan/TSP Project
23	US 97 Bend Pkwy & Powers Rd	Signalized/ Closed ^B	-	1.45	-	Powers Rd interchange (C-41)
24	US 97 Bend Pkwy NB Ramps & Powers Rd	Signalized ^B	< 0.85	0.28 / 0.09	0.70	Powers Rd interchange (C-41)
25	US 97 Bend Pkwy & Badger Rd	Closed ^B	-	-	-	US 97 right-on, right-off closure (C-42)
26	US 97 Bend Pkwy & Pinebrook Blvd	Closed ^B	-	-	-	US 97 right-on, right-off closure (C-42)
27	US 97 & Ponderosa St	TWSC/ Closed ^B	-	NA ^E / >2.00	-	US 97 right-on, right-off closure (C-42)
28	US 97 SB Ramps & Baker Rd	TWSC	< 0.85 (ramp) < 0.95 (Knott Rd)	0.02 / 1.26	0.06 / 0.86	-
29	US 97 NB Ramps & Knott Rd	TWSC	< 0.85 (ramp) < 0.95 (Knott Rd)	0.41/ >2.00	0.38 / >2.00	-
40	US 20 & O.B. Riley Rd	Signalized	< 0.85	0.91	0.82	-
46	Revere Ave & 3rd St (US 97)	Signalized	< 0.85	1.17	1.10	-
Study intersections meeting targets				2 / 28	10 / 23	

^A TWSC stands for two-way stop-controlled. RAB stands for roundabout.

^B Traffic control change due to US 97 Parkway Plan/TSP project.

^C Signalized intersection volume-to-capacity (v/c) results are reported for the overall intersection. RAB results are reported for the worst leg. TWSC intersection results are reported for the worst major approach/ worst minor approach.

^D This intersection was not analyzed as part of the TSP. This intersection would be directly impacted the design of the US 97 North Corridor project and any alternative mobility targets should be identified as part of that process.

^E Major street movement operates under free flow conditions, movement v/c results not applicable.

Bold and Red values indicate the adopted mobility target would not be met.

It should be noted that while the US 97 at Cooley Road intersection is forecast as failing to meet mobility targets in the 2040 mitigated scenario, the actual design of this intersection has not yet been finalized. The ultimate design of Phase 1 of the US 97 North Corridor project may significantly change the performance of this intersection as well as US 97 at Robal Road and US 97 at Nels Anderson Place. In addition, the ongoing US 97 Baker Road Interchange Area Management Plan (IAMP) will likely identify improvements to the US 97 ramp terminal intersections at Baker Road and Knott Road. Any alternative mobility targets needed at those intersections should be recommended as part of those respective efforts.

It should also be noted that the environmental impact statement for the US 97 North Corridor project included additional improvements at the US 20 and Empire Boulevard intersection. However, during the Bend TSP process it was determined that these improvements would not be included in the financially constrained project list. Therefore, no improvements were assumed to be in place for the purpose of this analysis.



3.3 FACTORS LIMITING THE ABILITY TO MEET EXISTING MOBILITY TARGETS

Several factors combine to make compliance with the current mobility targets within Bend difficult. They include the following.

Projected multimodal travel needs

The importance of US 20 and US 97 to statewide, regional, and local travel creates significant multimodal demands for both short and long trips along the corridor. These users include:

- People driving taking advantage of the higher speeds and grade-separated intersections to make local trips to homes, work, and shopping
- People driving making regional trips between cities (including between Redmond, Sisters, Sunriver, La Pine and other Central and Eastern Oregon destinations)
- Freight traveling to and through Bend
- Transit traveling along the main state facility or crossing at a local street
- People biking and walking along and across US 20 and US 97

Balancing the needs of each of these various users was a key factor in the discussions and decisions of both the Bend MPO Policy Board and Bend Citywide Transportation Advisory Committee related to evaluating scenarios and identifying projects and programs for the US 97 Parkway Plan and Bend TSP.

Existing and planned development patterns

In many areas along US 20 and US 97, adjacent existing development and planned urban form promoting increased density and mixed land use constrain the ability to widen the highway right-of-way or provide parallel alternate routes. Obtaining needed right-of-way for highway widening would require acquisition and removal of such development, which would be very expensive and counter to the goals and objectives of the community.

Financial factors

As is true for most agencies, funding for transportation improvements is limited and constrains the ability of ODOT to fund highway capacity improvements. ODOT and the City of Bend have collaborated on a funding strategy for nearly

The US 97 Parkway Plan and Bend TSP identified a comprehensive set of transportation solutions resulting in nearly \$1 billion of projects and programs deemed reasonably likely to be funded in the 20-year planning horizon, including contributions towards many projects on state highways. However even though the Bend TSP includes a robust transportation funding strategy that enables the projects and programs list to be designated reasonably likely to be funded, there are remaining facility mobility target performance deficiencies that could not be addressed within the funding constraints.

Other Strategies Being Applied to Enhanced Mobility

In addition to funding capacity improvements, the US 97 Parkway Plan and Bend's TSP the identify funding for programs and policies to improve multimodal conditions and help reduce motor vehicle demand. This includes a commitment to building a citywide low-stress bicycle and pedestrian network, implementing parking pricing and management in downtown Bend, supporting an expansion of the existing transit network (including mobility hubs and high-capacity transit) and implementing a travel demand management program for major employers and institutions to reduce motor vehicle demand.



4.0 ALTERNATIVE MOBILITY TARGET EVALUATION

Figure 2 shows ODOT’s methodology for determining alternative mobility targets⁷. A summary of each step is discussed below, and Table 2 lists the results for each individual intersection.

STEP 1: IMPLEMENT PLANNED IMPROVEMENTS

Prior to implementing alternative mobility targets, all feasible actions and improvements must be taken to meet the current targets. Even with the implementation of the reasonably likely to be funded improvements in the US 97 Parkway Plan and Bend’s TSP, alternative mobility targets will be needed at the following 10 study intersections:⁸

- US 97 Bend Parkway Southbound On-Ramp & Empire Boulevard (v/c = 0.99)
- US 97 Bend Parkway Northbound Ramps & Empire Boulevard (v/c = 1.10)
- US 20 & Empire Boulevard (v/c = 1.25)
- US 20 & Butler Market Road (v/c = 1.04)
- US 97 Bend Parkway Southbound On-Ramp/Division Street & 3rd Street (v/c = 0.88)
- US 97 Bend Parkway Northbound Ramps & Revere Avenue (v/c = 0.92)
- US 97 Bend Parkway Southbound Ramps & Colorado Avenue (v/c = 0.98)
- US 97 Bend Parkway Northbound Ramps & Colorado Avenue (v/c = 0.90)
- US 97 Bend Parkway Southbound Ramps & Reed Market Road (v/c = 0.89)
- Revere Avenue & 3rd Street (US 97) (v/c = 1.10)

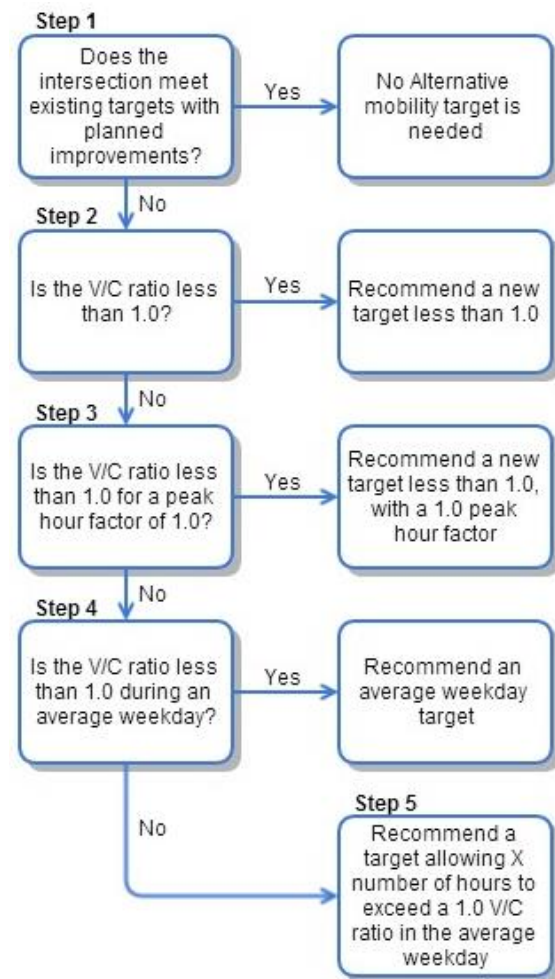


Figure 2: Alternative Mobility Target Methodology

STEP 2: INCREASE V/C TARGETS, STAYING BELOW CAPACITY

In cases where the v/c is forecasted to be greater than the OHP mobility target but less than capacity (v/c = 1.0) during the 30 HV, establish the proposed alternative target consistent with the v/c values used in the OHP. This approach would work for the following six of the 10 intersections needing

⁷ Planning Business Line Team Operational Notice PB-02, Oregon Department of Transportation, effective May 2, 2013.

⁸ Note: This excludes the intersections on US 97 with Cooley Road and Robal Road, which will be addressed by the North Corridor Project, as well as the US 97 ramp terminals with Baker Road and Knott Road, which will be addressed by the ongoing Interchange Area Management Plan.



alternative mobility targets, but not for the remaining four intersections still forecast to operate at v/c greater than 1.0 as listed in Table 2 below.

- US 97 Bend Parkway Southbound On-Ramp & Empire Boulevard (v/c = 0.99)
- US 97 Bend Parkway Southbound On-Ramp/Division Street & 3rd Street (v/c = 0.88)
- US 97 Bend Parkway Northbound Ramps & Revere Avenue (v/c = 0.92)
- US 97 Bend Parkway Southbound Ramps & Colorado Avenue (v/c = 0.98)
- US 97 Bend Parkway Northbound Ramps & Colorado Avenue (v/c = 0.90)
- US 97 Bend Parkway Southbound Ramps & Reed Market Road (v/c = 0.89)

STEP 3: REMOVE PEAKING WITHIN THE PEAK HOUR

In cases where v/c is forecasted to be greater than or equal to capacity during the 30 HV using the standard analysis procedures, evaluate the actual peak hour traffic volume for future year 30 HV projections rather than expanding the peak 15 minutes to be the 30 HV. If the resulting v/c is less than 1.0, establish the proposed alternative target. Setting the peak hour factor (PHF) for the 30 HV to 1.0 relaxes the peaking assumptions and allows for analysis of the peak hour volumes instead of the peak 15-minute volumes. Using this approach would work for the following intersection but not for the remaining three intersections that could not be addressed by Step 2.

- US 20 & Butler Market Road (new v/c = 0.94)

STEP 4: ANALYZE AVERAGE WEEKDAY CONDITIONS

In cases where v/c is forecasted to be greater than or equal to capacity during the design hour using the actual peak hour projection of traffic and in areas where design hours are affected by high seasonal traffic volumes, evaluate the annual average weekday p.m. peak (AWD) as the future year design hour rather than the 30 HV. If the resulting v/c is less than 1.0, establish the proposed alternative target. Analyzing average weekday conditions instead of the 30 HV gives a more accurate representation of typical conditions instead of peak summer conditions when there is an influx of visitors in Bend. Using AWD volumes with a PHF of 1.0, all study intersections except US 20 at Empire Boulevard (new v/c = 1.07) are forecast to operate with a v/c ratio of 1.0 or less, including the following two intersections that could not be addressed by Step 3.

- US 97 Bend Parkway Northbound Ramps & Empire Boulevard (new v/c = 0.90)
- Revere Avenue & 3rd Street (new v/c = 0.97)

STEP 5: HOURS OF CONGESTION

In cases where v/c is forecasted to be greater than or equal to 1.0 using the Annual Average Weekday PM Peak as the future design hour, determine the duration of the period during which the future Annual Average Weekday PM Peak hour will have a v/c greater than or equal to 1.0. Establish the proposed alternative target by increasing the number of hours that v/c can be greater than or equal to 1.0. An “hours of congestion” analysis assumes that traffic volumes that exceed capacity in the analysis hour are shifted to the “shoulder” hours, iteratively, until all traffic can be accommodated. The calculation of multi-hour conditions with peak spreading is fairly complex and it can be difficult to achieve consistent results. Also, because only the most congested intersections make it to Step 5 when



considering alternative mobility targets, it is often found that over-capacity conditions would be present for several hours of the day (in this case, a preliminary estimate for the US 20 at Empire Boulevard intersection is at least four hours), making such a target fairly ineffective.

Because of the difficulty with replicating results and managing the system using such a target, and considering an hours of congestion-based target would only be needed at one location, it is not recommended that this approach be applied to establish a new target for the US 20 at Empire Boulevard intersection. Instead, the recommended approach (discussed in more detail below) is to apply the average weekday target of a v/c less than or equal to 0.99 as described in Step 4. While this target could not be met through 2040, it could be met for many years (approximately 10 to 15 years). In the meantime, it is recommended that funding for the capacity improvements needed at this location be prioritized. If funding cannot be committed before the average weekday p.m. peak hour travel demand begins to exceed the proposed alternative mobility target, an update to the alternative mobility target can be considered at that time.



Table 2: Intersection Operation in the US 97 Parkway Corridor when applying the Alternative Mobility Target Methodology (2040 PM Peak Hour)

Int. No.	Intersection	Control ^D	Existing OHP Mobility Target	Step 1: 30 HV, w/ Recommended Improvements	Step 2: 30 HV, V/C ≤ 1.0	Step 3: 30 HV, PHF=1.0, V/C ≤ 1.0	Step 4: AWD, PHF=1.0, V/C ≤ 1.0
5	Bend Pkwy SB On-Ramp & Empire Blvd	Signalized ^B	< 0.85	0.99	0.99	0.96	0.88
6	Bend Pkwy NB Ramps & Empire Blvd	Signalized	< 0.85	1.10	1.10	1.01	0.90
7	US 20 & Empire Blvd	Signalized	< 0.85	1.25	1.25	1.18	1.07
8	US 20 & Butler Market Rd	Signalized	< 0.85	1.04	1.04	0.94	0.86
9	Bend Pkwy SB Off-Ramp & Butler Market Rd	RAB ^B	< 0.85	0.55	0.55	0.51	0.46
10	Bend Pkwy NB On-Ramp & Butler Market Rd	TWSC	< 0.85 (ramp) < 0.95 (Butler Mkt Rd)	0.11 / 0.13	0.11 / 0.13	0.10 / 0.10	0.08 / 0.08
11	Bend Pkwy SB On-Ramp/Division St & 3rd St	Signalized	< 0.85	0.88	0.88	0.74	0.68
12	Bend Pkwy SB Ramps & Revere Ave	Signalized	< 0.85	0.84	0.84	0.80	0.74
13	Bend Pkwy NB Ramps & Revere Ave	Signalized	< 0.85	0.92	0.92	0.91	0.81
16	Bend Pkwy SB Ramps & Colorado Ave	Signalized	< 0.85	0.98	0.98	0.80	0.72
17	Bend Pkwy NB Ramps & Colorado Ave	Signalized ^B	< 0.85	0.90	0.90	0.81	0.70
19	Bend Pkwy SB Ramps & Reed Market Rd	Signalized	< 0.85	0.89	0.89	0.74	0.66
20	Bend Pkwy NB Ramps & Reed Market Rd	Signalized ^B	< 0.85	0.80	0.80	0.77	0.66
22	Bend Pkwy SB Ramps & Powers Rd	Signalized ^B	< 0.85	0.81	0.81	0.66	0.58
24	Bend Pkwy NB Ramps & Powers Rd	Signalized ^B	< 0.85	0.70	0.70	0.74	0.68
40	US 20 & O.B. Riley Rd	Signalized	< 0.85	0.82	0.82	0.77	0.71
46	Revere Ave & 3rd St	Signalized	< 0.85	1.10	1.10	1.02	0.97
Study intersections meeting targets				STEP 1: 7 / 17	STEP 2: 13 / 17	STEP 3: 14 / 17	STEP 4: 16 / 17

A Signalized intersection volume-to-capacity (v/c) results are reported for the overall intersection. Roundabout (RAB) results are reported for the worst leg. Two-way stop control (TWSC) intersection results are reported for the worst major approach/worst minor.

B Control change due to US 97 Parkway Plan/TSP project.

Bold and Red values indicate a v/c ratio greater than the mobility target at that step.



5.0 RECOMMENDED ALTERNATIVE MOBILITY TARGETS

While the major investments recommended through the US 97 Parkway Plan, and identified as reasonably likely to be funded in the Bend TSP, will result in improved intersection performance on ODOT facilities, not all intersections will be able to meet state v/c mobility targets and there is a need to consider alternative mobility targets in select locations. Alternative mobility targets can help establish realistic expectations for future system performance and create targets that help the community continue to grow in accordance with its adopted land use plan.

The sections below describe the recommended alternative mobility targets, which have been separated into three categories:

- US 97 interchange ramp terminals,
- US 20 (3rd Street) intersections, and
- the Empire Boulevard corridor.

5.1 US 97 INTERCHANGE RAMP TERMINALS

Seven US 97 interchange ramp terminal intersections will require alternative mobility targets. However, with the exception of the US 97 northbound ramp terminal at Empire Boulevard, all of these can be accommodated through simple increases in the allowable v/c ratio while continuing to use the 30th highest annual hour of traffic as the basis for analysis. The new recommended v/c ratio targets are listed in Table 3. Note, that the US 97 Southbound ramp terminal/Division Street at 3rd Street will be treated differently, as described in section 5.2 and the Empire Boulevard ramp terminals will be treated differently as described in section 5.3

Although an interchange serves both mainline traffic and the crossroad to which it connects, it is important that an interchange be managed to avoid the formation of queues on off-ramps which back up into the portions of the ramps needed for safe deceleration from mainline speeds or onto the mainline itself. Therefore, because these alternative mobility targets will allow for more congestion at the ramp terminals, it is recommended that as an additional requirement queuing analysis is conducted to determine that with a probability equal to or greater than 95 percent, vehicle queues would not extend onto the mainline or into the portion of the ramp needed to safely accommodate deceleration.



Table 3: Recommended Alternative Mobility Targets for US 97 Interchange Ramp Terminal Intersections ^{A,B,C}

Intersection	Maximum Volume to Capacity Ratio Target
US 97 Bend Parkway Northbound Ramps at Colorado Avenue	0.90
US 97 Bend Parkway Southbound Ramps at Reed Market Road	
US 97 Bend Parkway Northbound Ramps at Revere Avenue	0.95
US 97 Bend Parkway Southbound Ramps at Colorado Avenue	0.99

Notes for Table 3:

^A The peak hour of analysis for applying these alternative mobility targets shall be the 30th highest annual hour.

^B In addition to meeting the maximum volume to capacity ratio target it shall be demonstrated, with a probability equal to or greater than 95 percent, that vehicle queues would not extend onto the US 97 Parkway mainline or into the portion of the ramp needed to safely accommodate deceleration.

^C The alternative mobility target for the US 97 interchange ramp terminal intersections on 3rd Street/Division Street is shown in Table 4. Alternative mobility targets for the US 97 interchange ramp terminal intersections on Empire Boulevard are shown in Table 5.

5.2 US 20 (3RD STREET) INTERSECTIONS

Five intersections along US 20 (3rd Street) will require alternative mobility targets. At the two intersections at Empire Boulevard and Revere Avenue, congestion by 2040 is forecast to be significant and would require conversion to an average weekday-based alternative mobility target (additional analysis conducted as part of the Bend TSP found this to be true for the intersection at Greenwood Avenue as well). While it would not be strictly necessary for all intersections along US 20, it is recommended that the alternative mobility targets for US 20 intersections be based on the annual average weekday p.m. peak hour rather than the 30th highest annual hour for the following reasons:

- The use of an average weekday-based target would be consistent with City of Bend mobility standards.
- US 20 (3rd Street) in Bend functions more similarly to a City arterial compared to the Parkway, with numerous at-grade intersections and driveways, slower travel speeds, and more multimodal activity.
- The three most congested intersections along the US 20 corridor that will ultimately require alternative mobility targets be set for average weekday conditions will control corridor operations.
- None of the intersections on US 20 involved are directly connected to a US 97 Parkway off-ramp, so the concern related to long ramp queues creating a safety hazard is not a factor.

The recommended alternative mobility targets for US 20 (3rd Street) intersections are listed in Table 4. Note, that the recommended alternative mobility target for the US 20 intersection at Empire Boulevard is discussed separately in section 5.3. Also of note is that the 2040 forecast v/c ratio at the US 20/ Butler Market Road intersection is 0.01 greater than the recommended target. However, considering this is a 20-year estimate, it is reasonable to assume the proposed target will be achievable.



Table 4: Recommended Alternative Mobility Targets for US 20 (3rd Street) Intersections ^{A,B}

Intersection	Maximum Volume to Capacity Ratio Target
US 20 (3 rd Street) at O.B. Riley Road	0.85
US 20 (3 rd Street) at Butler Market Road	
US 97 Bend Parkway Southbound On-Ramp/Division St at 3 rd Street	
US 20 (3 rd Street) at Revere Avenue	0.99

Notes for Table 4:

^A The peak hour of analysis for applying these alternative mobility targets shall be the annual average weekday p.m. peak hour, using a peak hour factor of 1.0.

^B The alternative mobility target for the US 20 (3rd Street) intersection at Empire Boulevard is shown in Table 5.

5.3 EMPIRE BOULEVARD CORRIDOR

Empire Boulevard is located near the confluence of US 20 and US 97 in Bend and serves a large amount of regional and local traffic, with unique origin-destination patterns given the current design of US 97. Even after implementing the US 97 North Corridor Phase 1 improvements, travel demand on Empire Boulevard near US 20 and US 97 is forecast to significantly exceed capacity. The North Corridor project has identified improvements which would likely address the mobility issues at this location, but the funding for those improvements is not yet identified. Given the unique traffic patterns, separate alternative mobility targets are recommended at the study intersections within this area.

The intersections along Empire Boulevard at US 20 and the US 97 Northbound Ramps both require an alternative mobility target based on average weekday conditions. While an alternative mobility target is not necessary for the intersection with the US 97 Southbound On-Ramp, it is recommended that it be treated the same for consistency and because the more congested operations at the other closely spaced intersections will control corridor operations anyway.

The new recommended v/c ratio targets are listed in Table 5. For the US 97 Northbound Ramp terminal, as with other ramp terminals described in section 5.1, it is recommended that queuing analysis be additionally required to determine that, with a probability equal to or greater than 95 percent, vehicle queues would not extend onto the mainline or into the portion of the ramp needed to safely accommodate deceleration.

As noted previously in Section 4.0, the recommended alternative mobility target for the intersection on US 20 at Empire Boulevard cannot be met through 2040. However, it is expected to be achievable for approximately 10 to 15 years. In the meantime, it is recommended that funding for the capacity improvements needed at this location be prioritized. If funding cannot be committed before the average weekday p.m. peak hour travel demand begins to exceed the proposed alternative mobility target, an update to the alternative mobility target can be considered at that time.



Table 5: Recommended Alternative Mobility Targets for the Empire Boulevard Corridor ^A

Intersection	Maximum Volume to Capacity Ratio Target
US 97 Bend Parkway Southbound On-Ramp at Empire Boulevard	0.90
US 97 Bend Parkway Northbound Ramps at Empire Boulevard ^B	
US 20 (3 rd Street) at Empire Boulevard	0.99

Notes for Table 5:

^A The peak hour of analysis for applying these alternative mobility targets shall be the annual average weekday p.m. peak hour, using a peak hour factor of 1.0.

^B In addition to meeting the maximum volume to capacity ratio target it shall be demonstrated, with a probability equal to or greater than 95 percent, that vehicle queues would not extend onto the US 97 Parkway mainline or into the portion of the ramp needed to safely accommodate deceleration.



6.0 APPENDIX
