Technical Memorandum #6: First Level Screening

U.S. 20 Bend Facility Plan

Bend, Oregon

July 28, 2023

Contents

Figures

Acronyms and Abbreviations

ATC	Automatic Traffic Control
City	City of Bend
LPIs	Leading Pedestrian Intervals
MUTs	Median U-Turns
ODOT	Oregon Department of Transportation
Plan	U.S. 20 Bend Facility Plan
RCUTs	Restricted Crossing U-Turns
ROW	Right-of-Way
v/c	Volume-to-capacity

1 Introduction

U.S. 20 is located in central Oregon and serves the residents of Bend, freight traffic, and other travelers. As the region has grown, so have congestion and safety concerns. The U.S. 20 Bend Facility Plan (Plan) will identify strategies to improve safety for all users, with an emphasis on improvements for people who walk, bike, and use public transit. The study area begins at the intersection of U.S. 20 (NE Greenwood Avenue) and NE 3rd Street and ends at the intersection of U.S. 20 and Powell Butte Highway.

This memorandum presents alternatives at critical intersections that will not meet mobility targets in the future, displayed in Figure 1. While U.S. 20 is an Oregon Department of Transportation (ODOT) facility, most of the minor side street approaches that intersect the highway are City of Bend (City) facilities.

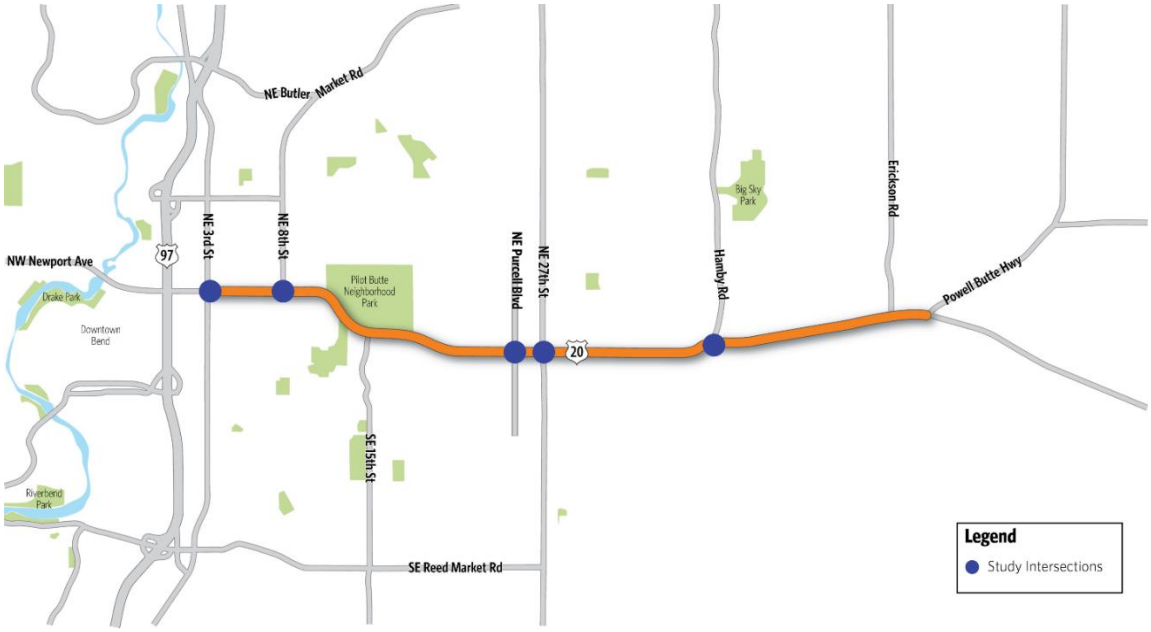
2 Intersection Improvements

Based on traffic analysis, five intersections along U.S. 20 are expected to not meet mobility targets for the design year 2042:

- NE 3rd Street
- NE 8th Street
- NE Purcell Boulevard
- NE 27th Street
- Hamby Road

The concepts described in Technical Memorandum #5 were considered at each intersection. The subsections below describe the reasons for which the concepts were either dismissed or proposed for further consideration.

Figure 1. Location of Proposed Intersection Improvements



2.1 U.S. 20 at NE 3rd Street

NE 3rd Street is a major north-south arterial parallel to U.S. 97, and its intersection with U.S. 20 is constrained by buildings on all four corners. From the east, U.S. 20 turns and continues north along NE 3rd Street at this intersection before crossing under U.S. 97. NE 3rd Street mainly serves businesses and shopping areas both to the north and south of the U.S. 20/NE Greenwood Avenue intersection. Any widening or other major geometric changes would have a significant impact on private properties and businesses. Additionally, the City is currently pursuing a road diet on NE Greenwood Avenue, which would convert the shared WB through/right lane to a right turn only lane that is dropped at this intersection.

2.1.1 Alternatives Considered and Dismissed

The bulleted list below describes each concept that was considered at NE 3rd Street and the reason(s) the alternative was not advanced.

- Roundabout
  - Significant right-of-way (ROW) impacts in all four quadrants.
- Removal of lefts
  - Concerns with diversion of traffic onto local roads.
  - Left turn volumes are high enough that mitigation would need to be provided.
- Median U-Turns (MUTs)/Restricted Crossing U-Turns (RCUTs)
  - No viable U-turn locations.
    - U-turn locations along U.S. 20 would have significant impacts to businesses adjacent to NE 1st Street, NE 4th Street, and NE 5th Street.

- Traditional Widening – Major and Minor
  - ROW impacts adjacent to U.S. 20 and NE 3rd Street.
  - Minor widening of adding an EB right turn would not provide a significant operational benefit.
    - Reduction of volume-to-capacity (v/c) ratio from 1.05 (in the No-Build scenario) to 0.99 does not meet the mobility target.
  - Major widening would significantly impact the buildings on the northeast and southwest corners of the intersection.

2.1.2 Proposed Alternative

The proposed alternative at NE 3rd Street is to focus on providing pedestrian, bicycle and transit enhancements as described in Section 2.1.3 below and to accommodate the planned road diet and lane changes. RCUTs, MUTs, and minor widening will not achieve the mobility target, and major widening of U.S. 20 to provide additional through lanes would result in significant ROW impacts adjacent to US 20.

Figure 1. NE 3rd Street Proposed Intersection Concept

2.1.3 Pedestrian, Bicycle and Transit Improvements

The proposed active transportation enhancements at this intersection include:

- Leading Pedestrian Intervals (LPIs) on all legs (subject to further analysis relative to ODOT's Signal Policy).

- Warning signage (Turning Vehicles Yield to Bikes/Peds) on all approaches (per Bend Safety Implementation Plan).
- Right-turn-on-red prohibition (per 2012 Multimodal Traffic Safety Assessment).
- Transit signal priority (to be implemented upon completion of Automatic Traffic Control (ATC) upgrade).
- Note: These improvements would tie into a joint ODOT/City project to modify the NE Greenwood Avenue cross-section immediately west of this intersection, which will add conventional bikes leading to Bend's downtown core

2.2 U.S. 20 at NE 8th Street

NE 8th Street is the next signalized intersection on U.S. 20 to the east of NE 3rd Street and serves as a major access point to residential neighborhoods immediately to the north and south.

2.2.1 Alternatives Considered and Dismissed

The bulleted list below describes each concept that was considered at NE 8th Street and the reason(s) for which the alternative was not advanced.

- Roundabout
  - Significant ROW impact in all four quadrants.
  - Causes a degradation in operations versus a signal.
    - Increase in v/c ratio from 1.16 (in the No-Build scenario) to 1.45 with a roundabout.
- MUTs/RCUTs
  - No viable U-turn locations.
    - U-turn locations along U.S. 20 would have significant impacts to churches on NE 10th Street and businesses adjacent to NE 6th Street and NE 7th Street.
- Traditional Widening – Major and Minor
  - ROW impacts adjacent to U.S. 20 and NE 8th Street.
  - Adding dual SB left turns and a NB right turn does not meet the mobility target (v/c of 0.98).

2.2.2 Proposed Alternative

The proposed alternative at NE 8th Street is to maintain the existing number of lanes and access from NE 8th Street while focusing improvements for people walking, bicycling and accessing transit as identified below.

Figure 2. NE 8th Street Proposed Intersection Concept

2.2.3 Pedestrian, Bicycle and Transit Improvements

The proposed active transportation enhancements at this intersection include:

- LPIs on all legs (subject to further analysis relative to ODOT's Signal Policy).
- Warning signage (Turning Vehicles Yield to Bikes/Peds) on all approaches.
- NB and SB approaches: green bike lanes (solid fill) immediately upstream from intersection.
- All approaches: green bike lane conflict markings traversing the first lane of cross-street traffic (subject to ODOT approval).
- Transit signal priority (to be implemented upon completion of ATC upgrade).

2.3 U.S. 20 at NE Purcell Boulevard

NE Purcell Boulevard is a major signalized intersection just west of NE 27th Street. Several car dealerships and a shopping mall are located at this intersection. North and south of U.S. 20, NE Purcell Boulevard winds through residential neighborhoods.

2.3.1 Alternatives Considered and Dismissed

The bulleted list below describes each concept that was considered at NE Purcell Boulevard and the reason(s) for which the alternative was not advanced.

- Roundabout
  - Significant ROW impact in all four quadrants.

- This location would only require impacting parking lots to construct a roundabout, however this would still pose a significant ROW cost and impact.

- MUTs/RCUTs
  - U-turn locations would impact ROW and parking near Dean Swift Road and NE Windy Knolls Drive.

2.3.2 Proposed Alternative

The proposed alternative at NE Purcell Boulevard is to widen and provide a dedicated NB right lane as shown in Figure 3. While this will not meet the mobility target, it would improve operations by decreasing the v/c from 1.06 to 0.92 with minimal ROW impacts. Bicycles would be accommodated with a keyhole at the newly-created right turn bay opening, similar to other treatments along the corridor.

Figure 3. Proposed Minor Widening at NE Purcell Boulevard

2.3.3 Pedestrian, Bicycle and Transit Improvements

The proposed active transportation enhancements at this intersection include:

- LPIs on all legs (subject to further analysis relative to ODOT's Signal Policy).
- Dual curb ramps on the intersection's northwest corner.
- Warning signage (Turning Vehicles Yield to Bikes/Peds) on all approaches.
- NB and SB approaches: green bike lane conflict markings immediately upstream from right turn lanes.

- EB and WB approaches: green bike lanes (solid fill) immediately upstream from intersection, and green bike lane conflict markings traversing the first lane of cross-street traffic (subject to ODOT approval).
- Upgrades to existing SB transit stop upstream from intersection (per Cascades East Transit).
- Transit signal priority (to be implemented upon completion of ATC upgrade).

2.4 U.S. 20 at NE 27th Street

NE 27th Street serves a large shopping area to the north, as well as a hospital at NE Neff Road. NE 27th Street also provides access to many residential homes and neighborhoods both to the north and south of U.S. 20.

2.4.1 Alternatives Considered and Dismissed

The bulleted list below describes each concept that was considered at NE 27th Street and the reason(s) for which the alternative was not advanced.

- Roundabout
  - A multi-lane roundabout would impact existing buildings located on three corners of the intersection, as well as adjacent driveway access.
- MUTs/RCUTs
  - Displacing the EB and WB left turns and providing a U-turn would meet the mobility target (v/c of 0.85), however several impacts were identified:
    - MUTs would impact parking, driveways, and business access near NE Bellevue Drive and NE Windy Knolls Drive
    - MUTs would need to be designed to accommodate WB-67s, as NE 27th Street is a major truck route, resulting in larger loons or bulb-outs and likely opposition from ODOT's Mobility Advisory Committee.
  - Diverting lefts was rejected as an alternative due to the high volume of left turning vehicles, as well as the need to maintain easy access to the hospital located to the north of U.S. 20 along NE 27th Street.

2.4.2 Proposed Alternative

Two different alternatives were considered at this intersection: minor and major widening. The minor widening alternative added an EB right turn lane with a porkchop island as shown in Figure 4. The major widening alternative added the same EB right turn lane and added dual left turn lanes on all approaches, shown in Figure 5. The minor widening alternative results in a v/c reduction of 0.3 (1.26 to 0.96). The major widening alternative, while more impactful, would achieve the mobility target with a v/c of 0.8.

Figure 4. Minor Widening Alternative at NE 27th Street

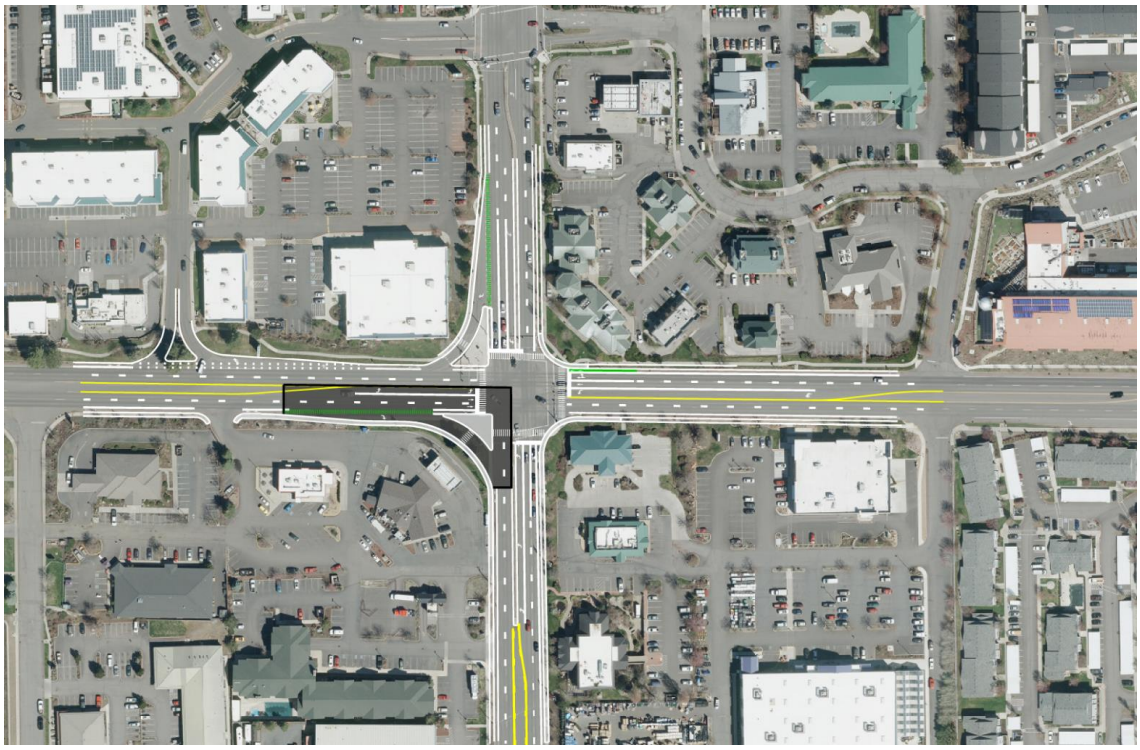
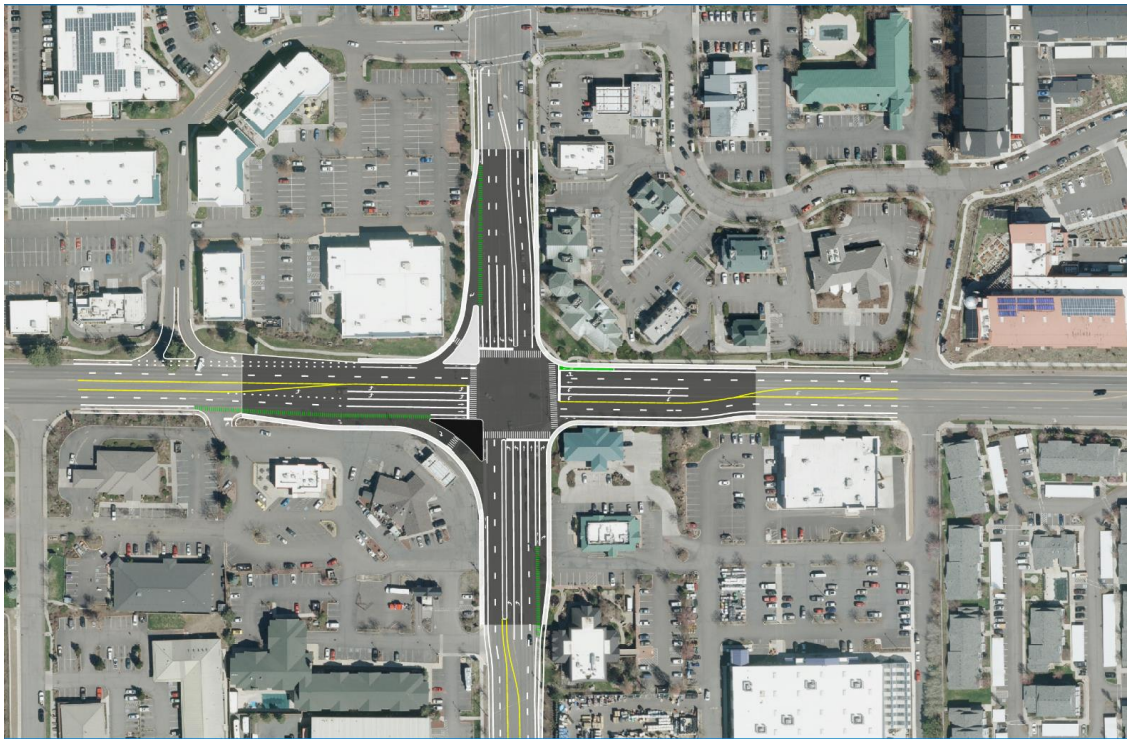


Figure 5. Major Widening at NE 27th Street



2.4.3 Pedestrian, Bicycle and Transit Improvements

The degree to which the U.S. 20/NE 27th Street intersection would be partially or fully rebuilt would depend on the alternative (or combination of alternatives) ultimately advanced from the options described above. A fully rebuilt intersection, for instance, would bring all curb ramps up to standard while providing opportunities to proactively incorporate other active transportation components such as the City's planned shared use path along NE 27th Street between U.S. 20 and NE Bear Creek Road. Depending on the final alternative to be advanced, proposed active transportation enhancements at this intersection include:

- LPIs on the east and north legs (subject to further analysis relative to ODOT's Signal Policy).
- Audible pedestrian signals.
- Dual curb ramps on the intersection's northeast and southeast corners.
- Warning signage (Turning Vehicles Yield to Bikes/Peds) on the NB and WB approaches.
- NB, SB and EB approaches: green bike lane conflict markings immediately upstream from right turn lanes.
- WB approach: green bike lane (solid fill) immediately upstream from intersection, and green bike lane conflict markings traversing the first lane of cross-street traffic (subject to ODOT approval).
- New EB transit stop immediately east of intersection (per Cascades East Transit).
- Transit signal priority (to be implemented upon completion of ATC upgrade, or in tandem with full intersection rebuild).

2.5 U.S. 20 at Hamby Road

Hamby Road is currently a single lane roundabout that was recently constructed in 2022. Hamby Road was converted from a two way stop controlled intersection to a roundabout to reduce vehicular delay and improve safety at the intersection.

2.5.1 Alternatives Considered and Dismissed

The bulleted list below describes each concept that was considered and the reason(s) for which the alternative was not advanced.

- Widening to multilane roundabout
    - Widening to a multilane roundabout would require reconstruction of the entire roundabout.
    - To achieve acceptable lane utilization, widening along U.S. 20 approximately 300 feet upstream and downstream of Hamby Road would be required.
- Changing intersection type to signal

- Changing the intersection type and converting to a signal would have a negative public perception as the roundabout was recently completed.
- A signal would not provide the same safety benefits that drove the selection of a roundabout at this location.

2.5.2 Proposed Alternative

The proposed alternative at this location is to modify the existing roundabout to add a right turn bypass lane on the NB and EB approaches as shown in Figure 6. This alternative would reduce the v/c to 0.97 while maintaining the existing roundabout configuration. Constructing the bypass lanes would also be less impactful during construction than converting the intersection to a signalized intersection.

Figure 6. Hamby Road Proposed Slip Lanes

2.5.3 Pedestrian, Bicycle and Transit Improvements

While infrastructure for people walking, bicycling and accessing transit would remain generally similar to current conditions, the newly-added bypass lanes on the EB and NB approaches would also include raised medians/refuge islands, thus enabling nonmotorized users to complete crossing movements in multiple phases.