KITTELSON & ASSOCIATES

AUNE STREET EXTENSION STUDY

Bend, Oregon

July 22, 2024

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Aune Street Extension Study

Bend, Oregon

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Executive Summary

In 2023, the City of Bend initiated a feasibility study to identify and evaluate infrastructure improvements options for the Aune Street Extension (East) and surrounding network to improve connectivity, mobility, and safety for all modes. The components of the feasibility study were identified in the city of Bend's Transportation System Plan, adopted in 2018, and were included in the transportation general obligation (GO) bond passed by Bend voters in 2020. This study considers multiple projects identified in the TSP, including the Aune Street Extension from the Parkway Undercrossing to 3rd Street, 3rd Street/ Miller Avenue intersection improvements, and enhanced crossings at identified locations on 3rd Street to support implementation of TSP Key Routes. The results of these efforts are documented in this Aune Street Extension Study Report, which includes a:

- Description of project background, intended outcomes, and stakeholder coordination;
- Summary of existing and future conditions analyses;
- Concepts and alignment alternatives for three key focus areas;
- Long-term options for the study area that can be considered; and
- Next steps and considerations for the design phase.

The preferred concepts and alignment alternatives were informed by findings from the existing and future conditions analyses, alternatives evaluation process, and discussions with city staff and key stakeholders. Overall, this report presents multiple alternatives that are consistent with the vision to increase safe and accessible east-west connections in the study area, especially for people walking, biking, and using transit. The concept alternatives are organized by sub-areas. These alternatives include both intersection and cross-sectional improvements that balance traffic circulation needs for all modes. The alternatives for each Sub-Area are summarized below.

- **Sub-Area A**: Includes alternatives for intersection improvements at 3rd Street/ Burnside Avenue to enhance safety and visibility of people walking and biking across 3rd Street on TSP Key Route 7 and the Low Stress Network (LSN).
- **Sub-Area B**: Includes alternatives for installing a traffic signal at the 3rd Street/ Miller Avenue intersection to enhance traffic circulation between 3rd Street and Aune Street/ the US 97/ Colorado Avenue interchange. Alternatives for complete streets improvements on Miller Avenue and Scott Street (East) support implementation of Key Route 7 and the LSN.
- **Sub-Area C**: Includes a new dedicated left-turn lane at Aune Street and enhanced crossing alternatives for bicycle and pedestrian connections from 2nd Street to Aune Street, which is part of Key Route 7.

The alternatives presented in this report provide the city flexibility to further refine these options and present them to the community for input in the design phase of the project, where a final preferred concept will be selected for implementation and construction.

Section 1
Introduction

Introduction

This report documents the key findings of the Aune Street Extension Study led by the City of Bend. The Aune Street Extension Study is a comprehensive feasibility study of infrastructure improvement options for the Aune Street Extension and essential multimodal connections in the surrounding network needed to implement Key Walking and Biking Routes. This report documents findings from existing, future, needs and opportunities, and concept development assessments that frame the recommended alternatives for the study area.

Each of these sections provide an overview of key findings from technical memorandums that were developed throughout the study period. These memorandums provide more detail about the discussions presented in this report and are provided in the Appendices for reference.

The Aune Street Extension Study provides background documentation and analysis to support the design and implementation phase of the Aune Street Extension Project, which is planned to begin in Spring/ Summer 2024.

PROJECT BACKGROUND

The City of Bend identified the need for the Aune Street Extension Study through several City of Bend Planning efforts including the Central Westside Plan (2015) and the Bend Transportation System Plan (2020). The project was included in the voter approved 2020 Transportation General Obligation Bond (GO Bond) with funding allocated for design and construction.

The purpose of the study is to identify near-term infrastructure on Aune Street and the surrounding roadway network that improves system connectivity for all users. The final recommended concepts improve multimodal east-west connectivity within the vicinity of the US97 parkway between key activity centers in Bend including 3rd Street, the Old Mill District, and Downtown. The study supports the implementation of TSP Key Routes, the low stress network (LSN), safety improvements at high-priority intersections, safety improvements at crossings on 3rd Street, and considers the impacts of development west of Aune Street. Long-term infrastructure options are also discussed to help inform future infrastructure decision making.

STUDY AREA

The study area is bounded by Dekalb Ave to the north, SE 3rd Street to the east, SE Woodland Boulevard to the south, and US97 to the west. The area includes the southbound US97/Colorado Avenue ramp intersection. The study included 12 study intersections below, shown in Figure 1:

1. Colorado Avenue/US97 SB Ramp
2. Colorado Avenue/US97 NB Ramp
3. Scott Street/Aune Street
4. 2nd/Davis Avenue
5. 2nd Street/Miller Avenue
6. 2nd Street/Woodland Boulevard

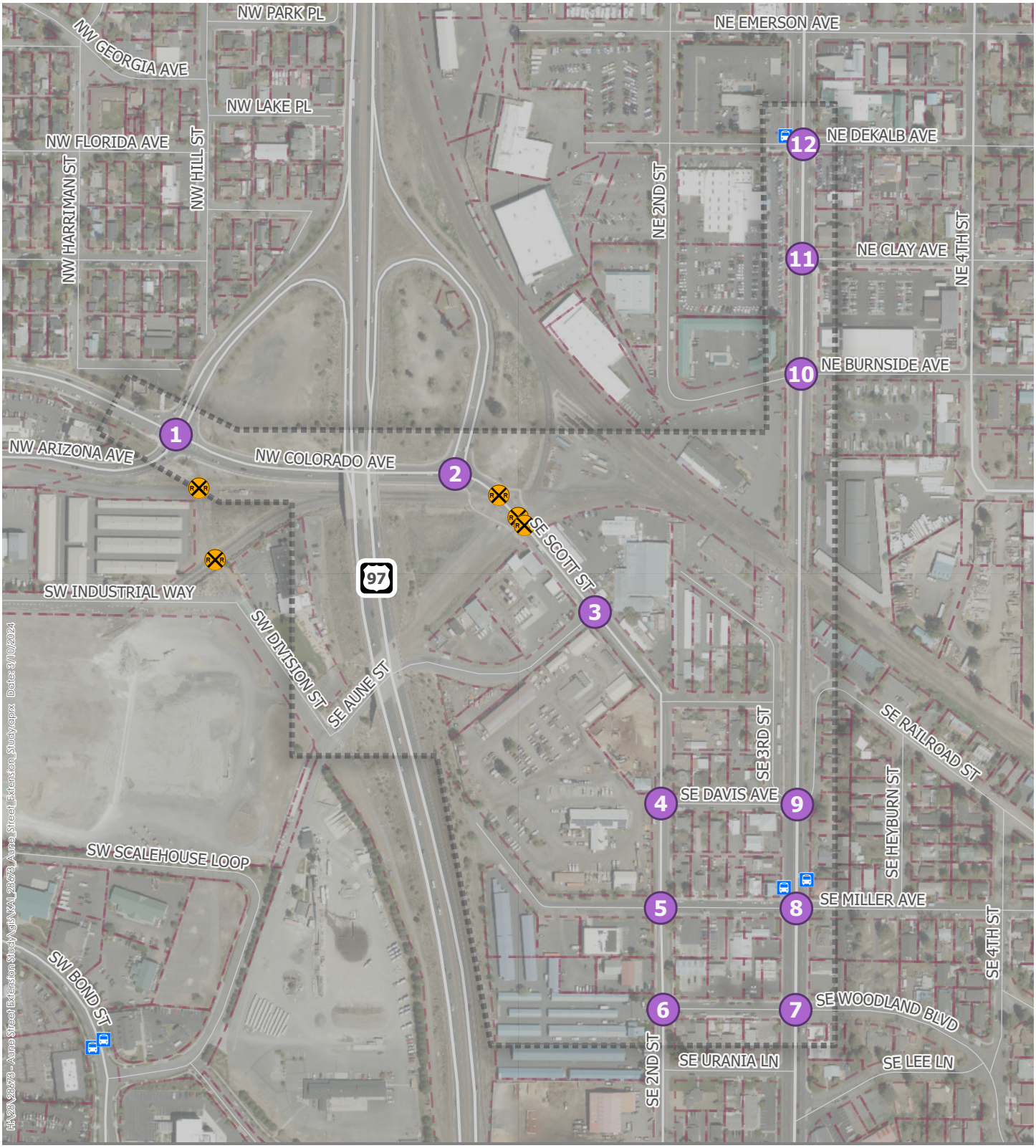
7. 3rd Street/Woodland Boulevard
8. 3rd Street/Miller Avenue
9. 3rd Street/Davis Avenue
10. 3rd Street/Burnside Avenue
11. 3rd Street/Clay Avenue
12. 3rd Street/Dekalb Avenue

The City of Bend operates and maintains all study intersections except for the Colorado Avenue/ US97 ramps, which are operated and maintained by the Oregon Department of Transportation (ODOT). The Colorado Avenue/ US97 SB ramp is the only signalized intersection in the study area. All others are side street stop controlled. The 3rd Street/ Davis Avenue intersection is restricted to right-in/ right-out. Modifications to the 3rd Street railroad undercrossing were not considered as part of this study.

Key Activity Centers and Destinations

Figure 2 displays key activity centers and destinations near the study area. As shown, the existing Aune Street alignment is located between several major activity areas in Bend, including the Old Mill District/ Mill Quarter to the west, the 3rd Street business corridor to the east, and Downtown Bend to the northwest. These areas are hubs for numerous businesses offering dining, retail, hospitality services and future residential housing units. The Old Mill District also offers popular recreational activities, including tourist attractions and access to the Deschutes River Trail. Today, Aune Street provides the only access to Crux Fermentation Project, a popular brewpub/ food truck pod located on Division Street. Bend Senior High is located northeast of the study area and Jaycee Park is located just east of the study area along Miller Ave/ Centennial Street.

Several mixed-use developments along Industrial Way and Arizona Avenue are near construction or under construction at the time of this study, including Timber Yards and Jackstraw.



Study Intersections

At-Grade Railroad Crossing

Cascades East Transit (CET) Stops

Parcels

Study Area

0 0.1 Miles

Figure 1

Study Area

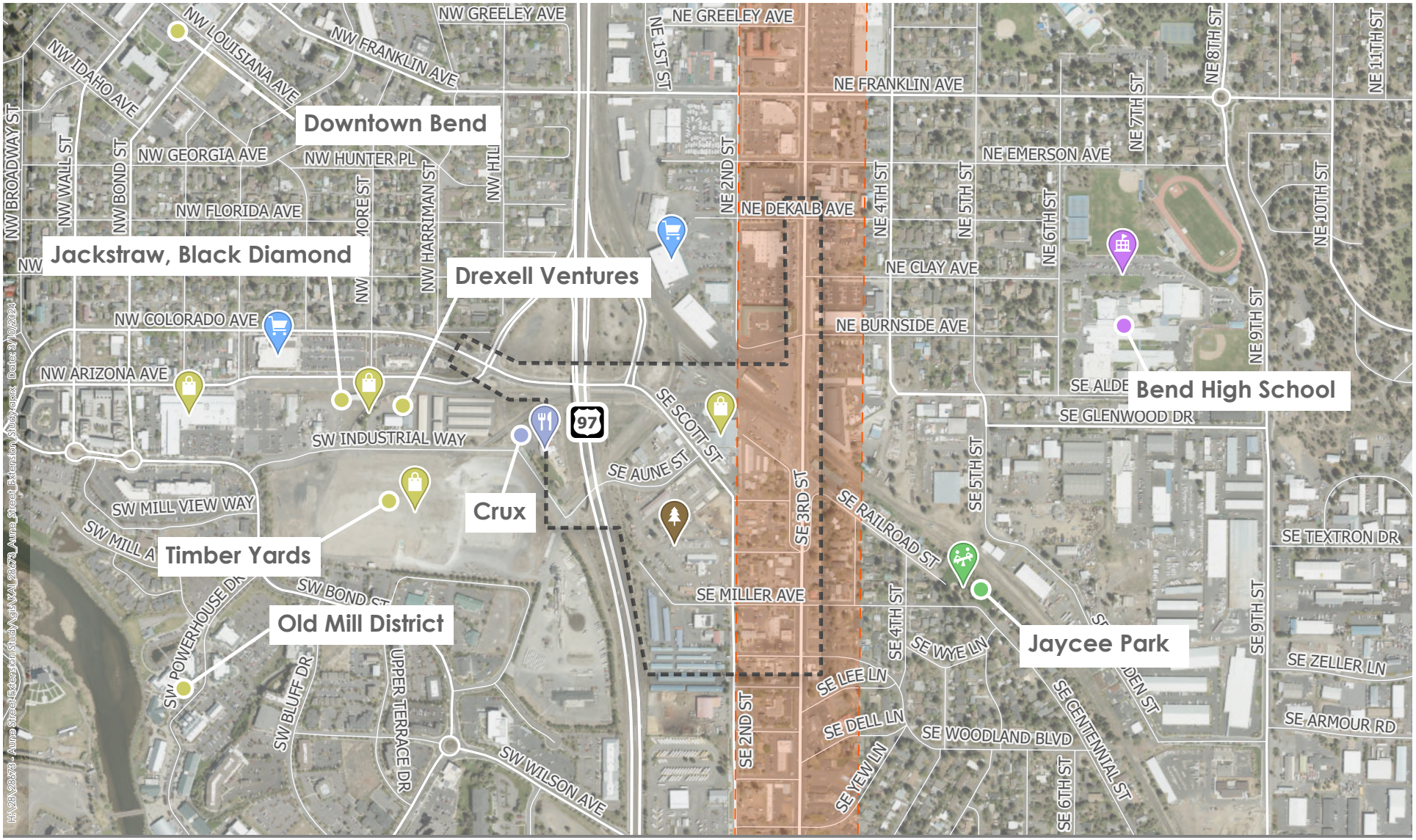


Figure 2

Key Activity Centers and Destinations

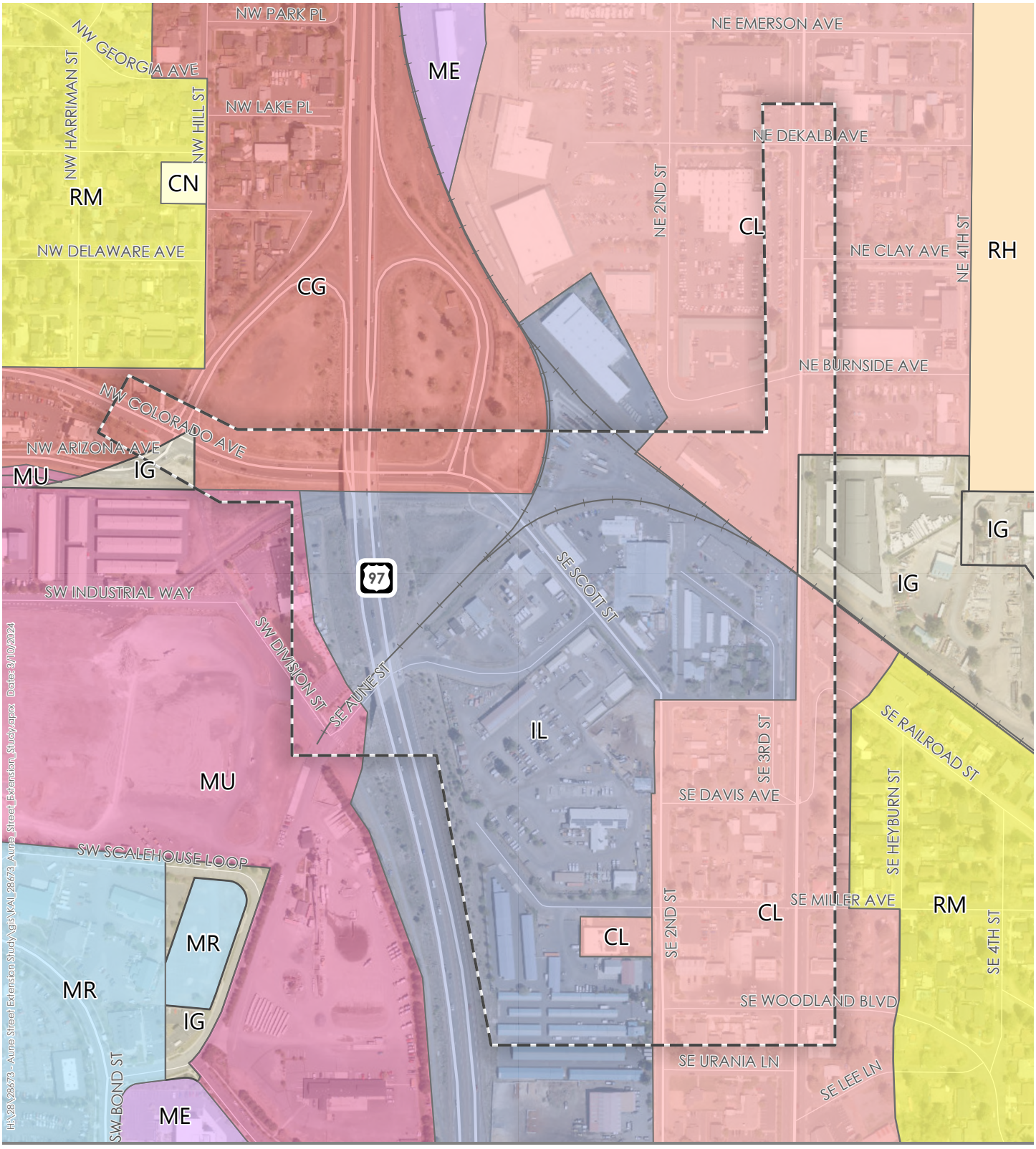
Land Use

Figure 3 displays zoning near Aune Street and surrounding network based on the Bend Comprehensive Plan. As shown, land uses near Aune Street are primarily industrial, commercial, and mixed use. Beyond the immediate vicinity of US97, land uses transition to residential urban areas. The Old Mill district southwest of Aune Street is primarily commercial and recreational riverfront use.

Beyond the direct vicinity of the study area, there are residential areas to the north and east and Mixed Riverfront (MR) to the west.

Planned/ Funded Projects

The outcomes of this report incorporate assumptions from planned and funded projects that increase the need for roadway improvements within the vicinity of US97, especially east-west connections like Aune Street. For more details on the traffic generation assumptions incorporated in this analysis, see the *Existing and Future Needs and Opportunities Memorandum* in Appendix A.



Zoning

- CG - Commercial General
- CL - Commercial Limited
- CN - Neighborhood Commercial
- IG - Industrial General
- IL - Industrial Light
- ME - Mixed Employment
- MR - Mixed Riverfront
- MU - Mixed Urban
- RH - Residential Urban High Density
- RM - Residential Urban Medium Density
- Study Area

0 — 0.1 Miles

Figure 3

Zoning

Source: City of Bend

Intended Outcomes

The study identified six intended outcomes that informed the alternatives development process and provided the framework for evaluating infrastructure options for the study area. These intended outcomes are based on goals, principles, and community values outlined in the Bend Transportation System Plan (TSP). The outcomes are shown in Exhibit 1. The development of these intended outcomes and their supporting evaluation criteria and objectives is documented in the *Identify Intended Outcomes & Evaluation Methodology Memorandum*, provided in Appendix B.

Exhibit 1. Intended Outcomes

Section 2
Stakeholder Coordination

Stakeholder Coordination

Throughout the alternatives development process, City staff and the project team engaged with initial stakeholders including ODOT, Burlington Northern and Santa Fe (BNSF), and property owners, to consider the feasibility of infrastructure options in the foundational stages of the Aune Street Extension project. Public engagement with community members will be a core element of the upcoming design phase.

ODOT

ODOT staff were engaged in the initial site visit for this study. While the study area included an operational evaluation of the US97/Colorado Avenue intersections, they are owned and operated by ODOT, therefore requiring additional coordination efforts. The Colorado interchange is part of the GO Bond project list to improve parkway connections at key areas throughout the City. Bond contributions will help leverage funding for ODOT to improve capacity. This project is not yet fully funded.

BNSF

BNSF staff were engaged throughout the alternatives development process to identify options and opportunities to improve safety and functionality for both BNSF and public interest as the land uses surrounding Aune Street transition to a more densely urbanized area. These discussions were incorporated in the development of initial near-term alternatives and long-term options of the Aune Street Extension Study and influenced the final alternatives options presented in this report.

Key takeaways from discussions with BNSF include:

- The southern wye adjacent to Aune Street is a critical facility for BNSF in Oregon. BNSF assumes and expects that this southern spur will remain in place for the foreseeable future.
- BNSF is receptive to working with the City of Bend to relocate the northern spur adjacent to Colorado Avenue (approximately 2,000 feet of track). No formal agreement has been reached between the City and BNSF; however, the removal of the northern spur could expand transportation alternatives under the Colorado Avenue undercrossing. The allocation of future right-of-way that could be acquired by the City as a result of the spur removal would need to be further evaluated.
- BNSF is open to allowing the City to utilize a maximum of 6 additional feet north of the existing curb on Aune Street under the Parkway Undercrossing to provide a sidewalk on the north side of the street – enhancing the safety and connectivity for people walking and biking. However, BNSF will not allow a fence between the sidewalk and the tracks as maintenance vehicles occasionally pull up on the curb to access the wye.

PROPERTY OWNERS

City of Bend Staff began initial engagement with property owners in the study area, however, more robust outreach to nearby property owners and the public will be conducted as part of the next project phase.

The City has coordinated with property owners on the northwest side of Aune Street and Scott Street (taxlots 181205AA00901 and 181205AA01000). These properties agreed to provide a 10-foot right-of-way dedication to the City along the frontage of Aune Street.

Section 3
Existing Conditions

Existing Conditions

This section describes key findings from the existing conditions assessment documented in the *Existing and Future Needs and Opportunities* memorandum, provided in Appendix A. Population and demographics, traffic operations, multimodal facilities, and crashes were analyzed. These findings supported the identification of existing needs and opportunities for multimodal infrastructure improvements in support of the Aune Street Extension Study. An overview of the methodology and operational standards used for conducting the existing and future conditions analyses is discussed in the *Methodology Memorandum*, provided in Appendix C.

POPULATION AND DEMOGRAPHICS

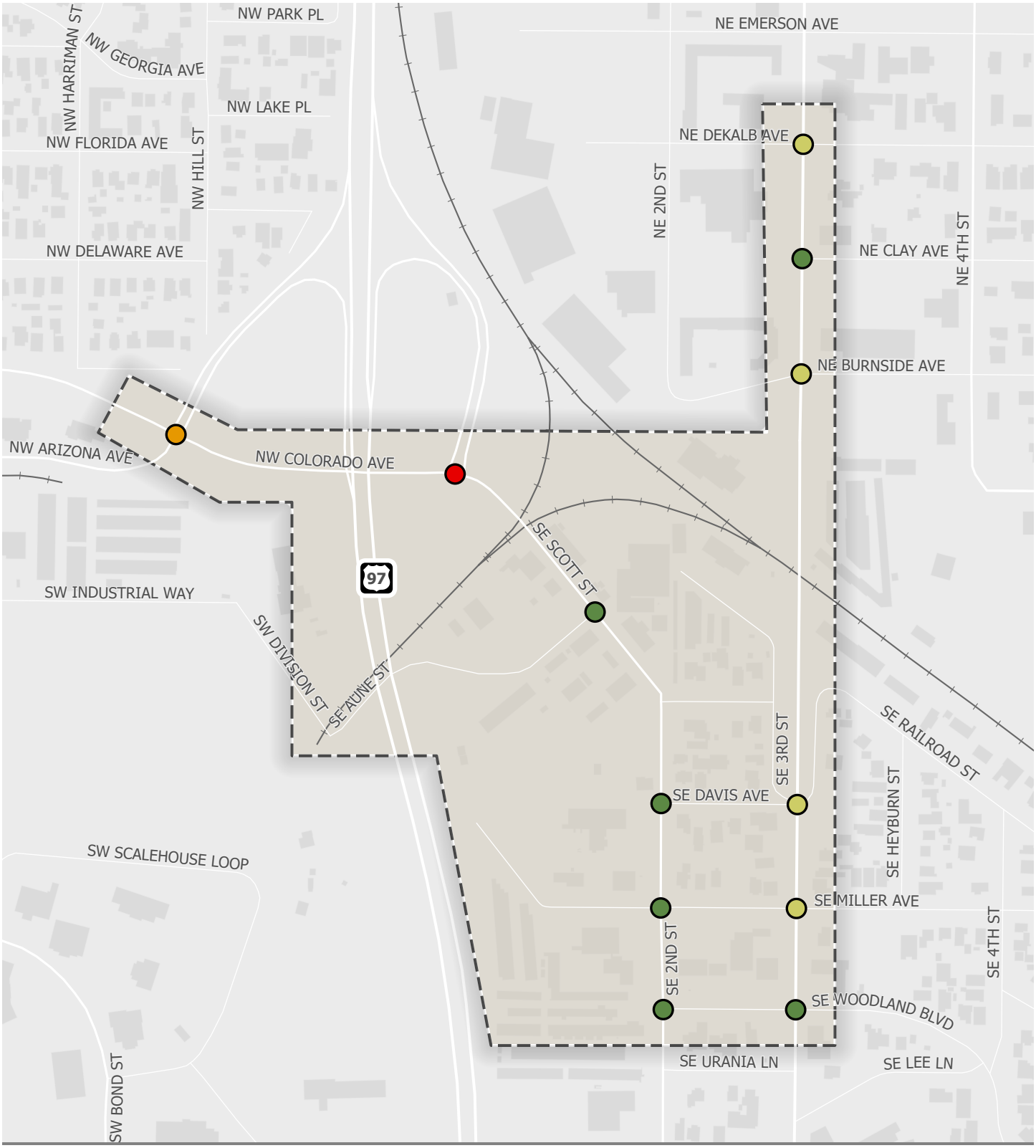
The intended outcomes of this study emphasize the need for meaningful, safe, and efficient transportation options for all users. To understand the primary populations being served by the Aune Street Extension project, population demographics for the study area were analyzed to identify transportation disadvantaged populations within the study area.

Demographic data can be viewed in the Bend MPO Demographic Viewer and is sourced from the American Community Survey (ACS) 2021 5-year estimate data. Demographic maps and detailed information are described in the *Existing and Future Needs and Opportunities Memorandum* (Appendix A). Generally, the percentage of the disadvantaged population within the study area was reported to be higher compared to the Bend MPO average. Therefore, transportation disadvantaged populations are expected to benefit from improved multimodal infrastructure that is a principal objective of the Aune Street Extension project.

EXISTING TRAFFIC OPERATIONS

The project team conducted a traffic operational analysis of the 12 study intersections to understand current demand on the transportation system. The analysis included an evaluation of traffic volumes, level-of-service, critical movements, volume-to-capacity ratios, and delay. These metrics helped identify the intersections or specific movements that set the direction for key infrastructure improvements that are needed today and in the future as the area develops. The analysis used traffic volumes that were collected in May 2023 and seasonally adjusted to reflect 30th peak hour conditions.

Figure 4 displays operational results at study intersections. Overall, the study intersections under City jurisdiction are observed to meet City standards today while the US97 interchange under ODOT jurisdiction either does not meet current mobility standards or it meet standards but has at least one movement failing.



Mobility Standards

- Does Not Meet Mobility Standards
- Meets Mobility Standards; Single Movement Failing
- Meets Mobility Standards; Single Movement Operates at LOS D
- Meets Mobility Standards

Figure 4

Existing Traffic Operations

MULTIMODAL FACILITIES

Today, the US97 mainline is a physical constraint for multimodal connections east and west of the highway. Therefore, as an existing east-west connection between dense areas of commercial, residential, and retail areas, Aune Street provides opportunities to advance safe, comfortable, and efficient multimodal transportation options for people biking, walking, rolling, or using transit. The Bend Transportation System Plan (TSP) Key Routes and Bicycle Low Stress Network (LSN) were significant factors in the development and evaluation of infrastructure options for the Aune Street Extension.

Key Walking and Biking Routes

The City of Bend has identified "Key Walking and Biking Routes" (Key Routes) within the Bend TSP. Key Routes are designed to be low stress[1] for pedestrians and bicyclists, provide safe and appealing connections to schools, parks, and other destinations, and facilitate cross-city travel. Three of the City's identified Key Routes are in the study area:

- **Key Route 7** – east-west route from Aune Street to Bend High School via 2nd Street, Miller Avenue, and 3rd Street.
- **Key Route 9** – north-south from Scott Street/ Miller Ave to China Hat Road.
- **Key Route 10** – north-south from Old Bend Redmond Highway to China Hat Road that utilizes the shared path west of US97 in the study area.

The Key Routes Projects and implementation of the bicycle low stress network are supported by the GO Bond and are shown in Figure 5.

[1]Low stress is defined as routes with Level of Traffic Stress (LTS) 1 or 2

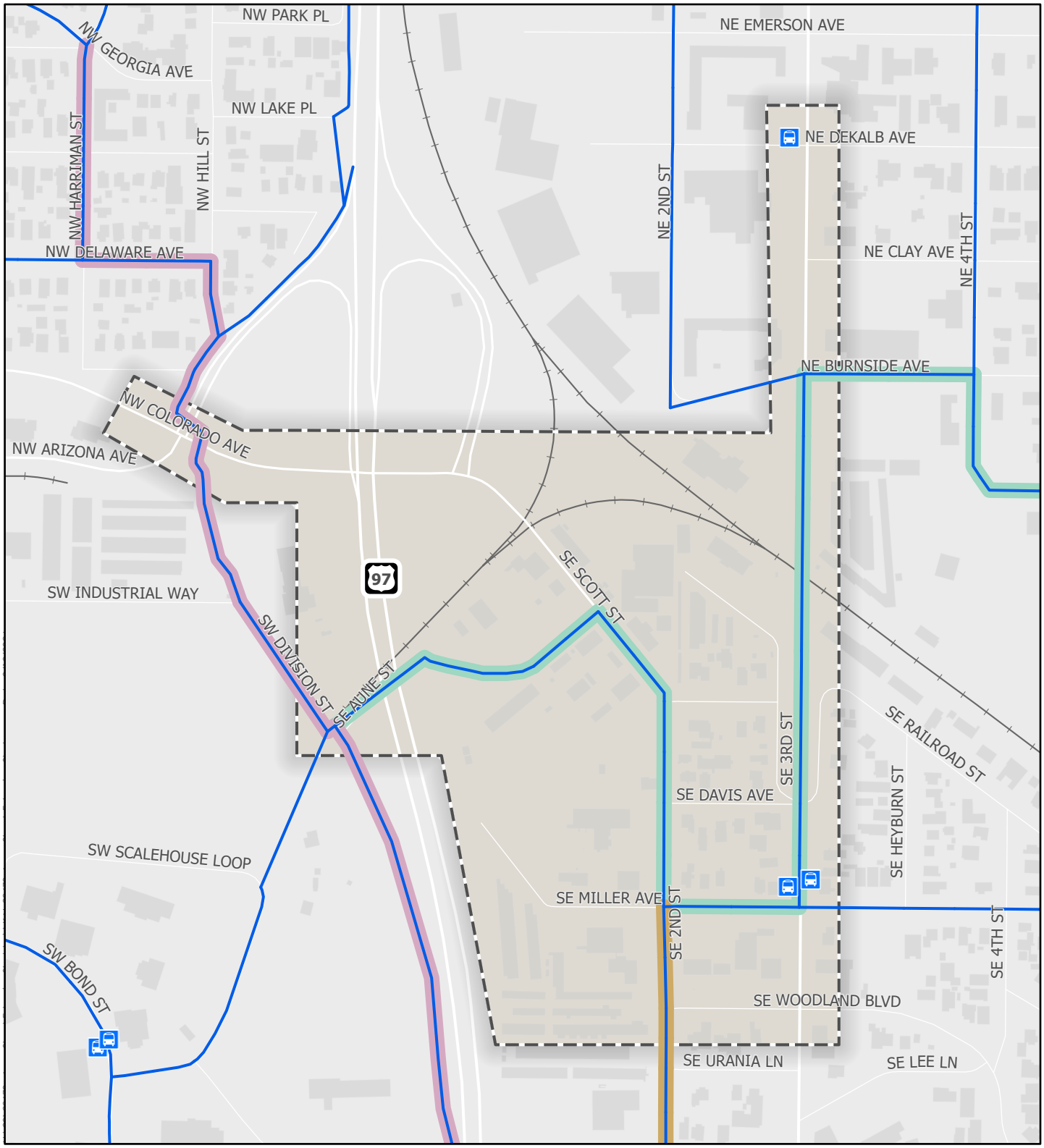


Figure 5

Key Routes and Bicycle LSN

Pedestrian Facilities

Pedestrian facilities refer to infrastructure that is designed to accommodate people who walk or roll. This infrastructure can typically include sidewalks, crossings, curb ramps, paths, or other infrastructure like pedestrian push buttons at signals. Pedestrian infrastructure that promotes an efficient and comfortable walking environment is a crucial element to the implementation of the TSP's Key Routes.

Existing sidewalks and at-grade crossings are displayed in Figure 6. As shown, most of the roadway network in the study area generally has sidewalk on at least one side. There are no marked crossings within the study area today and any needed modifications to curb ramps will be considered in the design phases of the Aune Street Extension.

Additional summarization of the existing sidewalk facilities is included in the *Existing Conditions and Future Needs and Opportunities Memorandum* (Appendix A).

PEDESTRIAN LEVEL OF TRAFFIC STRESS (LTS)

Using this existing inventory, the project team analyzed pedestrian Level of Traffic Stress (LTS) based on guidance from the ODOT Analysis Procedures Manual (APM). Pedestrian LTS is a framework used to assess the comfort of the walking or rolling environment based on perceived stress, with an LTS being low stress and an LTS 4 being high perception of stress. The *Existing Conditions and Future Needs and Opportunities Memorandum* provided in Appendix A describes more details about the analysis procedures and results.

Pedestrian LTS is shown in Figure 7. As shown, LTS is generally 2 or 3 throughout the study area, with segments of an LTS of 4 where there are no sidewalks.

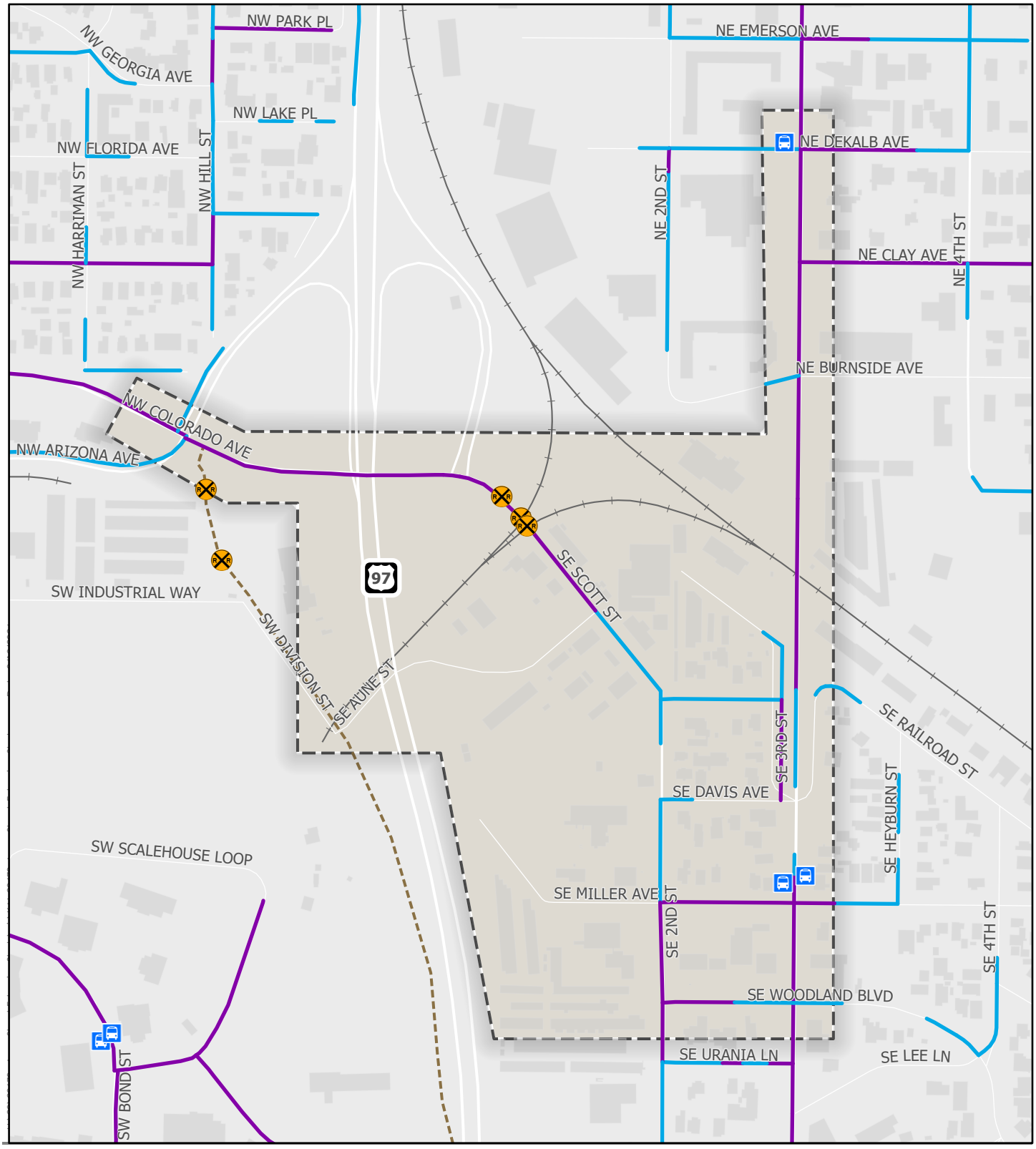
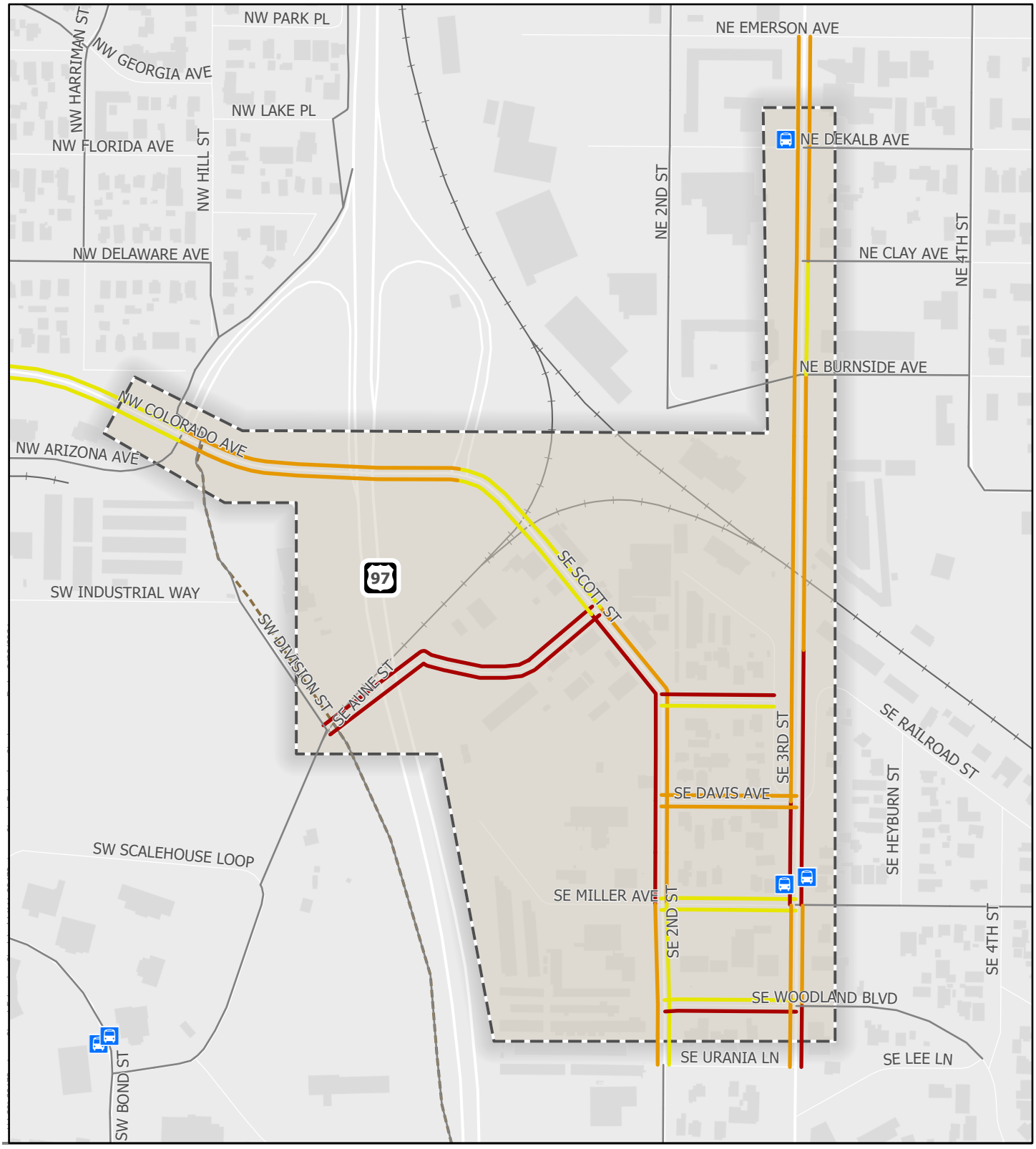


Figure 6

Pedestrian Facilities



Pedestrian Level of Traffic Stress (LTS)

- 2
- 3
- 4

Cascades East Transit (CET)

Paths and Trails

Cascades East Transit (CET)

Paths and Trails

Study Area

0 0.1 Miles

Figure 7

Pedestrian Level of Traffic Stress (LTS)

Bicycle Facilities

Bicycle facilities refer to infrastructure that is designed to help facilitate bicycle transportation and can include facilities like dedicated bike lanes, shared facilities like multi-use paths or bicycle boulevards, crossings, and other infrastructure to promote the safety and comfort of bicyclists. Bicycle facilities that can accommodate riders regardless of age or skill are necessary for the implementation of the low stress network and Bend TSP Key Routes.

Existing bicycle facilities in the study area are shown in Figure 8. As shown, the bicycle infrastructure in the study area includes on-street bicycle facilities and bicycle greenways. All the on-street bicycle facilities in the study area are directly adjacent to motor vehicle traffic, without any buffers.

There is a gap in bicycle facilities on 3rd Street along the BNSF railroad undercrossing between Burnside Avenue and Davis Avenue. The cross section on 3rd Street is reduced under the BNSF bridge where the on-street bicycle lanes are eliminated, and cyclists must either take the travel lane or dismount and use the sidewalks that parallel the roadway. This section of roadway and bicycle facilities is not included in the scope of this project or as part of the concept evaluation process.

Aune Street is a designated neighborhood greenway – a walking and bicycling route that may be more comfortable than nearby busier streets. There is a shared use path on the east side of US97 south of Aune Street between Division Street and Wilson Avenue. A complete streets project is planned for construction in Summer 2024 on 2nd Street south of Davis Avenue. The project will include 6-foot bike lanes on each side of the roadway with a 2-foot buffer and vertical buffer treatment separating bicyclists from motor vehicle traffic.

BICYCLE LEVEL OF TRAFFIC STRESS AND LOW STRESS NETWORK

The Bend TSP identified a system of low-stress bicycle routes that are required to be built or reconstructed to provide Level of Traffic Stress 1 or 2. This low-stress network (LSN) within the study area is mapped Figure 9 along with bicycle LTS. Like pedestrian LTS, bicycle LTS is a framework for evaluating bicycle facilities based on perceived stress. This analysis is also provided in Appendix A.

As shown, the gap in the bicycle network on 3rd Street is shown as LTS 4 (highest stress) and the roadway segments surrounding the Burnside Avenue and Miller Avenue intersections are shown as LTS 3.

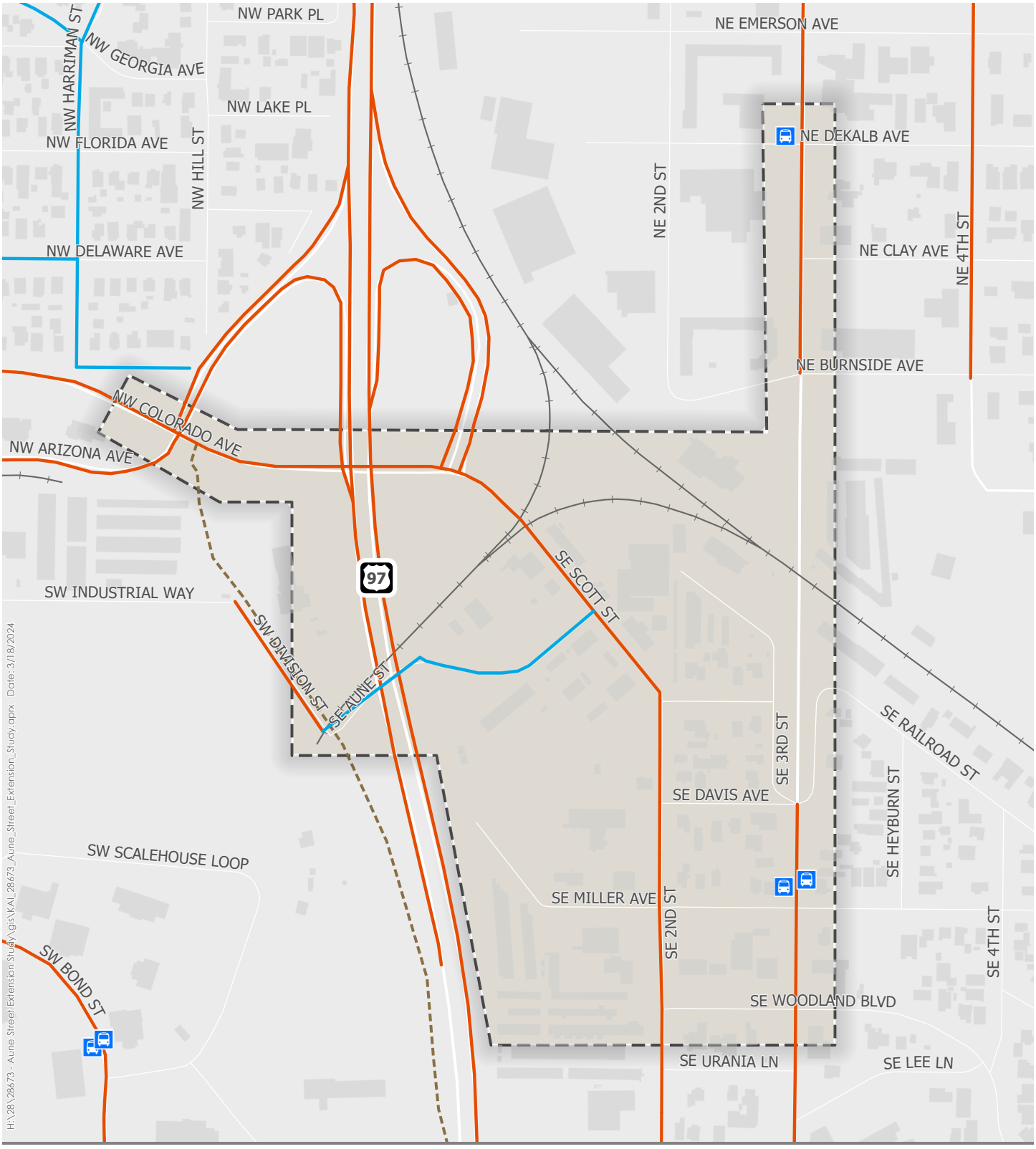
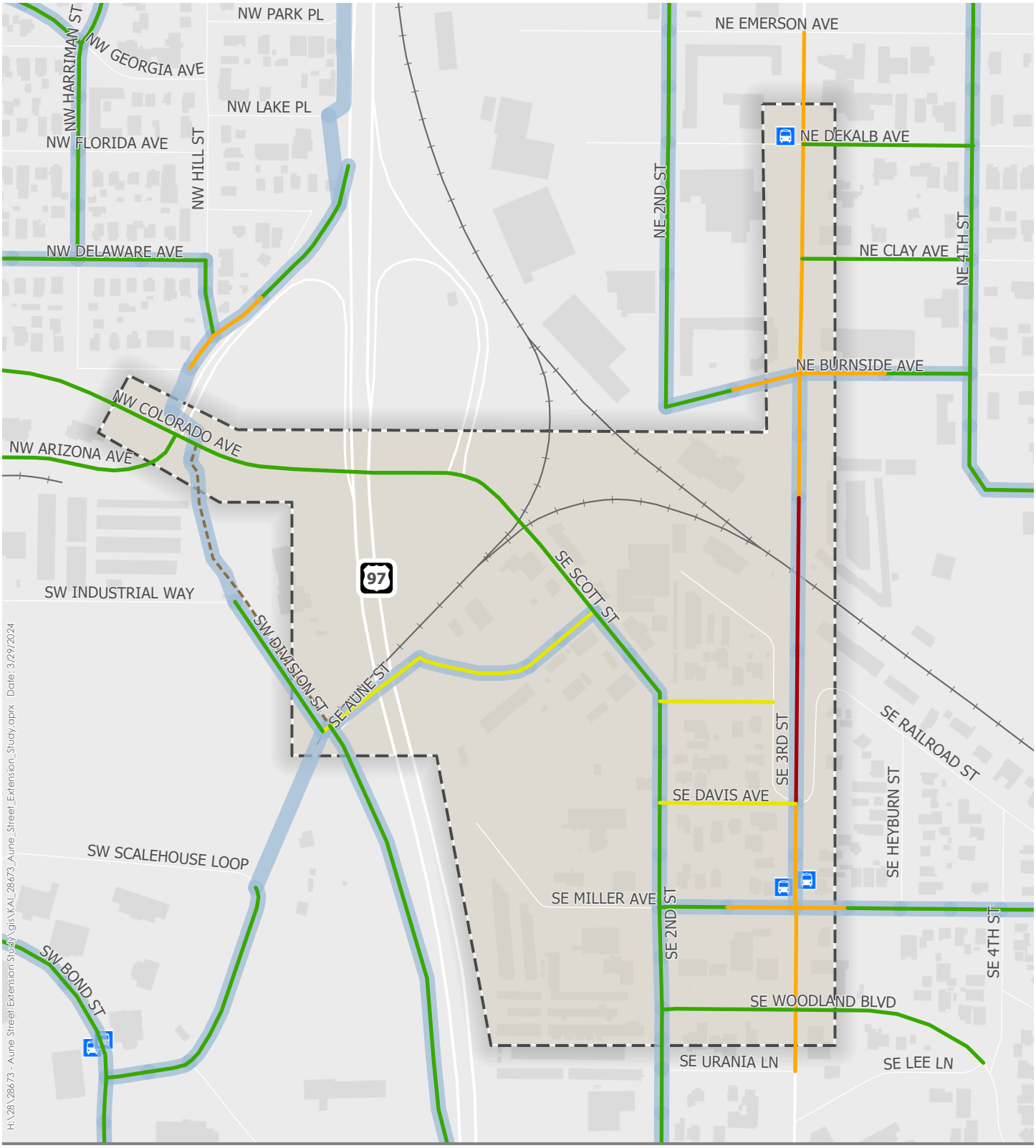


Figure 8

Bicycle Facilities



Bicycle Level of Traffic Stress (LTS)

- 4
- 3
- 2
- 1

Bicycle Low Stress Network (LSN)

Paths and Trails

Cascades East Transit (CET)

Study Area

0 0.1 Miles

Figure 9

Bicycle Level of Traffic Stress (LTS)

Transit

Cascades East Transit (CET) operates their fixed route along 3rd Street within the study area (Route 1 – South 3rd Street). There are northbound and southbound stops at 3rd Street/ Miller Avenue and a southbound stop at Dekalb Avenue. These stops are marked by a sign posts – there are no other transit amenities at these stops. The 2040 CET Master Plan (2020) and Bend Mobility Hub Feasibility Study (2022) identified a possible mobility hub within the vicinity of the Old Mill District and the study area. A mobility hub is being considered for the Timber Yards development along Industrial Way.

Railroad

BNSF owns and operates rail track within the study area. The rail track north of the study area runs north-south parallel to US97 before curving east to a wye at Colorado Avenue towards the industrial zone of Bend along 9th Street. The wye is used for turning railway equipment and rail car storage. There are two railroad spurs within the study area that are part of the wye junction, including one that runs adjacent to Aune Street on the north side and terminates at Division Street and another that runs adjacent to Colorado Avenue on the south side and terminates at Industrial Way. The railroad uses the wye and storage on a limited basis. However, the wye is a critical facility for maneuvering rail cars and is the only such junction in the Central Oregon region.

The wye crosses Scott Street just southeast of the northbound US97 ramps, creating three at-grade railroad crossings for vehicles and pedestrians. There are also two crossings on the shared use path between Colorado Avenue and Aune Street. The City and BNSF are actively discussing options to close shorten the rail spurs where they cross the shared use path.

CRASH HISTORY REVIEW

The project team conducted a crash assessment from the most recent 5 years of ODOT crash data (January 1, 2017, to December 31, 2021). Crashes are displayed by severity in Figure 10. Additional crash analysis documentation is provided in the *Existing Conditions and Future Needs and Opportunities Memorandum* (Appendix A).

Within the study period, there were 56 total crashes, of which two were fatalities - one at 3rd Street/ Miller Avenue and one at 3rd Street/ Burnside Avenue.

Critical crash locations are further described below:

- **3rd Street/ Miller Avenue** had 15 total crashes, the highest total crashes and highest injury or fatality crashes (9) compared to the other intersections. Twelve were angle crashes, including one fatality.
- **Colorado Avenue/ US97 Southbound Ramps** had the second highest number of total crashes within the study period at 12, three of which were injury crashes. Five were rear-end crashes and 7 were angle crashes.
- Most of the crashes at other 3rd Street intersections at Burnside Avenue, Clay Avenue, Dekalb Avenue, and Miller Avenue were angle crashes.

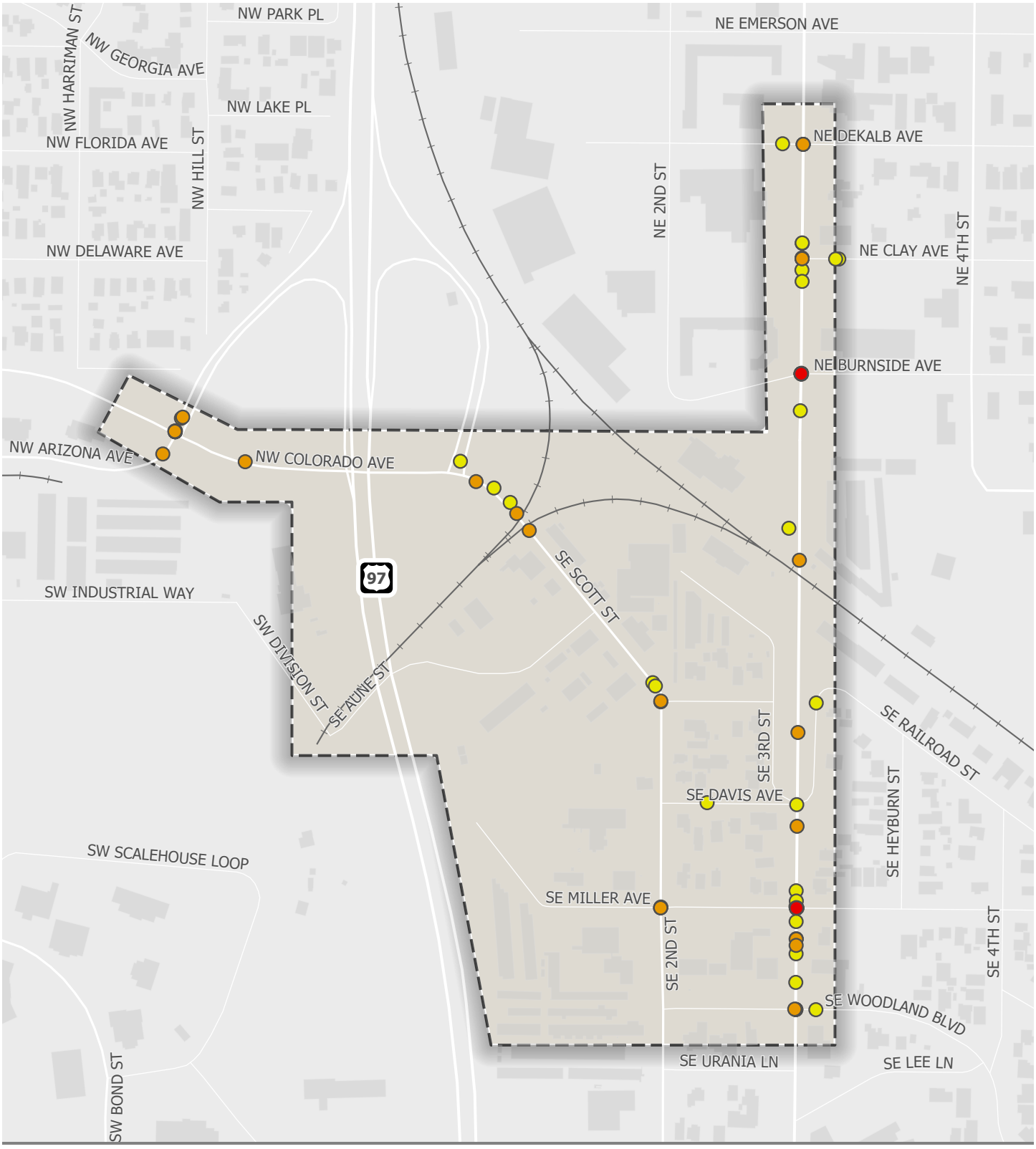


Figure 10

Crashes by Severity (2017-2021)

Section 4
Future Conditions

Future Conditions

The future conditions assessment provides an understanding of future motor vehicle traffic demands on roadways within the study vicinity. The analysis results support the development of infrastructure options that ensure the planned transportation network meets the long-term traffic needs based on growth and new developments.

The future conditions assessment includes an operational analysis using forecasted 2045 traffic volumes. The *Existing and Future Needs and Opportunities Memorandum* (Appendix A) and *Methodology Memorandum* (Appendix C) provide more details about forecasting methodology and assumptions and forecasted turning movement volumes. The project team referenced the Bend MPO Travel Demand Model (TDM) and relevant Transportation Impact Analysis (TIA) reports to ensure future conditions reflect anticipated growth and planned/ funded projects within the vicinity of the study area.

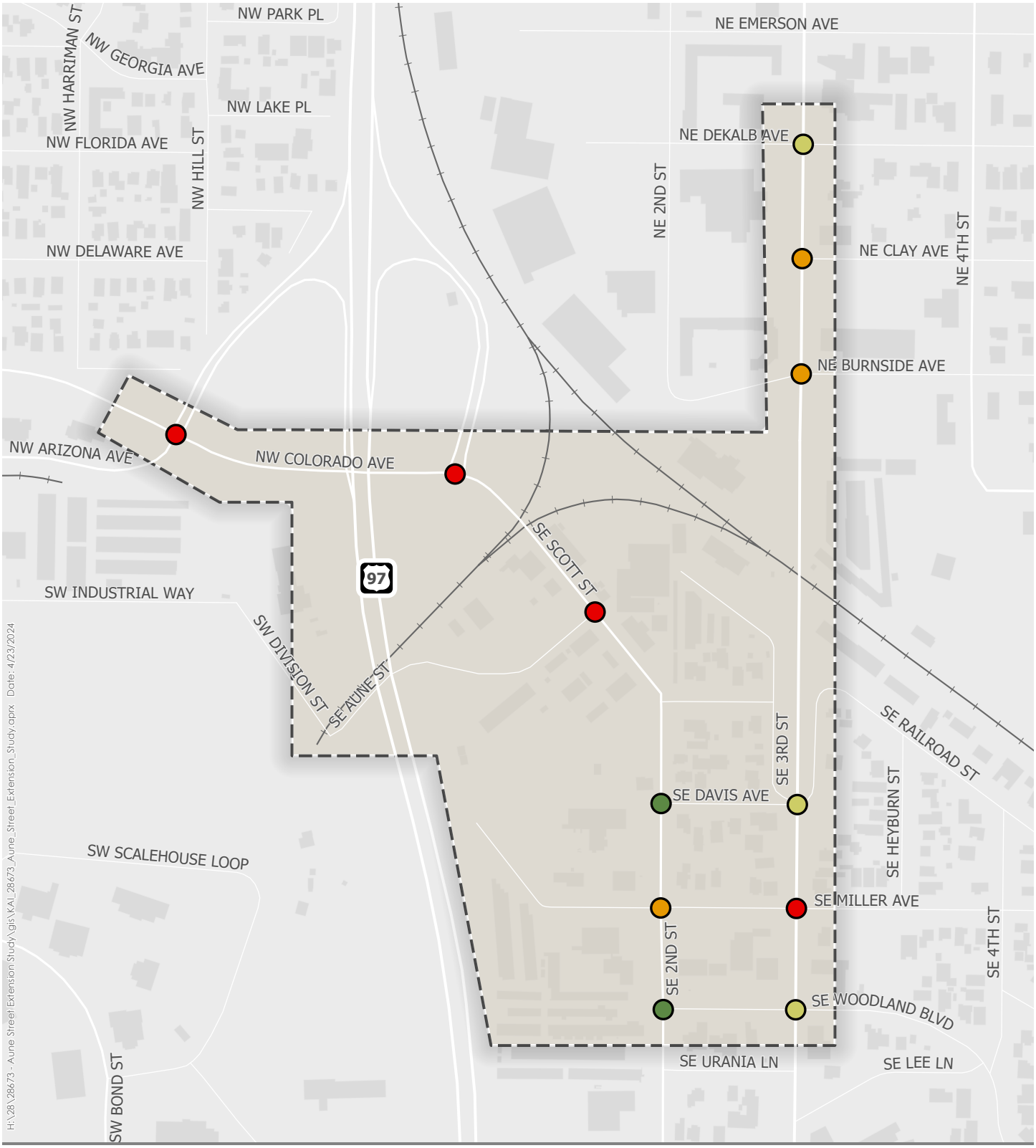
FUTURE TRAFFIC OPERATIONS

Future year (2045) operational analysis results are shown in Figure 11. The following intersections **are forecast to exceed** ODOT or City of Bend operational standards in 2045:

- Colorado Avenue/ Arizona Avenue/ US97 Southbound (SB) Ramps[2]
- Colorado Avenue/ Scott Street/ US97 Northbound (NB) Ramps[2]
- Scott Street/ 2nd Street/ Aune Street
- Miller Avenue/ 3rd Street

Consistent with the exiting conditions traffic assessment, side street left-turn movements onto 3rd Street continue have the highest delay. However, side-street volumes are less than 100 weekday peak hour vehicles at Dekalb Avenue, Clay Avenue, Burnside Avenue, Davis Avenue, and Woodland Boulevard and therefore do not exceed City of Bend operational standards.

[2] To fully address the operational deficiencies at the Colorado Avenue interchange, an Interchange Area Management Plan (IAMP) will be needed, consistent with IAMP guidelines established by the ODOT Transportation Development Division. The future traffic operations assessment analyzed Colorado Avenue/ Scott Street/ US97 Northbound (NB) Ramps as side street stop controlled, consistent with existing traffic control.



Mobility_Future_PM

- Does Not Meet Mobility Standards
- Meets Mobility Standards; One or More Movement Failing
- Meets Mobility Standard; One or More Movements Operate at LOS D
- Meets Mobility Standards

Study Area

0 0.1 Miles

Figure 11

Future Traffic Operations

Section 5
Concept and Alignment Layout

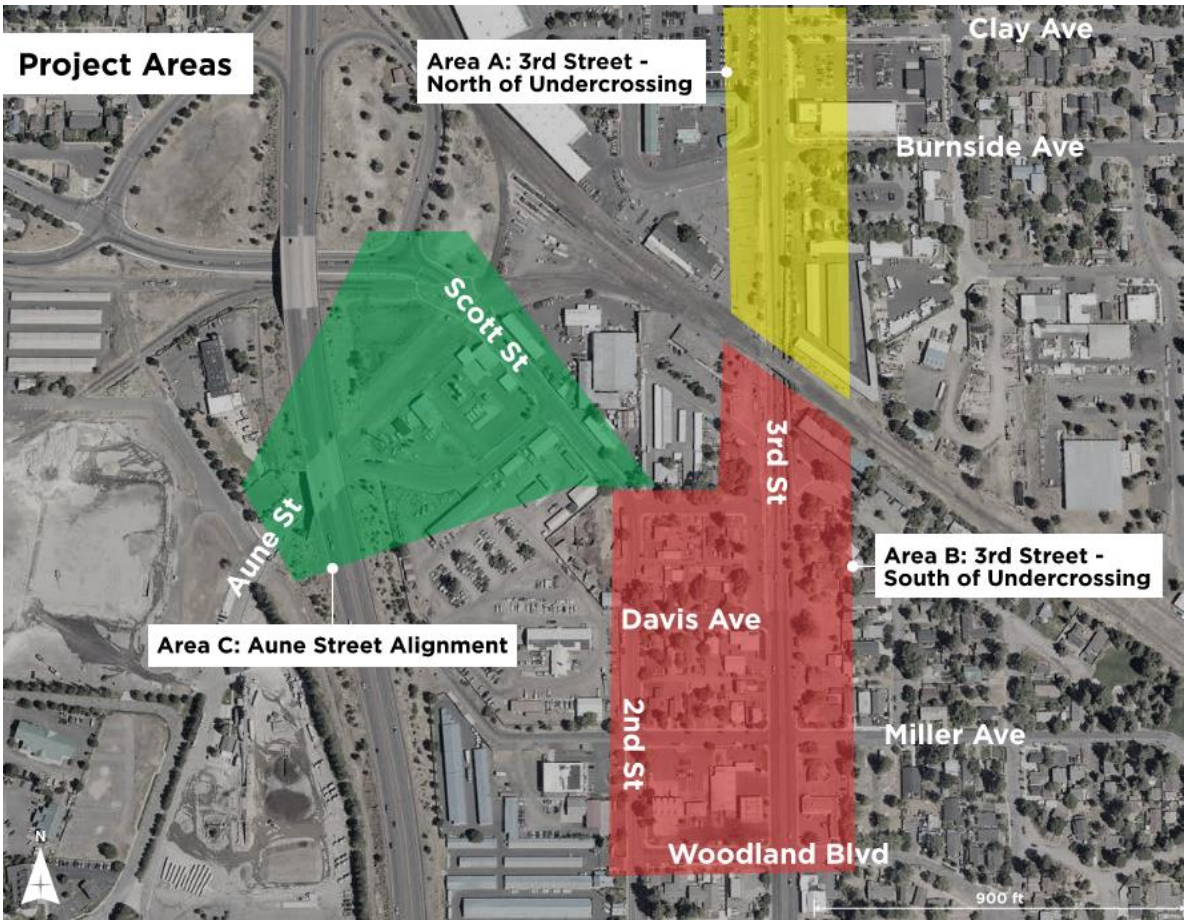
Concept and Alignment Layout

The following sections describe infrastructure options for the Aune Street Extension Study, including options for implementing Key Walking and Biking Routes ("Key Routes") identified in the Bend Transportation System Plan (TSP). The options reflect project and city mobility and connectivity goals, address identified needs and opportunities, and are informed by the outcomes of the alternative evaluation process, workshop discussions with City staff, and initial coordination efforts with BNSF. The *Initial Alternative Development Memorandum* (Appendix D) and the *Alternative Evaluation Refinement Memorandum* (Appendix E) provide details regarding alternatives development and refinement process that culminate into the concepts presented in this report. An updated alternative evaluation criteria matrix was assessed for the refined alternatives presented in this report and is provided in Appendix F.

The concepts and alignment layout of infrastructure options for the Aune Street Extension Study focus on three distinct parts of the study area, illustrated in Figure 12. These areas include:

- **Sub-Area A**: 3rd Street influence area between the BNSF railroad undercrossing and Clay Avenue.
- **Sub-Area B**: 3rd Street influence area between the BNSF railroad undercrossing and Woodland Boulevard. Includes 2nd Street from Scott Street to Woodland Boulevard.
- **Sub-Area C**: Aune Street influence area and Scott Street north of Scott Street/Scott Street intersection to the Colorado Interchange.

Figure 12. Sub-Areas



The division of sub-areas was guided by their distinctive challenges and considerations. However, the intersection and cross-section concepts also address connectivity between these areas for all modes to ensure a well-connected transportation system for all users.

The concept and alignment alternatives for the Aune Street Extension study area are shown in Figure 13. As shown, there are multiple alternatives options for each location. This range of options provides City staff with the opportunity to further evaluate alternative options in the design process and select a final alternative that can be implemented to meet the GO Bond goals and schedule.

Each concept alternative shown in the figure will be discussed in more detail in the following sections. Planning level cost opinions[3] are provided in Appendix G.

Additionally, a constructability review and fatal flaw analysis was conducted to support the evaluation of each alternative. The constructability review ensures that the proposed concepts incorporate construction expertise to achieve the goals established for the project. This review is provided in Appendix H and discussed with each alternative.

[3] Cost opinions are provided from the 2023 GO Bond Project Estimates (Inflation rate was applied to develop year 2026 estimates) prepared for the City of Bend. They are preliminary and intended to communicate magnitude of cost. Detailed cost estimates will be completed as part of the design phase.

Aune Street Extension Study Alternatives

Preliminary Design Subject to Change
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Option A3

Option A2

Option A1

Option C2

Option C1

Option B2

Option B1

Clay Ave
3rd St
Burnside Ave
Burnside Ave
Scott St
Aune St
Scott St
SE Railroad St
Parking striping is for illustrative purposes only
2nd St
SE 3rd St
Davis Ave
Miller Ave
3rd St
Woodland Blvd

Scale: 1" = 100'
100 50 0 100

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KEY ROUTES

The TSP identifies a system of Key Routes designed to be low stress for pedestrians and bicyclists. In the area surrounding Aune Street, there are three proposed Key Routes previously shown in Figure 5.

As part of this Study, alternatives for identified Key Routes in the TSP were considered based on the range of options for improvements to and from Aune Street, 2nd Street, and 3rd Street. As a result of the alternatives development process and discussions with City staff, the project team has the following recommendations for Key Route 7:

1. Locate the 3rd Street segment of Key Route 7 on the west side of 3rd Street.
2. Relocated Key Route 7 from Miller Avenue to East Scott Street.

The Key Route 7 change is shown in Figure 14. It is recommended that Key Route 7 be located on the west side of 3rd Street because the existing sidewalk infrastructure on the east side of 3rd Street is in poor condition and will require significant maintenance support and upgrades. Additionally, the walking network on 3rd Street south of the undercrossing is incomplete where the sidewalk intersects Railroad Street. Pedestrians currently must use the side of the roadway on a steep grade to get to 3rd Street where there are no sidewalk facilities north of Miller Avenue. Facilitating Key Route 7 on the west side aligns with the low stress network on 2nd Street across from Burnside Avenue. Additionally, the city has plans to reconstruct the retaining wall on the west side of 3rd Street, which could incorporate a wider sidewalk facility along this segment of 3rd Street.

Locating Key Route 7 on the west side of 3rd Street opens opportunities for the Route to be located on lower-volume streets south of the undercrossing such as East Scott Street. Compared to Miller Avenue, East Scott Street is expected to have lower vehicular volumes in 2045 and requires less out-of-direction travel for bicyclists or pedestrians traveling from 3rd Street to Aune Street or Colorado Avenue using the path on the west side of the undercrossing. Compared to Miller Avenue, East Scott Street has narrower driveways, reducing the pedestrian exposure to vehicles moving in and out of businesses and residences.

More confident southbound bicycle riders using 3rd Street instead of the sidewalk on the west side will likely turn on Davis Avenue instead of East 3rd Street to continue to 2nd Street. Davis Avenue is also a low-volume, shared roadway and can facilitate similar movements to the relocated Key Route 7 on East Scott Street.

Miller Avenue will remain a critical link of the LSN as identified in the TSP. To support implementation of the LSN, the Study evaluated options for complete streets improvements on Miller Avenue that are discussed in Sub-Area B.

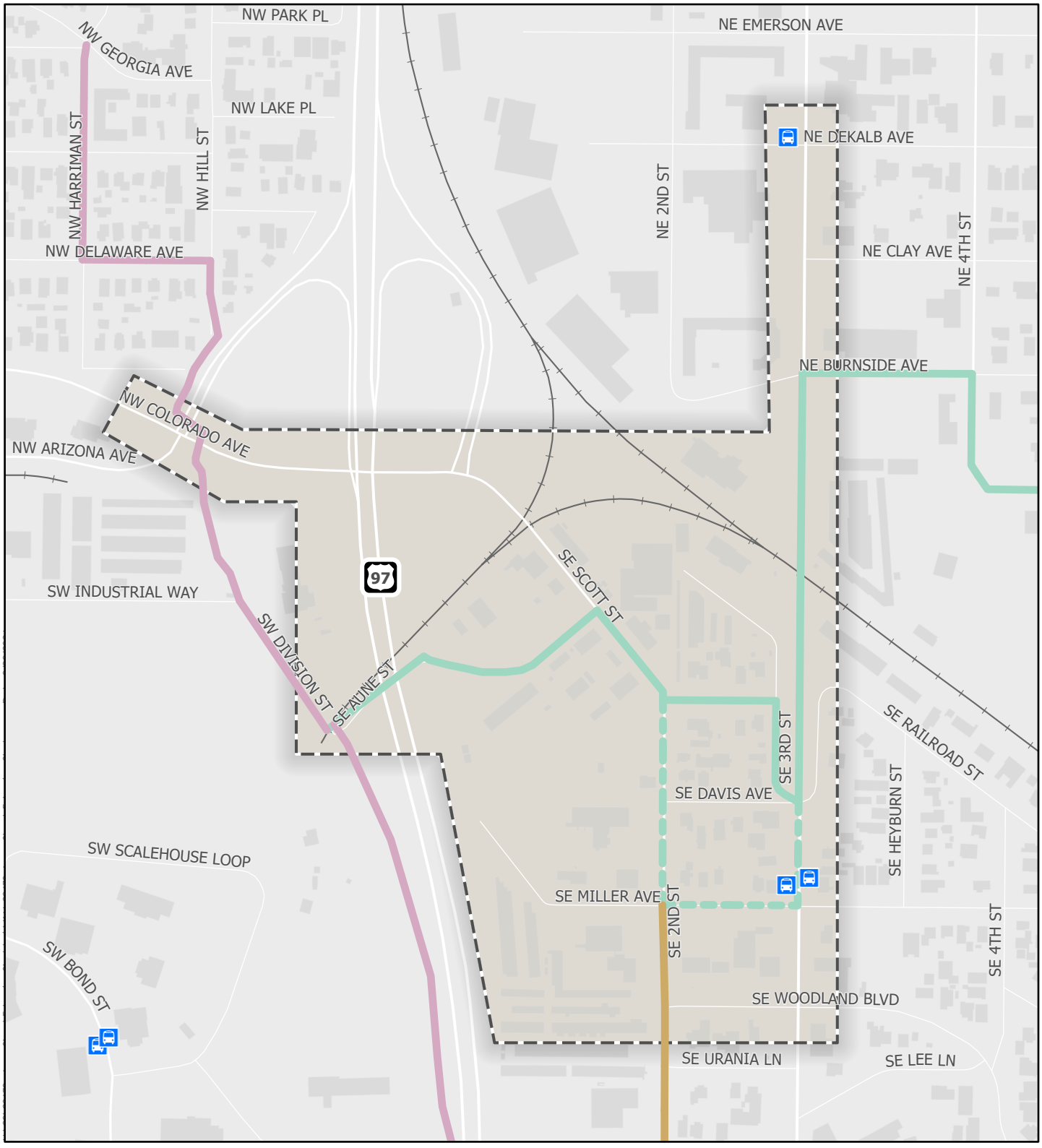

Figure 14

Changes to Key Route 7

SUB-AREA A – NORTH OF UNDERCROSSING

The concepts presented in this section provide infrastructure options for an enhanced crossing at 3rd Street/ Burnside Avenue that provides an east-west connection from the Bend Senior High School area across 3rd Street to the LSN network on 2nd Street and Key Route 7 on the west side of 3rd Street. Burnside Avenue is a four-leg intersection located immediately south of the 3rd Street transition area from a five-lane cross-section to a three-lane cross-section. The intersection of 3rd Street /Burnside Avenue is stop controlled on Burnside Avenue. Between Clay Avenue and Burnside Avenue, 3rd Street transitions from a 5-lane section to the north to a 2-lane section south toward the undercrossing. This presents additional challenges for providing a safe and comfortable crossing for bicyclists and pedestrians when drivers on 3rd Street are focused on the roadway transition. Therefore, the selected intersection treatment options provide infrastructure to reduce crossing distance and increase driver awareness of non-vehicular users. There are no marked or enhanced crossings on 3rd Street between Franklin Avenue and Wilson Avenue.

Improvements at Burnside Avenue support the implementation of Key Route 7 and the LSN identified in the TSP. In the TSP, Key Route 7 is proposed to connect with 3rd Street at Burnside Avenue. As discussed in the Key Routes section, the Key Route requires a crossing at Burnside Avenue to facilitate the Key Route on the west side of 3rd Street. An east-west crossing north of the railroad undercrossing provides a direct connection of the LSN.

3rd Street/ Burnside Avenue

The project team identified three intersection alternatives for a proposed crossing north of the railroad undercrossing that support the implementation of Key Route 7 and the crossing to the Low Stress Bicycle Network.:

- **Alternative A.1**: Crossing South of Burnside Avenue
- **Alternative A.2**: Crossing North of Burnside Avenue
- **Alternative A.3**: Crossings and Modal Filters

The TSP also identifies a long-term project to widen 3rd Street to four lanes under the railroad with complete street design from Emerson Avenue to Miller Avenue (C-54). Any future designs for widening 3rd Street and the undercrossing should include infrastructure improvements to pedestrian walkways under the bridge, consistent with City of Bend standards. All options for Sub-Area A are compatible with a future 3rd Street widening.

Table 1 summarizes the key considerations (consistent with categories used in the *Initial Alternatives Development Memorandum* in Appendix D) that differentiate each alternative. The following considerations are excluded from the Table because all 3 alternatives were assessed the same for each alternative:

- **Environmental Resources**: No anticipated conflicts with environmental resources.
- **Conflicts or Coordination with BNSF**: No coordination needed.
- **Key Routes**: Key Routes in Sub-Area A are consistent with the TSP. The north-south connection on 3rd Street is recommended to be on the west side.

- **Impacts or Benefits to Transportation Disadvantaged Populations (TDPs)**: Enhances safety and efficiency of multimodal east-west crossings in areas with populations of TDPs.
- **Bicycle and Pedestrian Connectivity**: Facilitates continuation of low stress network across Burnside Avenue to 2nd Street north of the undercrossing. Signage and pavement markings increase visibility of people crossing.

Table 1. Sub-Area A Key Considerations

Key Differentiating Considerations	Alternative A.1: Crossing on South Side	Alternative A.2: Crossing on North Side	Alternative A.3: Crossings and Modal Filters
Bicycle and Pedestrian Connectivity	Eliminating northbound left turns reduces conflict points.	Eliminating southbound left turns reduces conflict points. Curb extensions reduce crossing distance.	Eliminating all left turns and the east-west through movement reduces conflict points – fewer conflict points than Alternatives A.1 and A.2. Curb extensions reduce crossing distance.
Network Changes	Would eliminate northbound left-turns which would reduce conflict points. Drivers use Dekalb Avenue to make left turn.	Would eliminate southbound left-turns which would reduce conflict points. Drivers use Clay Avenue to make left turn.	All left turns are eliminated. Left turn movements use the surrounding local system to turn. East-west through movement is also eliminated.
Business Access	No changes to existing accesses.	No changes to existing accesses.	No changes to existing accesses.
Cost Estimate	$600,000 (Assumes RRFB, median and 600ft of sidewalk enhancements on the westside of 3rd St)	$650,000 (Assumes RRFB, median and 600ft of sidewalk enhancements on the westside of 3rd St, curb ramps	$800,000 (Assumes, RRFB, approaching medians and median separation through the intersection, 1,000ft of sidewalk enhancements on both sides of 3rd St, curb ramps
Traffic Operations	Northbound left-turn lane replaced with a pedestrian refuge area. Northbound left turns must turn at Dekalb Avenue.	Southbound left-turn lane replaced with a pedestrian refuge area. Southbound lefts must turn at Clay Ave.	Restricted to right-in/ right-out. Left turns must be made at Clay Avenue or Dekalb Avenue.
Constructability	Cross slopes will need to be evaluated to meet ADA requirements. Will need to further evaluate construction staging to minimize full closures on 3rd Street.	Cross slopes will need to be evaluated to meet ADA requirements. Curb extensions may require new stormwater infrastructure.	Cross slopes will need to be evaluated to meet ADA requirements. Will need to further evaluate construction staging to minimize full closures on 3rd Street during construction of medians. Curb extensions may require new stormwater infrastructure.

The following sections provide a conceptual layout and description of opportunities and challenges for each alternative.

ALTERNATIVES A.1 (CROSSING ON SOUTH SIDE) AND A.2 (CROSSING ON NORTH SIDE)

Alternative A.1 is displayed in Figure 15 and Alternative A.2 in Figure 16. The alternatives both show an enhanced crossing and Rectangular Rapid Flashing Beacon (RRFB)[4] on 3rd Street at Burnside Avenue, but Alternative A.1 shows it on the north side and Alternative A.2 shows it on the south side. The enhanced crossing features are generally the same for both alternatives, except Alternative A.2 includes curb extensions and A.1 does not due to constraints from the 3rd Street undercrossing. While a RRFB has not typically been applied when crossing roadways with one travel lane in each direction, Bend Standard Drawings and Specifications reference the ODOT Traffic Manual Uncontrolled Marked Crosswalk Treatment Matrix that provides guidance on implementation of enhanced features at uncontrolled crossing locations. According to guidance in the matrix, a RRFB is an optional treatment for context of 3rd Street. The merging southbound traffic immediately north of the intersection, tunnel and sag curve from the undercrossing northbound, and designated key route east-west route are reasons a RRFB is recommended at this location.

The enhanced crossing features striped crossing markings and a median placed in the existing northbound left turn lane (Alternative A.1) or center turn lane on the north side of the intersection (Alternative A.2), which provides a pedestrian refuge area. A RRFB will be installed on the 3rd Street approaches. Longitudinal crosswalks will be striped on the east and west side of Burnside Avenue to cross people from 3rd Street or Burnside to the enhanced crossing. Opportunities and challenges of Alternatives A.1 and A.2 are essentially identical and are described on the following page.

[4] Standards for design and implementation of RRFBs are established by the Manual on Uniform Traffic Control Devices (MUTCD), the Federal Highway Administration (FHWA), the City of Bend, and ODOT.

Opportunities

- A crossing at Burnside Avenue facilitates the continuation of the low stress network to 2nd Street north of the undercrossing.
- The construction of a pedestrian refuge island reduces the total number of lanes a pedestrian must cross at a time.
- An RRFB significantly increases visibility and awareness of pedestrians in the crossing, especially on a high-volume roadway like 3rd Street where vehicles are shifting positions through the lane reduction and have limited sight distance coming from the undercrossing. The City has installed similar crossing treatments that include RRFBs on 3rd Street at Hawthorne Avenue, Seward Avenue and Roosevelt Avenue.

Challenges

- The median refuge island restricts left turning movements, requiring drivers to use the surrounding local network to turn.
- Burnside Avenue is a four-leg intersection located immediately south of the 3rd Street transition area from a five-lane cross-section to a three-lane cross-section. Navigating lane shifts may divert driver attention, potentially reducing awareness of the crossing. Drivers heading northbound have more limited sight distance due to the sag curvature of the undercrossing, also limiting visibility.
- People bicycling westbound on A.1 or eastbound on A.2 must either use the sidewalk to cross 3rd Street or move out-of-direction to access the shared crossing.

Alternative A.1 - Crossing South of Burnside

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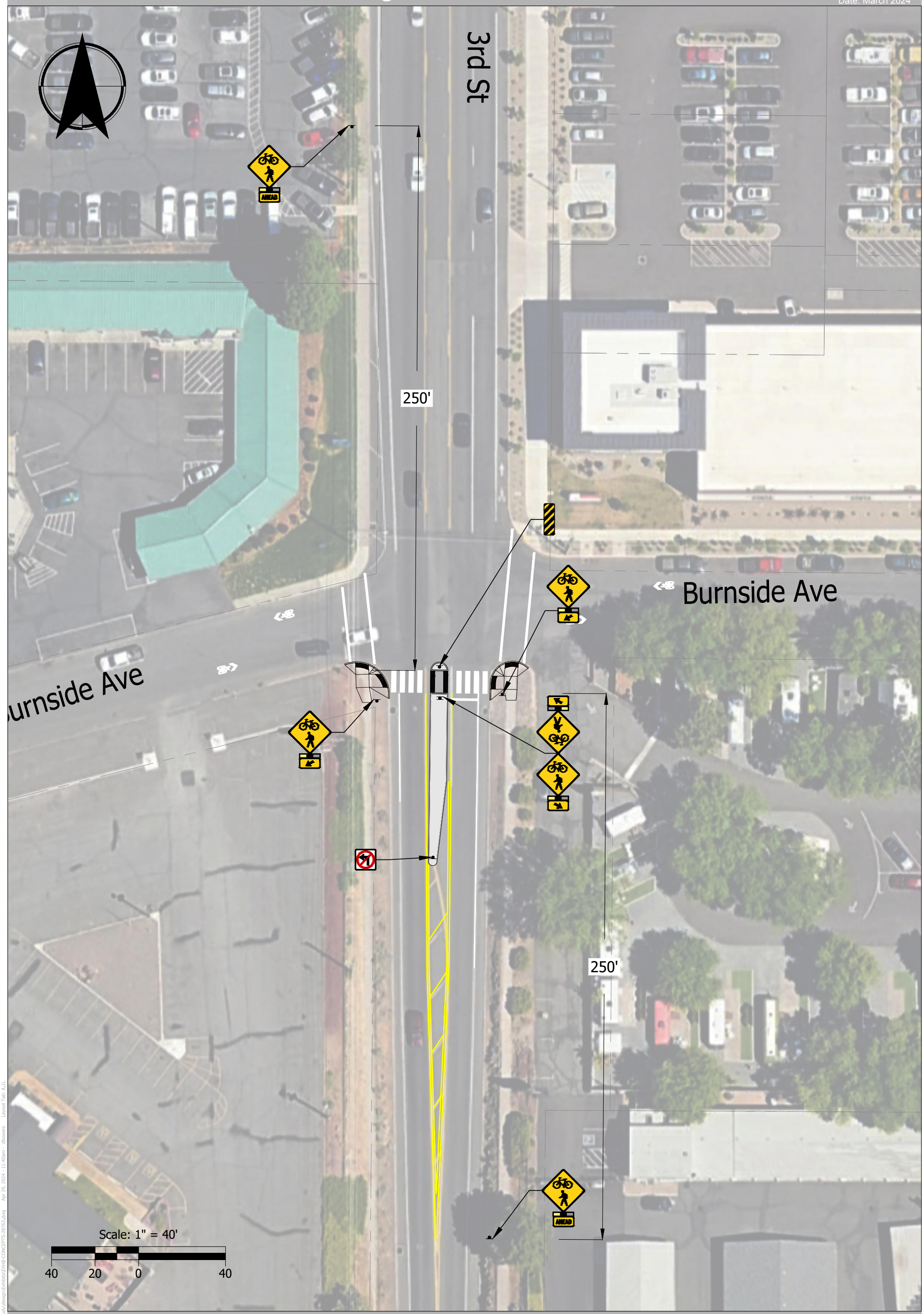

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Alternative A.2 - Crossing North of Burnside

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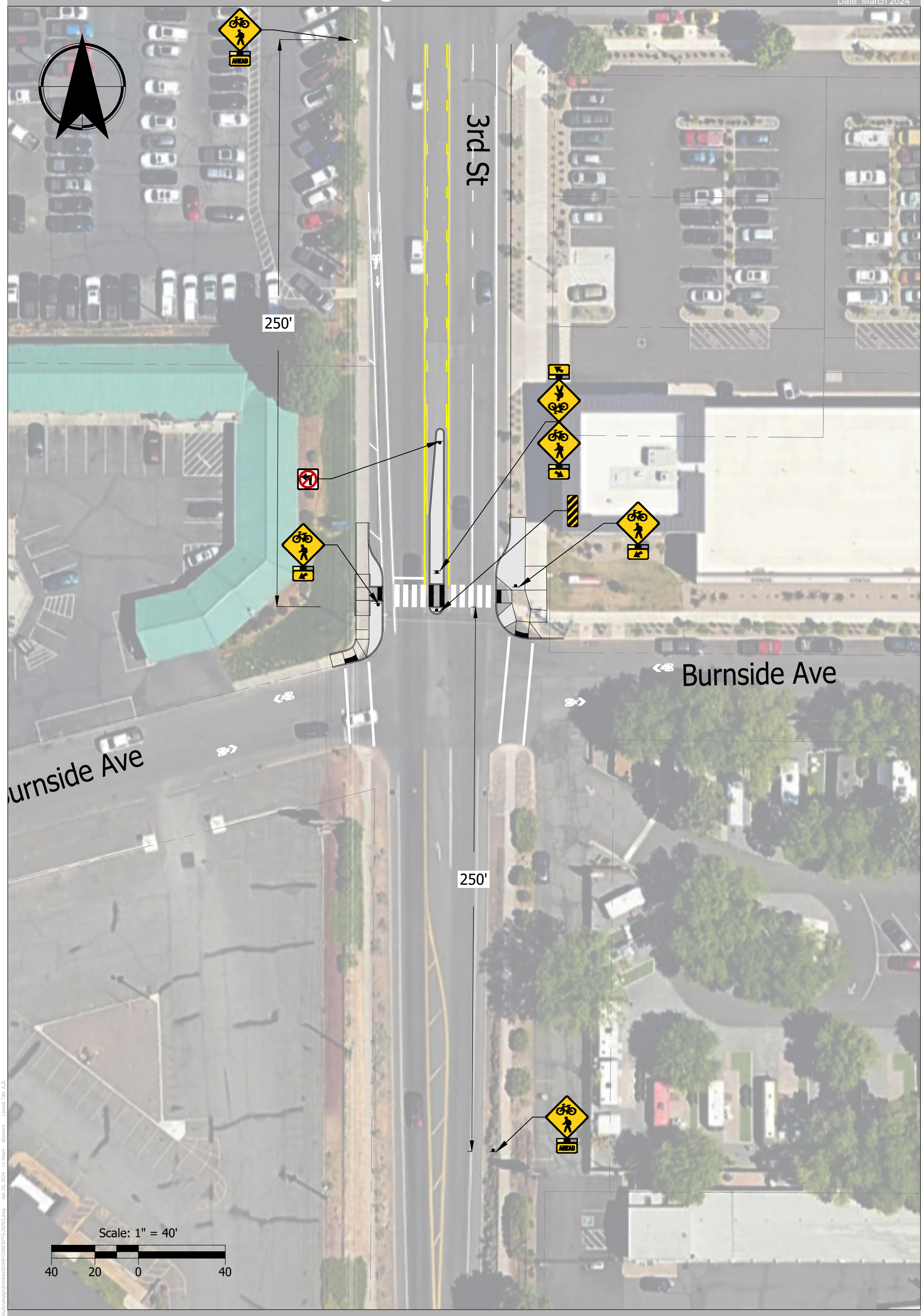

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ALTERNATIVE A.3

Alternative A.3 is displayed in Figure 17. This alternative includes several elements that enhance the comfort and visibility of pedestrians and bicyclists using the crossing, including high visibility pavement markings for pedestrians, green pavement markings for bicyclists, curb extensions, median islands that serve as refuge areas, bicycle left-turn boxes, and signage. Burnside Avenue would be restricted to right-in/ right-out for vehicles to provide median separation and modal filters along 3rd Street for people biking. An RRFB would be installed on each 3rd Street approach. Opportunities and challenges for this approach are described below.

Opportunities

- A crossing at Burnside Avenue facilitates the continuation of the low stress network to 2nd Street north of the undercrossing.
- Separating bicyclists and pedestrian crossing areas reduces pedestrian-bicyclist conflicts.
- The construction of pedestrian and bicycle refuge areas and construction of curb extensions reduces the total number of lanes to cross at a time.
- High visibility elements, like pavement markings, signage, and RRFBs, alert drivers to heavy usage of non-vehicular travel.
- An RRFB significantly increases visibility and awareness of pedestrians in the crossing, especially on a high-volume roadway like 3rd Street where vehicles are shifting positions through the lane reduction and have limited sight distance coming from the undercrossing. The City has installed similar crossing treatments that include RRFBs on 3rd Street at Hawthorne Avenue, Seward Avenue and Roosevelt Avenue.
- Bike left-turn boxes and bicycle actuated push buttons provide space for cyclists to reorient their bicycle and actuate the RRFB.

Challenges

- Restricts left turning movements and the east-west through movement on Burnside Avenue. Drivers will have to use Dekalb Avenue or Clay Avenue.
- Like Alternative A.1 and A.2, navigating lane shifts may divert driver attention, potentially reducing awareness of the crossing. Drivers heading northbound have more limited sight distance due to the sag curvature of the undercrossing, also limiting visibility.
- Existing manholes and stormwater facilities may have to be relocated where curb extensions are shown.

Alternative A.3 - Modal Filters

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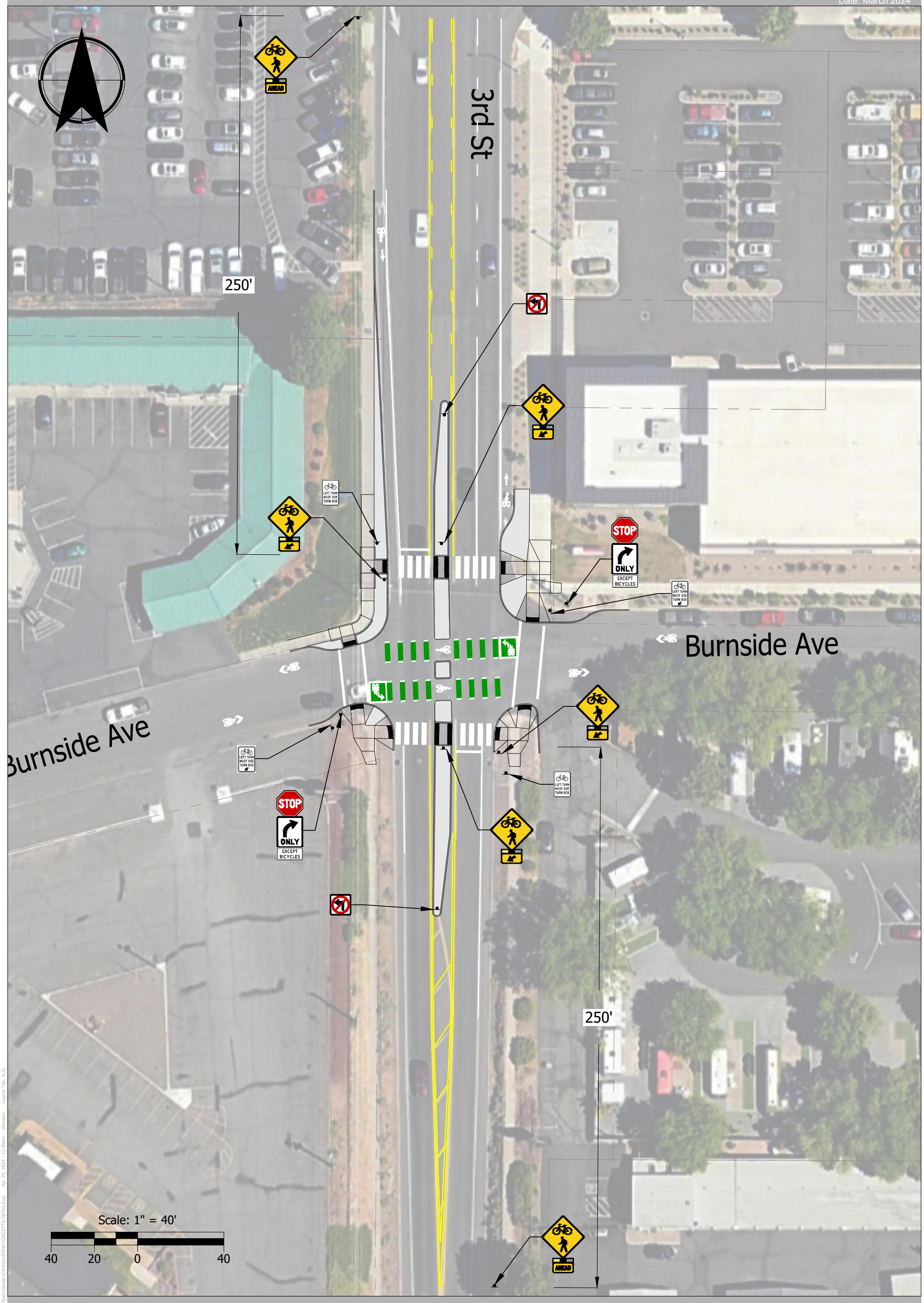

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SUB-AREA B

Findings from the *Existing and Future Conditions Assessment Technical Memorandum* indicate an increase in traffic demand on Miller Avenue due to regional growth as well as increased traffic generated from new developments in the Timber Yards and Jackstraw area. Therefore, implementing traffic control on 3rd Street within this area is necessary to support the higher turning movement demand expected on Miller Avenue. Infrastructure improvements are also needed to reduce the level of stress experienced by pedestrians and bicyclists crossing 3rd Street at Miller Avenue on the LSN.

During the initial phase of developing alternatives, the project team examined various traffic control options to address safety and operations. This included a variety of traffic control and traffic flow options at Miller Avenue and Woodland Boulevard. Discussions with City staff and findings from the *Initial Alternatives Development* (Appendix D) and *Alternative Evaluation & Refinement* memorandum (Appendix E) determined that installation of a traffic signal at Miller Avenue would be the most beneficial for facilitating safe and efficient multi-modal connections between 3rd Street and 2nd Street. Therefore, a traffic signal at 3rd Street/ Miller Avenue is the recommended alternative for this intersection.

Immediately north of Miller Avenue the two northbound lanes merge into a single lane. With the merge located just after the intersection, lane utilization and traffic operations are impacted since the inside through lane sees a higher proportion of traffic compared to the merging right lane. Therefore, the project team identified two alternatives that help facilitate the merging movement while also supporting east-west bicycle and pedestrian crossings as part of the LSN.

Bicycle and pedestrian treatments such as protected intersection features can be considered in the design phase for both alternatives when survey information is available.

3rd Street and Miller Avenue Intersection

The intersection alternatives for 3rd Street/ Miller Boulevard include:

- **Alternative B.1**: Traffic Signal with Restricted Southbound Left
- **Alternative B.2**: Traffic Signal with Northbound Single Through Lane

Table 2 summarizes the key considerations that differentiate each 3rd Street/ Miller Avenue intersection alternative. The following considerations are excluded from the Table because all were assessed the same for each alternative:

- **Environmental Resources**: No anticipated conflicts with environmental resources.
- **Conflicts or Coordination with BNSF**: No coordination needed.
- **Key Routes**: Key Route 7 is proposed to change from Miller Avenue as identified in the TSP to SE 3rd Street/ East Scott Street for both alternatives. The LSN would be retained on Miller Avenue, consistent with the TSP.
- **Impacts or Benefits to Transportation Disadvantaged Populations (TDPs)**: Provides signalized crossing and pedestrian refuge area on the northside. Restricting southbound left-turning movements reduces conflict points at the intersection.

- **Business Access**: Business access north of Miller Avenue is restricted to Right-In/ Right-Out. Restricts left turns to business access north of Miller Avenue.

Table 2. Sub-Area B – 3rd Street/ Miller Avenue Key Considerations

Key Differentiating Considerations	Alternative B.1: Traffic Signal with Southbound Left Turn Eliminated	Alternative B.2: Traffic Signal with Northbound Single Through Lane
Bicycle and Pedestrian Connectivity	Eliminating southbound left turns and reduces conflict points.	Reduces total number of lanes to cross on the northbound approach from 2 to 1. Curb extensions reduce crossing distance on 3rd Street.
Network Changes	Would eliminate southbound left-turns which would reduce conflict points. Drivers must use the surrounding network to make left turns.	Drivers will merge from 2 lanes to 1 lane between Wilson Avenue and Miller Avenue, instead of after the Miller Avenue intersection.
Business Access	Business access north of Miller Avenue is restricted to Right-In/ Right-Out	Business access north of Miller Avenue is restricted to Right-In/ Right-Out
Cost Estimate	$5.6M (traffic signal and medians)	$5.6M (traffic signal and medians) – Cost estimate would increase with if curb southeast of Miller was reconstructed
Traffic Operations	Meets city mobility standards.	Meets city mobility standards.
Constructability	ROW acquisition for signal equipment is needed. Franchise utility coordination required. Possible grading challenges at driveways. Coordination with CET during construction.	ROW acquisition for signal equipment is needed. Will need to further evaluate special construction staging to minimize full closures on 3rd Street near Davis Avenue. Franchise utility coordination required. Possible grading challenges at driveways. Coordination with CET during construction.

ALTERNATIVE B.1 – RESTRICT SOUTHBOUND LEFT

Alternative B.1 consists of a traffic signal at 3rd Street/Miller Avenue and installation of a median from Miller Avenue to Davis Avenue, shown in Figure 18. The median restricts left turns (right-in/ right-out (RIRO)) at Davis Avenue (existing RIRO) and East Railroad Street and restricts the southbound left turn at 3rd Street/Miller Avenue. The concept includes roadway improvements on the east side of 3rd Street to facilitate the Miller Avenue LSN.

TRAFFIC OPERATIONS

As an updated and refined alternative, traffic operations for this concept were not previously documented. Thus, the project team has evaluated and documented those operations here.

The traffic signal was analyzed with protected/permissive phasing for the northbound left-turn movement and permissive phasing on Miller Avenue. The utilization for the northbound lanes were estimated to be

80% in the inside northbound lane in 20% in the outside northbound lane for this analysis. The alternative meets the city's mobility standards with existing and future (2045) traffic volumes. Detailed operational analysis results are provided in Appendix I.

Queues are estimated to be approximately 600 feet for the northbound through (extends past Lee Lane) and 425[5] feet for the southbound approach. The side street queues can be contained within the block.

Opportunities

- Adding a median in the existing southbound left-turn lane allows for the inclusion of a pedestrian refuge island and increases the northbound effective green time for the traffic signal.
- The traffic signal provides signalized left turning movements to address the increased eastbound demand on Miller Avenue.
- Restriping and using the southbound left turn lane as a median provide an opportunity to extend the two northbound lanes north of Miller Avenue to allow for more room for driver decision-making ahead of the merge.
- Restricting the southbound left turning movement reduces the likelihood of cut through traffic from Miller Avenue to Centennial Street.
- This option is expected to have minimal impacts to right-of-way.
- Introduces a traffic control device to address turning movement crash history as identified in the Bend TSAP and in the 2021 ODOT State Priority Index System (SPIS).
- The low-stress network connection will be on Miller Avenue, consistent with the TSP.

Challenges

- Restricting left turning movements north of Miller Avenue shifts traffic to neighborhood network and may increase out-of-direction travel.
- Drivers would likely use the Woodland Boulevard intersection to make the southbound left turning movement with the restriction of the southbound left at Miller Avenue. This may increase circulation in the local street network.
- Business access north of Miller Avenue would be restricted to right-in/ right-out.
- Providing a full access signalized approach on the east leg of Miller Avenue could attract cut through traffic from Wilson Avenue and Centennial Street. Intersection turning movements, turning restrictions, and traffic calming elements may be considered in the design phase to restrict cut-through traffic and reduce traffic stress for people biking and walking. Traffic calming treatments such as speed humps/speed tables, traffic circles, or bulb outs may reduce the likelihood of cut through traffic and attractiveness of the route choice for regional trips.

[5] Estimated queue likely extends farther than the 425 feet because of the reduction in lanes north of Davis Avenue. Davis Avenue is approximately 275 feet north of Miller Avenue.

Alternative B.1 - Restrict Southbound Left Turn

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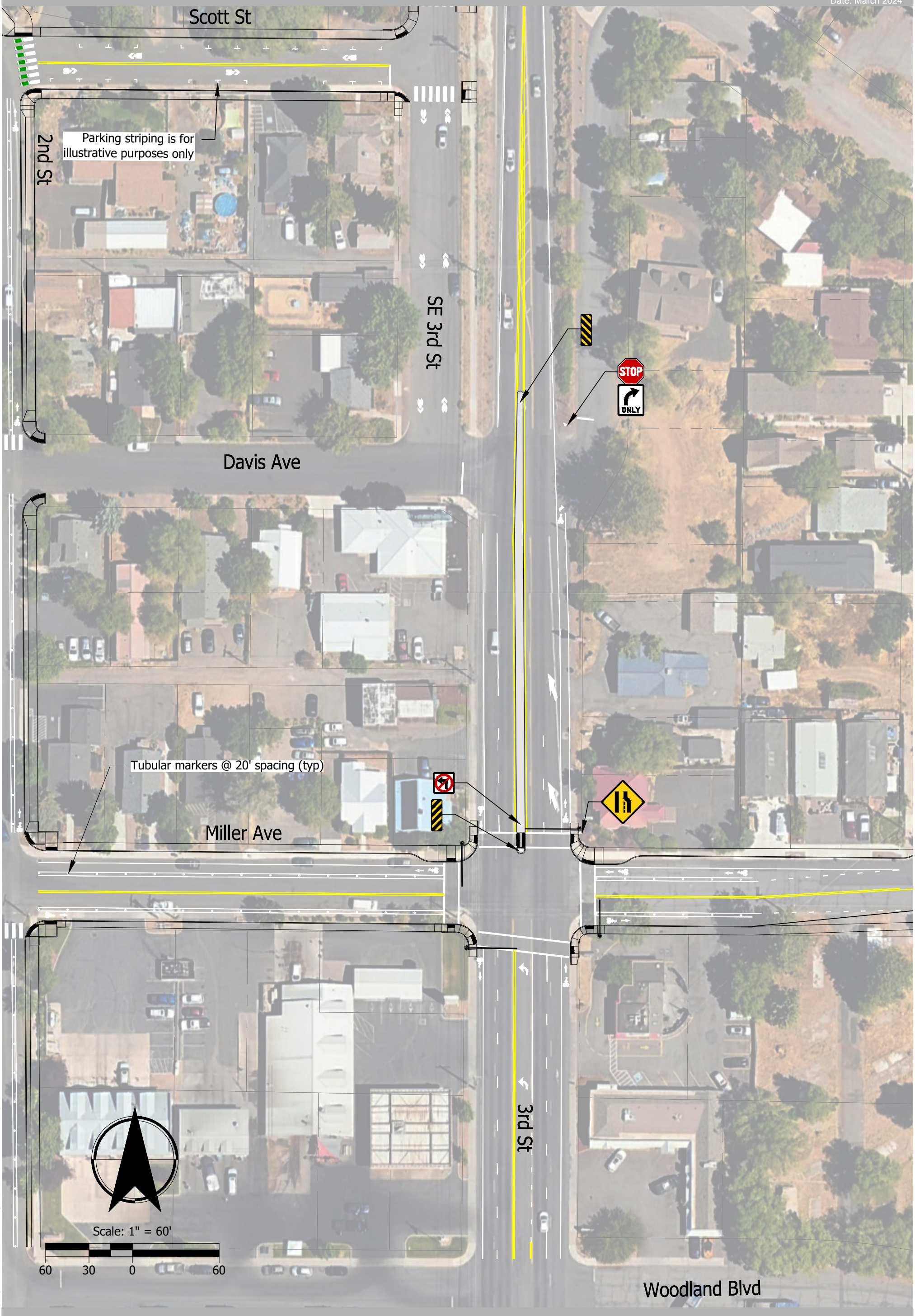

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ALTERNATIVE B.2 – SINGLE NORTHBOUND THROUGH LANE

Figure 19 shows Alternative B.2, which includes a traffic signal at 3rd Street/Miller Avenue. It maintains left turns on 3rd Street and adds a central median to 3rd Street on the north side of the intersection. To maintain the northbound and southbound left turns and to meet MUTCD design standards for merge and taper lengths, the start of the northbound transition from two lanes to one lane must be relocated south of the intersection near Dell Lane. Access control should be evaluated on the east side of 3rd Street between Dell Lane and Miller Avenue where the merge occurs and the cross section is reduced to one northbound lane. Reconstructing the curb would create a visual queue for drivers of the lane reduction whereas paint alone may get worn or can become hidden in snowy conditions.

The concept includes roadway improvements on the east side of 3rd Street to facilitate the Miller Avenue LSN.

TRAFFIC OPERATIONS

As an updated and refined alternative, traffic operations for this concept were not previously documented. Thus, the project team has evaluated and documented those operations here.

The traffic signal was analyzed with protected/permissive phasing for 3rd Street and permissive phasing on Miller Avenue. Detailed operational analysis results are provided in Appendix J. The alternative meets the city's mobility standards with existing and future (2045) traffic volumes. Similar to Alternative B.1, the project team assumed lane utilization for the northbound lanes to be 80% in the inside northbound lane in 20% in the outside northbound lane for this analysis.

Queues are estimated to be approximately 1,275 feet for the northbound through (extends to Yew Lane), 425 feet for the southbound through, 300 feet for the eastbound approach, and 50 feet for the westbound approach. The observed northbound queue may be less than estimated as vehicles use the tapering portion of the roadway to position themselves while the signal is red. The eastbound queue extends the length of the block and could result in vehicles on 2nd Street turning onto Miller Avenue to immediately be met by the back of a queue or vehicles queuing on 2nd Street while waiting for the queue to subside.

Opportunities

- Introduces a traffic control device to address turning movement crash history as identified in the Bend TSAP and in the 2021 ODOT State Priority Index System (SPIS).
- The low-stress network connection will be facilitated on Miller Avenue, consistent with the TSP.
- Relocating the northbound merge south of Miller Avenue provides more length and time for driver decision-making.
- Curb extensions reduce total distance people have to cross.
- The traffic signal provides signalized left turning movements to address the increased eastbound demand on Miller Avenue.
- This option is expected to have minimal impacts to right-of-way.
- Maintaining left turns on 3rd Street eliminates the need for out-of-direction travel through the neighborhood network.

Challenges

- Business access north of Miller Avenue would be restricted to right-in/ right-out. Restricting left turning movements north of Miller Avenue shifts traffic to neighborhood network and may increase out-of-direction travel.
- Providing a full access signalized approach for all legs of Miller Avenue could attract cut through traffic from Wilson Avenue and Centennial Street. Traffic calming treatments such as speed humps/speed tables, traffic circles, or bulb outs may reduce the likelihood of cut through traffic and attractiveness of the route choice for regional trips.
- Relocating the northbound merge between Miller Avenue and Wilson Avenue may result in queues that block side-streets and business driveways during peak hour.
- Eastbound queueing during the peak hour could extend to 2nd Street.

Alternative B.2 - Single Northbound Through Ln

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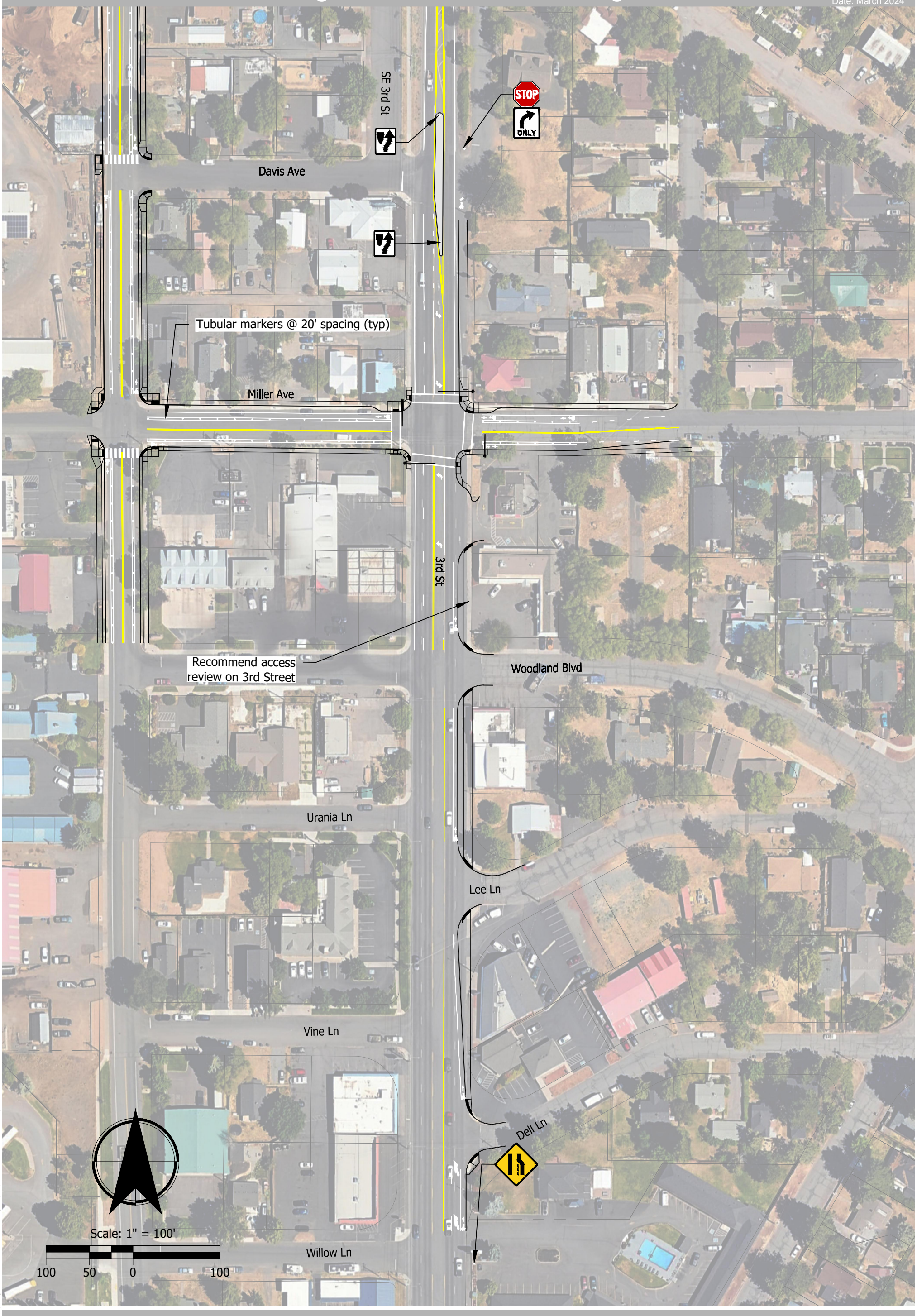
Date: March 2024



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Cross Sections

The project team developed cross-section alternatives for Miller Avenue and East Scott Street that include enhanced bicycle and pedestrian facilities in support of the Key Routes and LSN identified in the Bend TSP. This section provides an overview of the existing cross-sections and alternatives for each segment.

MILLER AVENUE CROSS-SECTION

Miller Avenue is identified in the Bend TSP as the east-west connection between 3rd Street and 2nd Street for the LSN. The project team developed two alternatives for the Miller Avenue cross-section that enhance bicycle and pedestrian comfort and safety along the segment between 3rd Street and 2nd Street to support implementation of the Key LSN, shown in Figure 20.

The cross-section alternatives for Miller Avenue include:

- **Alternative Miller-1**: 60-foot right-of-way and sidewalks and bicycle lanes on both sides.
- **Alternative Miller-2**: 60-foot right-of-way and a shared-use path on the north side.

EXISTING CROSS-SECTION

Miller Avenue consists of two, 11-foot travels lane and 7 feet of on-street parking. Lanes and parking are not striped. Five-foot curb tight sidewalks are provided on both sides. Available right-of-way extends beyond the back of walk for a total of 60 feet.

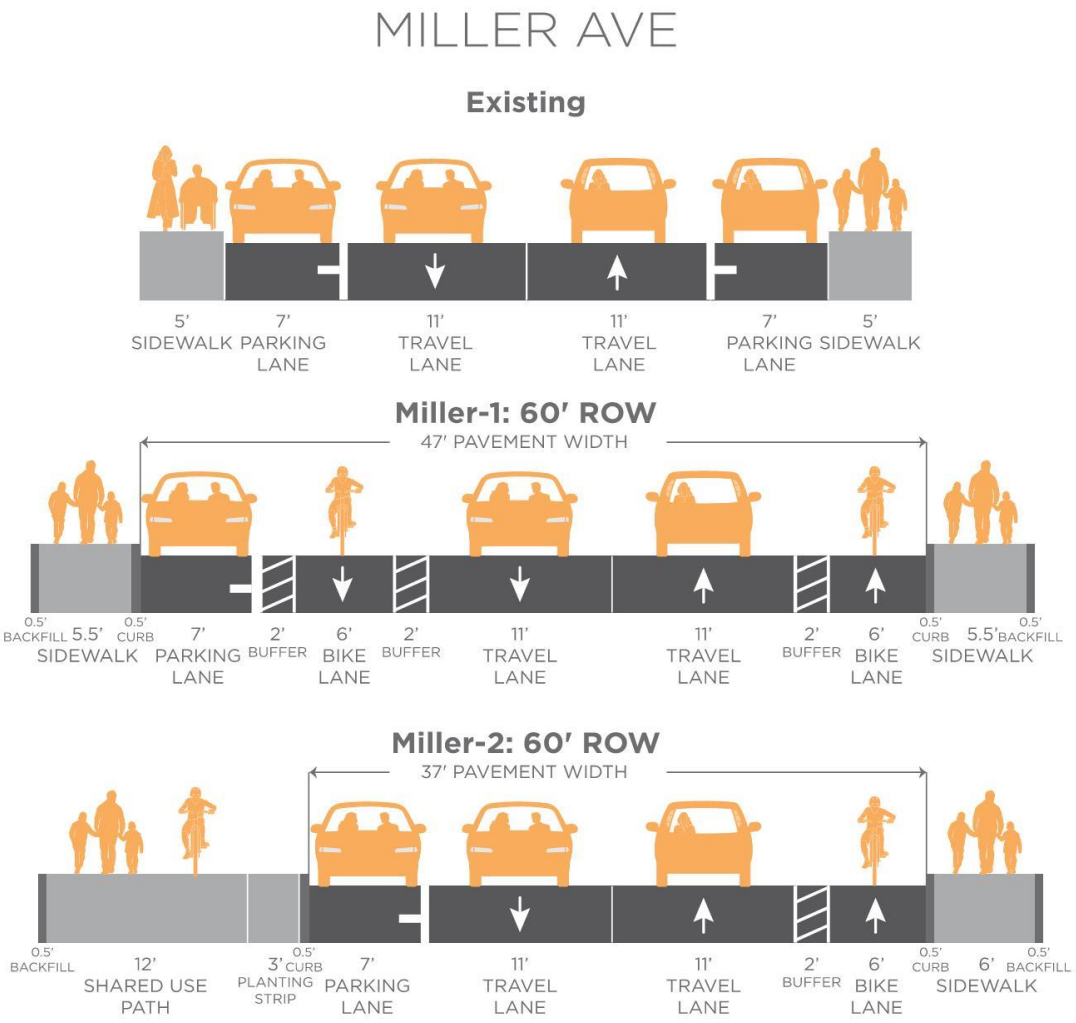
ALTERNATIVE MILLER-1

This option maximizes the use of the existing right-of-way (60 feet). It includes 11-foot travel lanes, buffered, curb tight bicycle lanes, on-street floating parking on one side, and a 6-foot curb-tight sidewalk on both sides. To accommodate the LSN by providing bicycle and pedestrian facilities, on-street parking is reduced to one side of the roadway.

ALTERNATIVE MILLER-2

This option maximizes the use of the existing right-of-way and provides a low-stress off-street connection for people biking on the LSN. It includes 11-foot travel lanes and on-street parking, a 12-foot shared use path, and 3-foot landscape buffer on the north side. The south side includes a 6-foot bicycle lane with a 2-foot buffer and a 6-foot sidewalk.

Figure 20. Miller Avenue Cross-Sections



EAST SCOTT STREET CROSS-SECTION

East Scott Street is the recommended east-west connection for Key Route 7 between 2nd Street and 3rd Street. Compared to Miller Avenue, East Scott Street is expected to have lower vehicular volumes in 2045 and requires less out-of-direction travel for bicyclists or pedestrians traveling between 3rd Street and Aune Street using the path on the west side of the undercrossing. Compared to Miller Avenue, East Scott Street has narrower driveways, reducing the pedestrian exposure to vehicles moving in and out of businesses and residences. The project team developed an alternative for East Scott Street, shown in Figure 21.

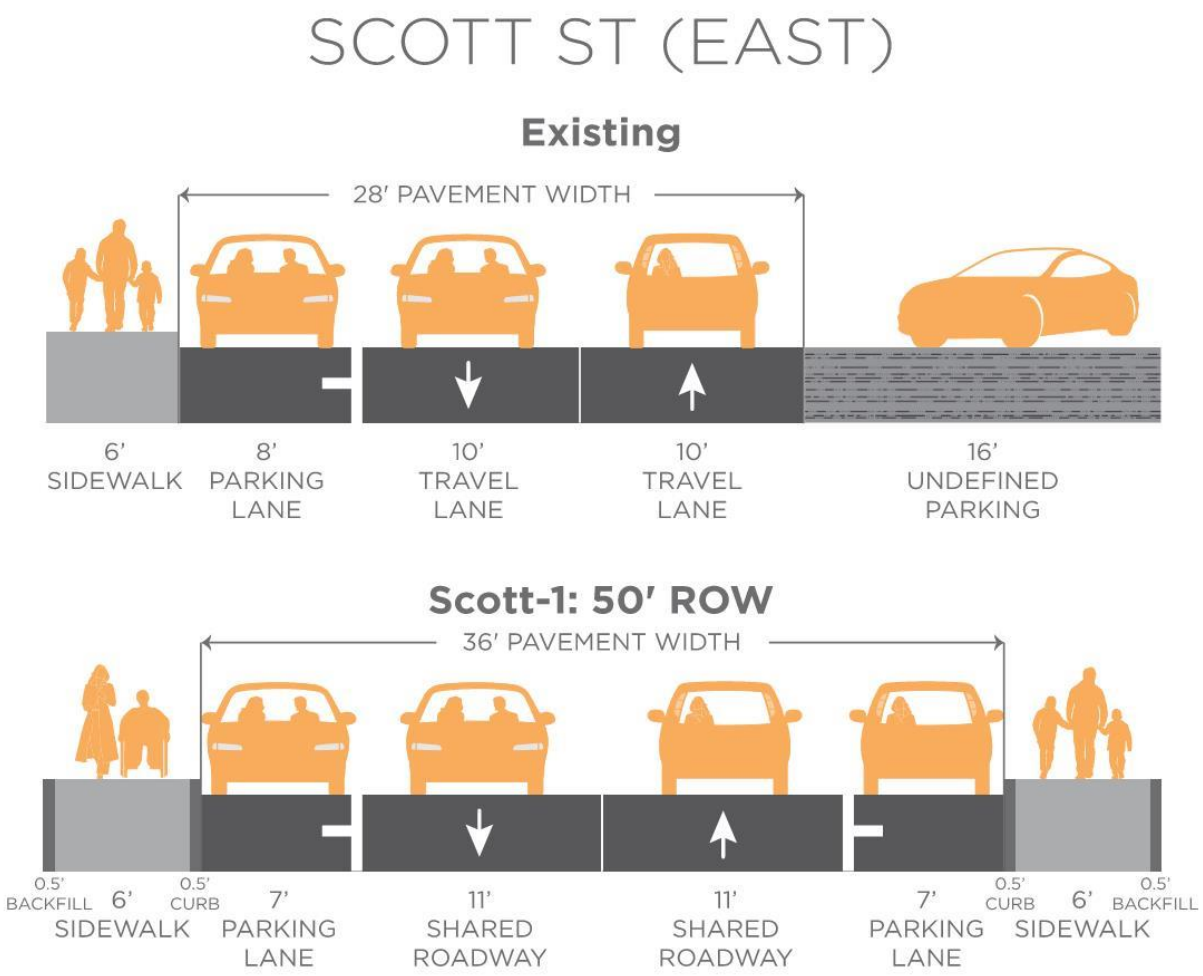
EXISTING CROSS-SECTION

The existing East Scott Street cross-section has 50-feet of right-of-way and includes approximately 28 feet of pavement that is used for through traffic and on-street parking and a 6-foot curb tight sidewalk on the south side. The remaining right-of-way is gravel on the northside of the roadway and is used by many adjacent property owners for parking.

ALTERNATIVE SCOTT-1

This option includes two 11-foot shared travel lanes, 7-foot on-street parking on both sides, and 6-foot curb tight sidewalks on both sides of the roadway. Mailboxes, utilities, and/or light fixtures would be required to use the space allocated to the curb tight sidewalk. This option provides pedestrian facilities and a shared roadway for cyclists.

Figure 21. Scott Street East Cross-Sections



SUB-AREA C

Sub-Area C includes several key connections for facilitating the flow of motor vehicles, bicycle, and pedestrian traffic between major activity centers (e.g., 3rd Street and the Old Mill District) and the Colorado Avenue interchange. Upcoming mixed-use developments including Timber Yards and Jackstraw are expected to generate additional volume on Aune Street for drivers traveling to and from the area west of US97. As a result, volume is expected to exceed capacity on the Aune Street approach at the Scott Street/ 2nd Street intersection by 2037 with the existing traffic control and lane configuration. Aune Street and 2nd Street are also part of Key Route 7 and the LSN, making bicycle and pedestrian connections a central focus in this vicinity. Establishing a connected network of pedestrian and bicycle facilities on 2nd Street with Aune Street, Scott Street East, Miller Avenue, and Davis Avenue is critical for developing a consistently interconnected route for Key Routes 7/9 and the LSN.

The alternatives for Sub-Area C include:

- Intersection improvement options at Aune Street/ Scott Street/ 2nd Street;
- Complete streets upgrade on 2nd Street; and
- Complete streets upgrade on Aune Street.

These alternatives provide options for balancing the need for low-stress active transportation infrastructure with increasing demands of traffic. These options maintain the existing 250-foot distance between the intersection and the at-grade railroad crossing to the north. The City should continue to coordinate with BNSF to ensure any intersection improvements comply with at-grade crossing requirements.

Both concepts maximize the use of the current Aune Street alignment and side street stop control configuration. The current concepts are shown with property impacts to the northern properties on Aune Street. Widening south toward the Forest Service property should further be explored in the design phase with updated survey. Utility impacts and building setbacks will need to be evaluated as well as right-of-way impacts to accommodate curb radii and curb ramps.

Table 3 summarizes the key considerations that differentiate each alternative. The following considerations are excluded from the Table because both alternatives were assessed the same for each alternative:

- **Environmental Resources**: No anticipated conflicts with environmental resources.
- **Conflicts or Coordination with BNSF**: Additional coordination with BNSF required to solidify agreements at northern spur and near the wye (within BNSF ROW). Confirm improvements at Aune St/Scott St with proximity to at grade crossing.
- **Network Changes:** No changes to the network.
- **Business Access:** Modifications to businesses are likely.
- **Impacts or Benefits Transportation to Transportation Disadvantaged Populations:** Provides enhanced crossing at Scott Street/ 2nd Street and Aune Street intersection.
- **Bicycle and Pedestrian Connectivity:**
- **Traffic Operations:** Meets City standards until 2037. After 2037, delay exceeds the 50 second threshold defined by the City for two-way stop-controlled intersections.

Table 3. Sub-Area C Key Considerations

Key Differentiating Considerations	Alternative C.1: Side Street Stop and Shared Use Path from Aune Street to Scott Street	Alternative C.2: Side Street Stop and Shared Use Crossing
Key Routes	Key Route 7 will be on East Scott Street and proceed to the north side of Aune Street. A southbound bicycle lane and northbound shared-use path provides low-stress connections to Key Route 7/9 on 2nd Street.	Key Route 7 will be on East Scott Street and proceed to the north side of Aune Street. A two-way, off-street shared-use path on the northeast side of 2nd Street provides a low-stress option for people traveling on Key Route 7. A southbound bicycle lane provides a connection for people bicycling on Key Route 9.
Bicycle and Pedestrian Connectivity	A shared-use path and shared crossing provide low-stress bicycle and pedestrian connections to and from Aune Street. The shared crossing includes a refuge area that reduces the number of lanes someone must cross at one time.	A shared-use path and shared crossing provide low-stress bicycle and pedestrian connections to and from Aune Street. The shared crossing includes a refuge area that reduces the number of lanes someone must cross at one time. Minimizes vehicle-bicycle conflicts between Aune Street and East Scott Street.
Cost Estimate	$5.1 million (upgrade Aune Street and 2nd Street to complete streets, intersection upgrades at Aune St/Scott St) Cost estimate may vary based on pavement and sidewalk quantities.	
Constructability	Requires utility coordination and ROW acquisition for the shared use path on the north side. Will need to further evaluate construction staging to minimize full closures on 2nd Street (median) and Aune Street.	

Aune Street/ 2nd Street/ Scott Street

ALTERNATIVE C.1 - SIDE STREET STOP AND SHARED USE PATH BETWEEN AUNE STREET AND SCOTT STREET

The alternative includes a 10-foot shared-use path on the northeast side of 2nd Street between Scott Street and Aune Street and a shared crossing with a median refuge area. These features provide a two-way low-stress connection for people walking and biking Key Route 7 and the LSN. A southbound bicycle lane is also provided to connect people biking southbound from Key Route 7 to Key Route 9. The crossing on the southeast leg of 2nd Street is recommended to be closed.

The existing right-of-way for the property on the northwest corner of Aune Street/Scott Street is curbtight to the existing Aune Street roadway. The addition of the 10-foot dedication from the property owner is unable to accommodate the separated shared use path and the curb ramps at the northwest corner. Therefore, additional right-of-way discussions and coordination will be required. The dedication from the adjacent property to the west (taxlot 181205AA00901) is sufficient for the shared use facility to be constructed within the dedicated right-of-way space.

The timeline of redevelopment in the surrounding area is uncertain, however, if/when adjacent properties redevelop the City should consider acquiring right-of-way for construction of future intersection infrastructure improvements to enhance connectivity for all modes and continuous sidewalk on 2nd Street to improve the pedestrian network.

Opportunities

- Less right-of-way impact until more robust traffic control is necessary.
- Shared-use path provides a low-stress off-street option for people biking on 2nd Street.
- Enhanced pedestrian crossing on Scott Street with pedestrian refuge area to support Key Route 7, Key Route 9, and the LSN.
- Maintains 250 feet between the intersection and at-grade railroad crossing.
- Dedicated eastbound left-turn lane for vehicles on Aune Street.
- Provides opportunities for enhanced bicycle and pedestrian crossings.
- Pavement markings and wayfinding signage can be implemented to increase the visibility of people walking and biking and guide users to the low stress connections.

Challenges

- Does not meet the City's operational standards past the year 2036.
- Business driveway access near the intersection likely to be impacted to develop shared-use path. Will need to be further evaluated in design.
- Will require right-of-way from the northwest property to fit pedestrian facilities that connect to the enhanced crossing.

Alternative C.1

Preliminary Design Subject to Change
Date: March 2024

KITTELSON & ASSOCIATES
PHONE: CONTACT:

Aune Street Extension Study
Bend, OR

ALTERNATIVE C.2 – SIDE STREET STOP AND SHARED CROSSING

Figure 23 shows a shared use crossing alternative, which features a shared bicycle and pedestrian crossing on Scott Street. South of the intersection, northbound cyclists would have the option to ramp up onto a shared use path or merge with traffic for a 100-foot section of Scott Street adjacent to Aune Street. The shared use space would allow cyclists to use the marked crosswalk on the north side of the intersection to access Aune Street. A bike ramp would be constructed north of the crossing for cyclists to rejoin the existing bike lane north of the intersection. A tactile detectable indicator (TDI) is provided at the bicycle ramp to aid wayfinding for pedestrians who have low vision or are blind.

Similar to concept C1, right-of-way acquisition will be required from the property on the immediate northwest corner of Aune Street/Scott Street to construct the shared use path and curb ramps.

Opportunities

- Facilitates a connection to the Aune Street shared use path.
- Provides an aligned crossing for both pedestrians and bicyclists, perpendicular to motor vehicle traffic.
- Bicyclists have an option to make left turns and through movements without looking over their shoulder and merging with traffic.

Challenges

- Requires additional right-of-way from the northwest property for the shared use path.
- Northbound cyclists are required to merge with traffic or use the shared use path.
- No buffer is provided between the shared-use path and the roadway due to constraints from the surrounding built environment.

Alternative C.2

Preliminary Design Subject to Change
Date: March 2024

Scale: 1" = 50'

50 25 0 50

Tactile Detectable Indicator

STOP

Tubular markers @ 20' spacing (typ)

Parking striping is for illustrative purposes only

Aune St

Scott St

KITTELSON & ASSOCIATES

PHONE: CONTACT:

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Bend, OR

Aune Street Cross-Section

Aune Street is a critical east-west connection providing access for all modes of transportation under US97. It is a key connection of Key Route 7 to Key Route 10. Aune Street is currently underutilized from a vehicular perspective as the roadway connection to the west becomes a private road. As upcoming development occurs and the connection to Bond Street is completed, Aune Street is expected to facilitate an increasing amount of vehicular and multimodal traffic.

Figure 24 shows the Aune Street roadway improvement concept.

EXISTING CROSS-SECTION

Aune Street is currently a 36' wide paved roadway without a centerline. BNSF owns the right-of-way underneath the undercrossing with an easement to provide public access to vehicles and alternative modes. The BNSF rail spur underneath the undercrossing creating a pinch of available width the City can utilize for transportation improvements.

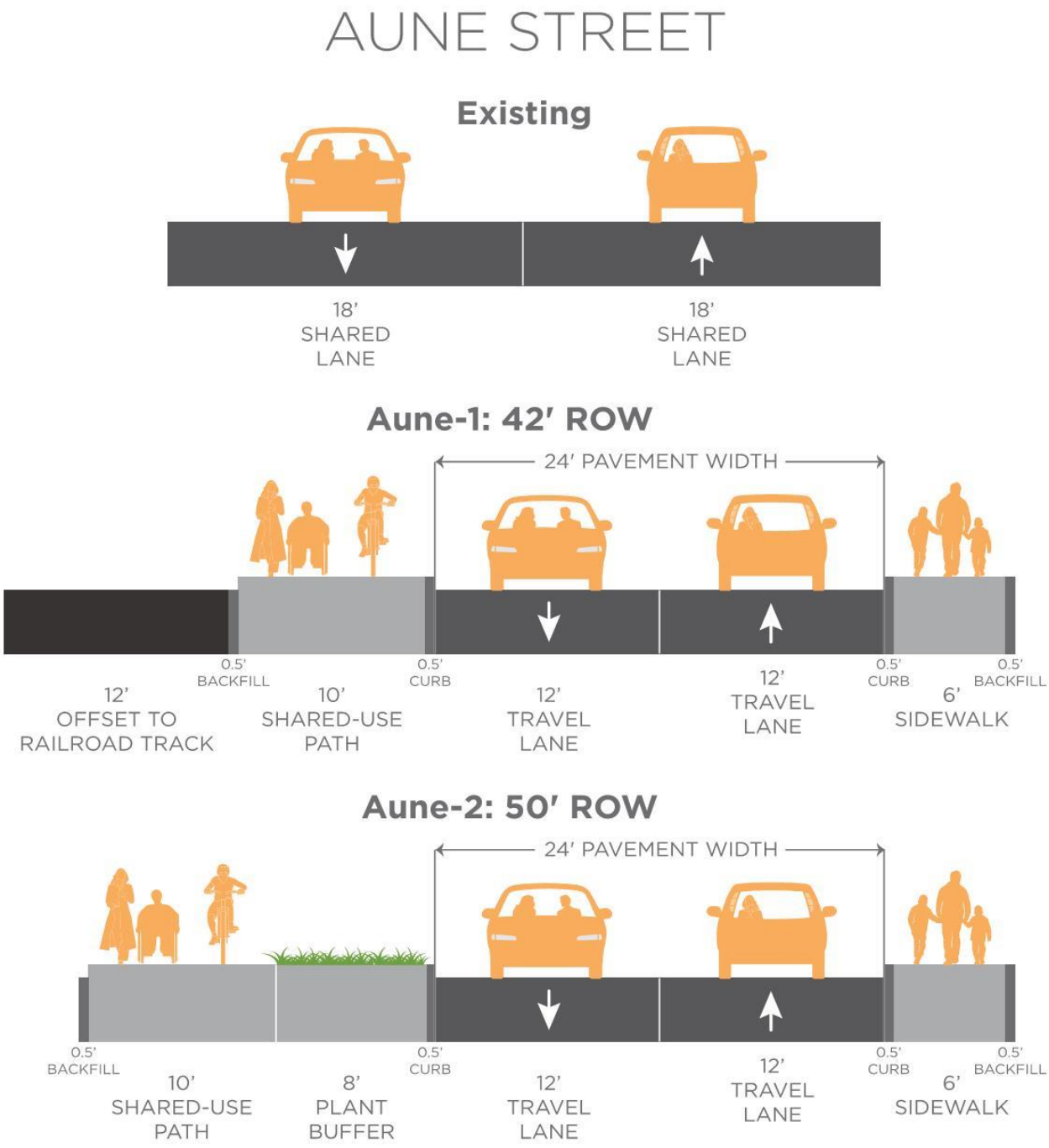
ALTERNATIVE AUNE-1

As previously mentioned, BNSF is open to allowing the City to utilize a maximum of 6 additional feet north of the existing curb on Aune Street under the Parkway Undercrossing. This increases the City's transportation infrastructure width to 42 feet. Within this cross section the project team, City, and BNSF have discussed 12-foot shared travel lanes, a 10-foot curb tight shared use path on the northside and a 6-foot curb tight sidewalk on the southside.

ALTERNATIVE AUNE-2

East of the undercrossing and the BNSF easement there is an opportunity to provide an 8-foot planter strip between the shared use path and the travel lane. Alternative 2 requires right-of-way from the parcel on the northwest corner of Aune Street/Scott Street, however, with the acquisition, a 50-foot cross section creates separation between the shared use path and the travel lane.

Figure 24. Aune Street Concepts



Second Street Cross-Section

The City of Bend TSP identifies 2nd Street as a route for low-stress multimodal facilities, with Key Route 7 proposed on 2nd street between Miller Avenue and Aune Street and Key Route 9 proposed on 2nd Street to Wilson Avenue.

Figure 25 shows concepts for two alternatives for the 2nd Street improvements, based on available right-of-way. The majority of available right-of-way on 2nd Street in the study area is 60 feet, however, the segment between East Scott Street and Davis Avenue is 50 feet. Alternative 1 can be implemented with the existing 50 feet of right-of-way, whereas Alternative 2 builds on Alternative 1 and can be implemented when the full 60 feet is available throughout the corridor.

EXISTING CROSS-SECTION

The existing cross-section of 2nd Street includes two 12-foot travel lanes, a 6-foot bike lane on each side, and a 6-foot sidewalk on the east side of the roadway and sidewalk gaps on the west side. The city will be implementing a grant project in 2024 to restripe 2nd Street from Wilson Avenue to Davis Avenue to have include buffered bike lanes with a vertical buffer treatment.

ALTERNATIVE 2ND-1

Alternative 1 is a 50-foot cross-section consisting of two 11-foot travel lanes, 6.5-foot bike lanes on each side of the roadway with 2.5-foot buffers, and a 6-foot sidewalk with a 3-foot landscape buffer on the east side of 2nd Street. This option provides separate facilities for bicyclists and pedestrians and ties into the planned improvements to 2nd Street south of Davis Avenue. Alternative 1 can be implemented on 2nd Street where the right-of-way is constrained to 50 feet. Where 60 feet is available, Alternative 2 can be implemented. Where right-of-way is not available pedestrians would be encouraged and routed (with marked crossings) to the east side of 2nd Street.

ALTERNATIVE 2ND-2

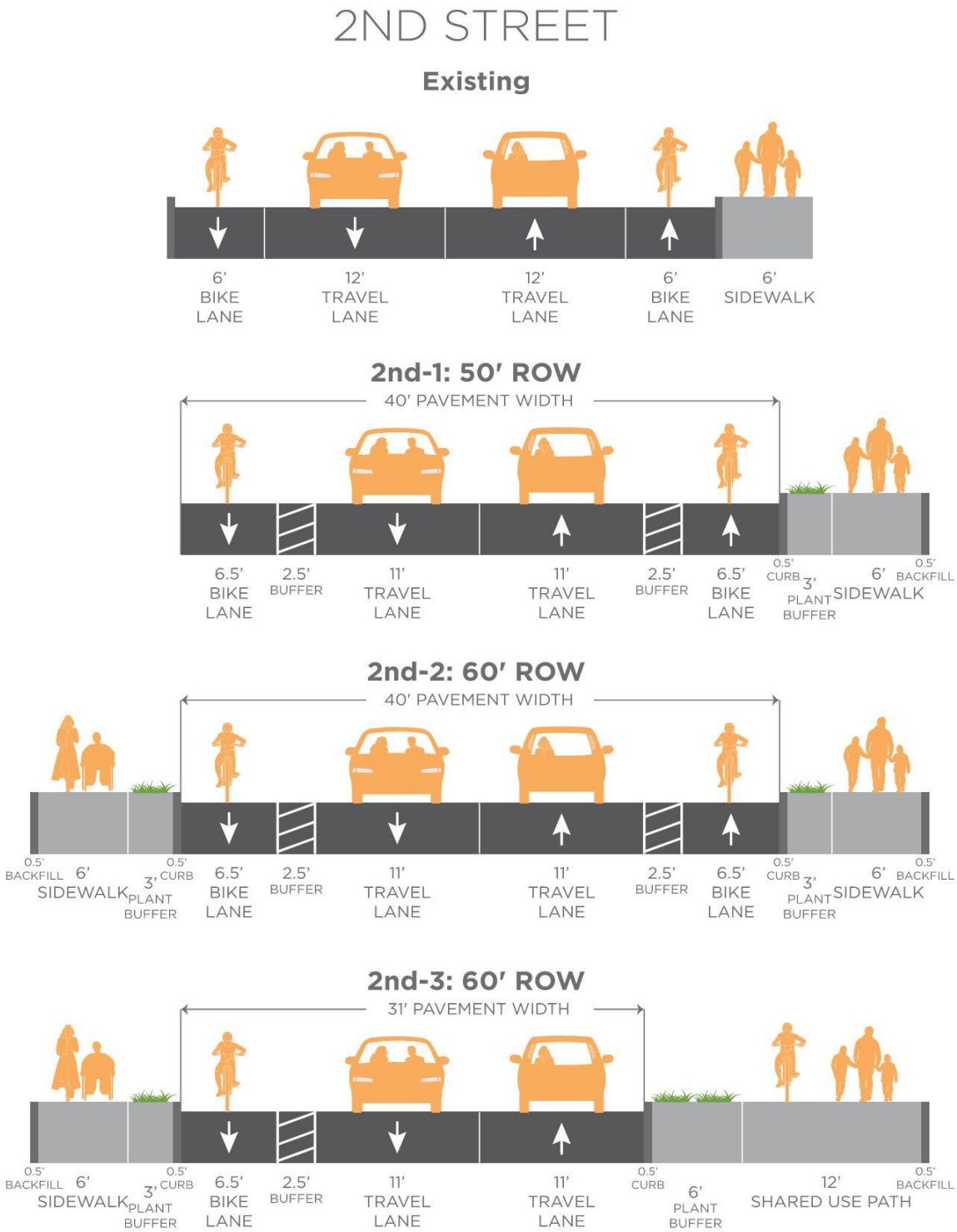
Alternative 2 is a 60-foot cross-section that includes the same features as Alternative 1 with the addition of a 6-foot sidewalk and 3-foot landscaped buffer on the west side of 2nd Street.

ALTERNATIVE 2ND–3

Alternative 3 is like Alternative 2, except the east side includes a 12-foot shared use path and 6-foot plant buffer instead of a sidewalk and separated bicycle lane. This alternative provides a low-stress two-way connection for people walking and biking on Key Route 7 and the LSN and would only be implemented on the segment between Aune Street and Scott Street. This option minimizes potential vehicle-bicycle conflicts for the movement between Aune Street, 2nd Street, and Scott Street on Key Route 7.

Sidewalk on the westside of the cross section should be incorporated once right-of-way is available to create and continuous sidewalk connection south of Scott Street.

Figure 25. 2nd Street Concepts



Section 6
Long-Term Options

Long-Term Options

The alternatives presented in this report provide infrastructure options that can be reasonably implemented in the near term. These options are largely within the existing right-of-way except for minor widening north of Aune Street. The timing of development in the area is uncertain and creates opportunities for the City to explore alternative routes and traffic control when development occurs.

A long-term investment on the existing 2nd Street corridor will require an intersection improvement at Aune Street/Scott Street/2nd Street (as indicated in the analysis results) in 2037. Other corridor improvements that would benefit from additional right-of-way could include bicycle wayfinding infrastructure at Aune Street/Scott Street East to improve bicycle safety and visibility for the Key Route, a roundabout at 2nd Street/Miller Street to improve traffic flow and safety, and other 2nd Street corridor improvements to improve multimodal accessibility and safety such as wider sidewalks and buffer strips.

As redevelopment occurs the City may also explore alternative routes for Aune Street from 2nd Street/Miller Avenue to the existing Aune Street alignment through the current industrial land between 2nd Street and US97. Alternative alignment options could improve connections to Colorado Avenue and potentially reduce the total number of rail crossings.

Section 7
Conclusion & Next Steps

Conclusion & Next Steps

The conceptual alternatives presented in this report improve east-west connectivity, safety, and multimodal options on Aune Street and the 3rd Street influence area. These initial alternatives are recommended to move forward to the next phase of the project, where they will be further refined based on additional analysis from design and input gathered from the community before selecting a final preferred alternative. The initial alternatives provide the city flexibility to implement improvements in a phased approach, especially as the long-term vision for Aune Street and the surrounding properties becomes clearer.

Initial planning level cost estimates for the three subareas presented are roughly $11.5 million. The GO Bond has allocated $6.35 million for design and construction. As the city continues to explore and refine the initial alternatives in subsequent project phases, the following factors should be considered when evaluating and selecting the final preferred alternative:

- The implementation of the preferred alternatives for Aune Street/ Scott Street/ 2nd Street is dependent on the ability to repurpose the parking area south of Café De Chutes. The city should continue engaging property owners of these businesses to identify the feasibility of the alternative options and mitigating impacts to those businesses.
- The long-term vision for Aune Street is influenced by the availability/ redevelopment of the industrial property to the north of Aune Street and the USFS property to the south of Aune Street. The city should continue engaging these property owners to explore the possibilities of the future Aune Street extension alignment and their compatibility with implementation of near-term options presented in this report.
- As development occurs west of 2nd Street the City could explore opportunities to partner with developers to construct frontage improvements (i.e., shared use path) along the west side of the roadway.
- Reconstructing the curbline on the east side of 3rd Street between Dell Lane and Miller Avenue creates additional coordination needs with business owners and increased costs. Tradeoffs for each alternative should be clearly communicated to the public during outreach activities.

Appendix

Appendix

A. Existing and Future Needs and Opportunities Memorandum
B. Identify Intended Outcomes & Evaluation Methodology
C. Methodology Memorandum
D. Initial Alternative Development Memorandum
E. Alternative Evaluation & Refinement Memorandum
F. Evaluation Criteria
G. Cost Opinions
H. Constructability Review
I. Alternative B.1 Existing and Future Operational Analysis
J. Alternative B.2 Existing and Future Operational Analysis