



DRAFT Final Concept Report

Bend Safety Implementation Plan

June 2015



Introduction

This report summarizes the conceptual design of safety solutions at priority locations in the four corridors addressed by this project:

- 3rd Street between Greenwood Avenue and Murphy Road
- Colorado Avenue between Bend Parkway and Bond Street
- Greenwood Avenue West between 3rd Street and Awbrey Road
- Greenwood Avenue East between 3rd Street and 12th Street

Corridor Concepts

The Alta team, which includes Kittelson Associates, Inc, and Century West, developed two to three street design concept alternatives for each corridor based on the findings of the Existing Conditions, Opportunities and Challenges memo. The recommended corridor crossing plans were based on input received during two public open house events, discussions with key stakeholders, and meetings with the Technical Advisory Committee (TAC).

Two priority projects from each corridor crossing plan, plus four additional projects pre-selected by City staff, were recommended for conceptual and preliminary design.

Concept Design

The team created two alternatives for each location, order of magnitude construction costs, and a schedule of maintenance requirements and costs. In April 2015, the concepts were shared with the TAC and the public at an open house. Based on those comments, as well as comments and questions from property owners and other stakeholders, City staff confirmed the TAC direction on the final concept for each location. The final concepts will move forward to preliminary engineering. The TAC and the public will continue to be involved in refining the design of improvements through the next phase of the project.

Selected Projects:

- 27th Street and Conners Avenue
- 3rd Street and Reed Market Road
- 3rd Street and Roosevelt Avenue
- 3rd Street and Hawthorne Avenue
- Colorado Avenue and Bend Parkway Approach Ramps
- Colorado Avenue - Bond Street to Bend Parkway
- Purcell Boulevard and Neff Road
- Franklin Avenue and 3rd Street
- Greenwood Avenue and 3rd Street
- Greenwood Avenue and 4th Street
- Greenwood Avenue and 6th Street
- Neff Road and Williamson Boulevard



Toolbox of Counter-Measures

Median Refuge

- Allow pedestrians a safe place to wait
- Improve visibility of pedestrian crossings, particularly at un-signalized intersections
- Provide space for supplemental signs on multi-lane roadways

Best Use:

- Curbed, multi-lane roadways
- More than 15,000 ADT on four lane roads
- Intermediate to high travel speeds
- Mixture of pedestrian and vehicle traffic

Four Options:

- Left Side Median
- Right Side Median
- Median with Bicycle Gap

Six Locations:

- 3rd Street & Hawthorne Avenue
- 3rd Street & Roosevelt Avenue
- Greenwood Avenue & 4th Street
- Greenwood Avenue & 6th Street
- Neff Road & Williamson Boulevard
- 27th Street & Conners Avenue

Corner Radii Modification

- Reduce crossing distance for pedestrians
- Improve visibility of pedestrians at intersections
- Reduce speed of turning vehicles

Best Use:

- Corners that were designed to accommodate larger turning vehicles than are now necessary
- Intersections where larger vehicles can turn across a painted median or into an adjacent travel lane
- Intersections with a high number of conflicts between right-turning vehicles and pedestrians

Corridor Modification

- Reduce crossing distance for pedestrians
- Repurpose space in the public right-of-way for people

Best Use:

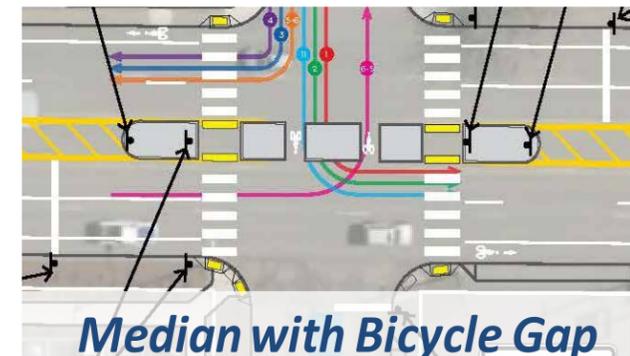
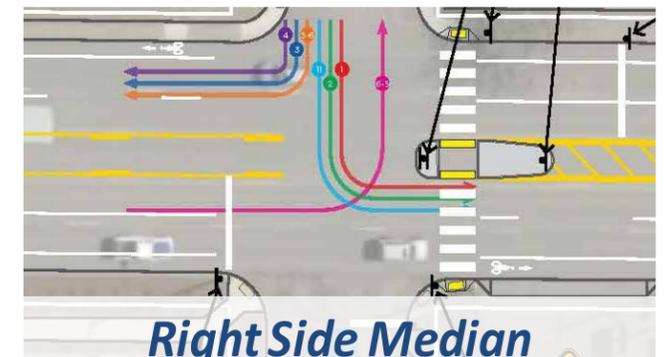
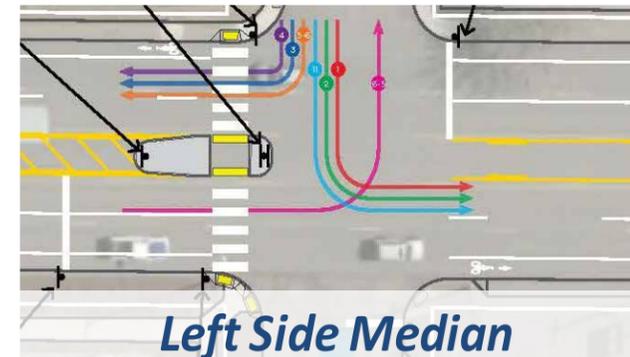
- Roads built wider than needed for existing traffic volumes and desired vehicle speeds
- Corridors with high volumes of pedestrians, or potential for higher pedestrian volumes
- Reducing the opportunity for multiple-threat crashes

Bicycle Safety

- Heighten the level of visibility and awareness of potential conflicts
- Denote a clear right-of-way

May include:

- Color (green)
- Pavement markings
- Signs
- Signal detection



Selection Considerations

The City of Bend Bike and Pedestrian Technical Advisory Committee (TAC) reviewed all of the concepts and identified the preferred option for each location. In reviewing and discussing the concepts, the TAC considered how the conceptual design performs with regard to the following considerations:

- Improved safety for all road users
- Cost efficiency
- Maintenance impacts relative to safety and community benefits
- Community support for each project
- Improvement of access to destinations
- Minimization of real estate property impacts
- Address universal accessibility at transit stops and adjacent destinations
- Coordination with current adopted plans (including the TSP), as well as anticipated development projects

This report presents the concepts developed for each project site. The Preferred Concept presented for each side reflects minor modifications to the design made by the City of Bend as a result of discussion with the TAC, and conversations at the Open House meetings in April 2015.



27th Street & Conners Avenue

TAC Preferred Concept Plan : Option 1

Countermeasures

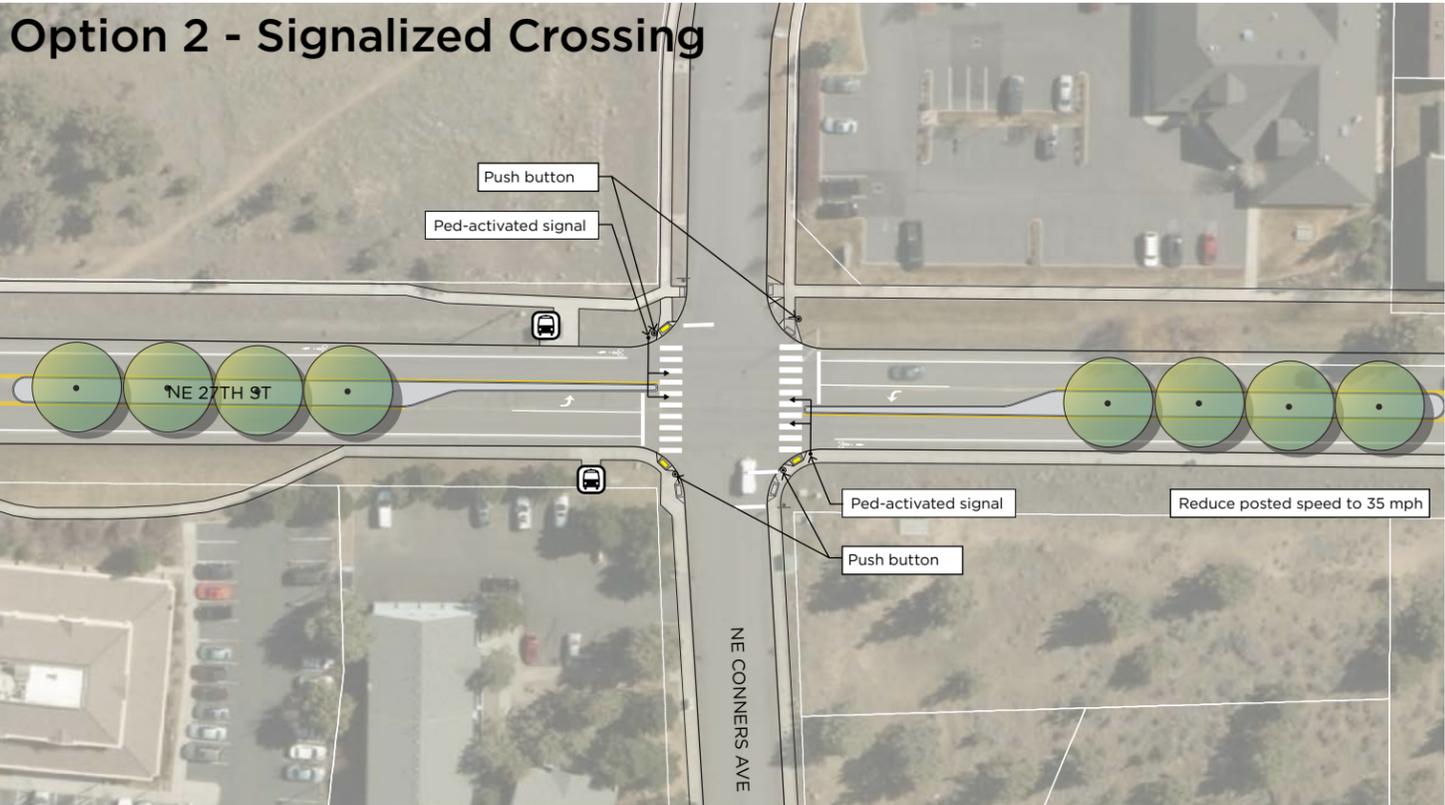
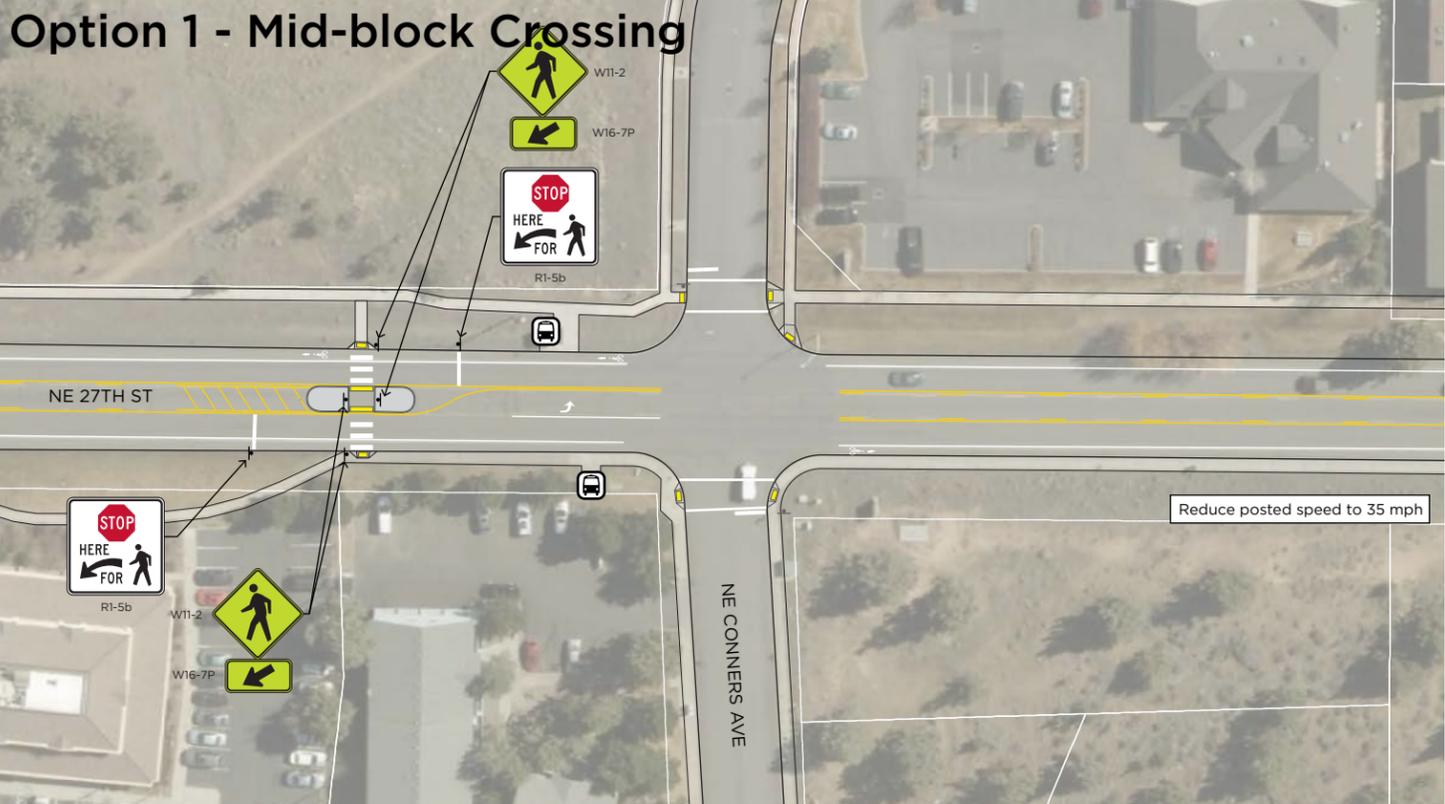
Option 1 features a marked crosswalk, median refuge island and mid-block crossing north of the intersection on 27th Street. Option 1 also includes appropriate pedestrian crossing warning signage (W11-2, W16-7P, and R1-5b). Option 2 calls for the installation of a full traffic signal at the intersection.

Summary of Recommended Improvements

- Add marked crosswalk, mid-block crossing and median refuge island on north leg of intersection

Next Steps

- Coordinate with CET regarding possible bus stop relocation



3rd Street & Reed Market Road

TAC Preferred Concept Plan

Countermeasures

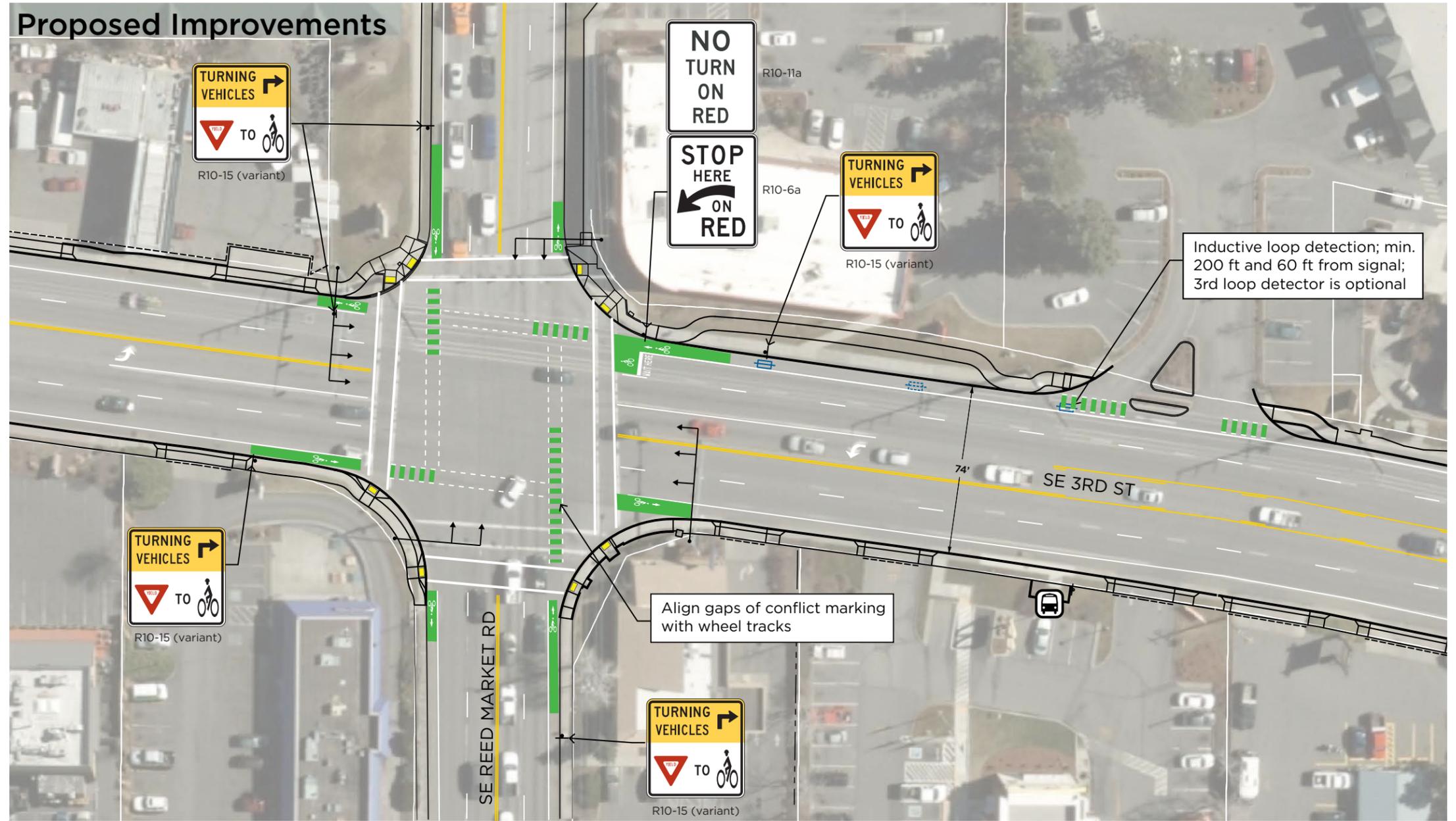
The proposed improvements include features bike lanes on all four legs of the intersection in each direction. The northbound approach on the south leg of the intersection features a green bike box. Bike lanes at intersection approaches are filled with green, and green bike lane line extensions are used in the intersection. Static warning signs are posted to alert right turning motorists of the presence of bicycles proceeding straight through the intersection.

Summary of Recommended Improvements

- Bicycle safety improvements through the intersection to reduce the potential for “right hook” crashes
- Add green fill in bike lanes at intersection approaches, and green bike box on south leg of intersection. No right turn allowed on red light.
- Add continuous bike lane line extension through intersection, supplemented with green fill between dashed line extension
- Add static warning signs (R10-15 Variant) to traffic signal mass arms and intersection approaches
- Add inductive loop detection; min. 200ft and 60 ft from signal; 3rd loop detector is optional.

Next Steps

- Consider a dynamic flashing warning sign in future phases



3rd Street & Roosevelt Avenue

TAC Preferred Concept Plan : Option 2

Countermeasures

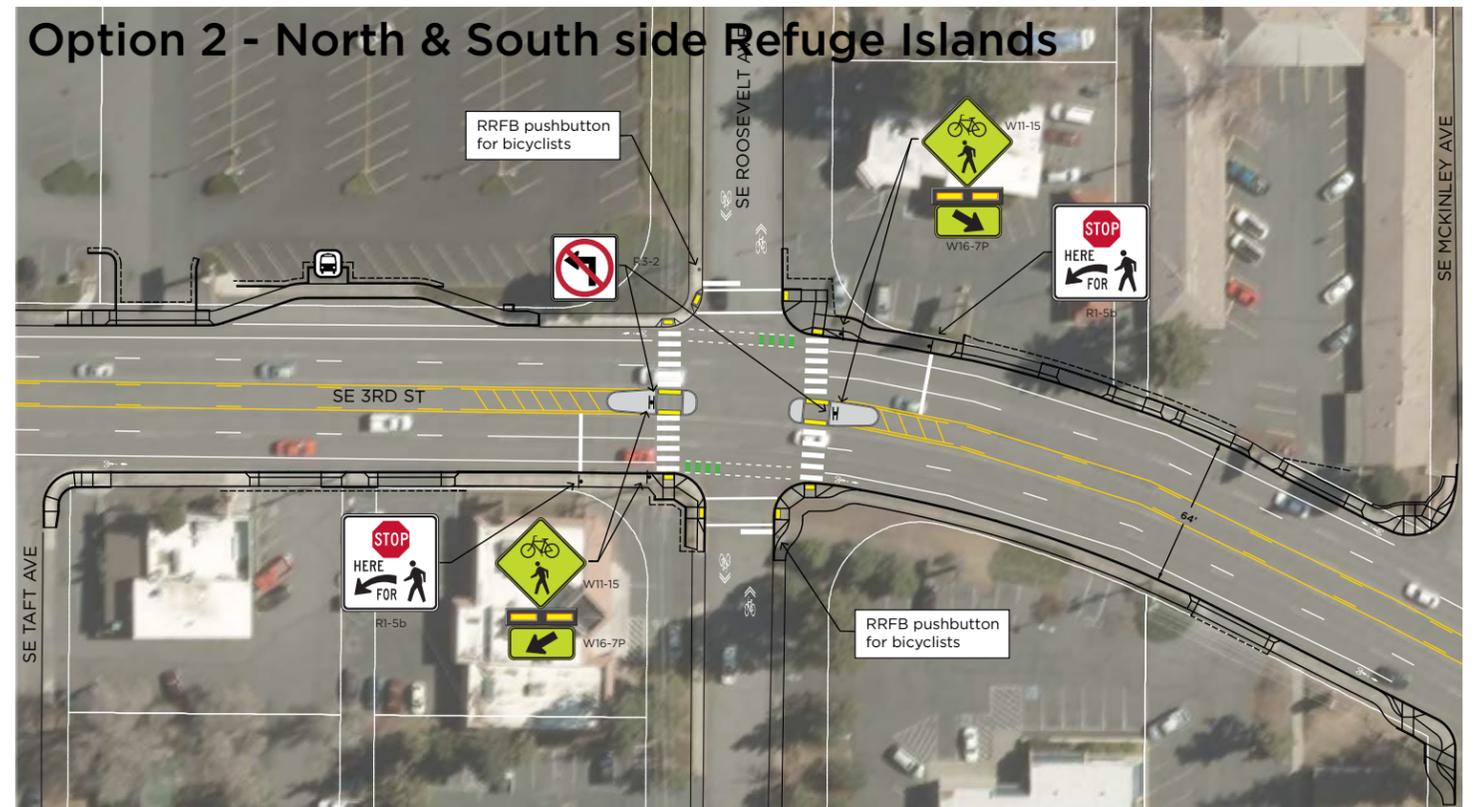
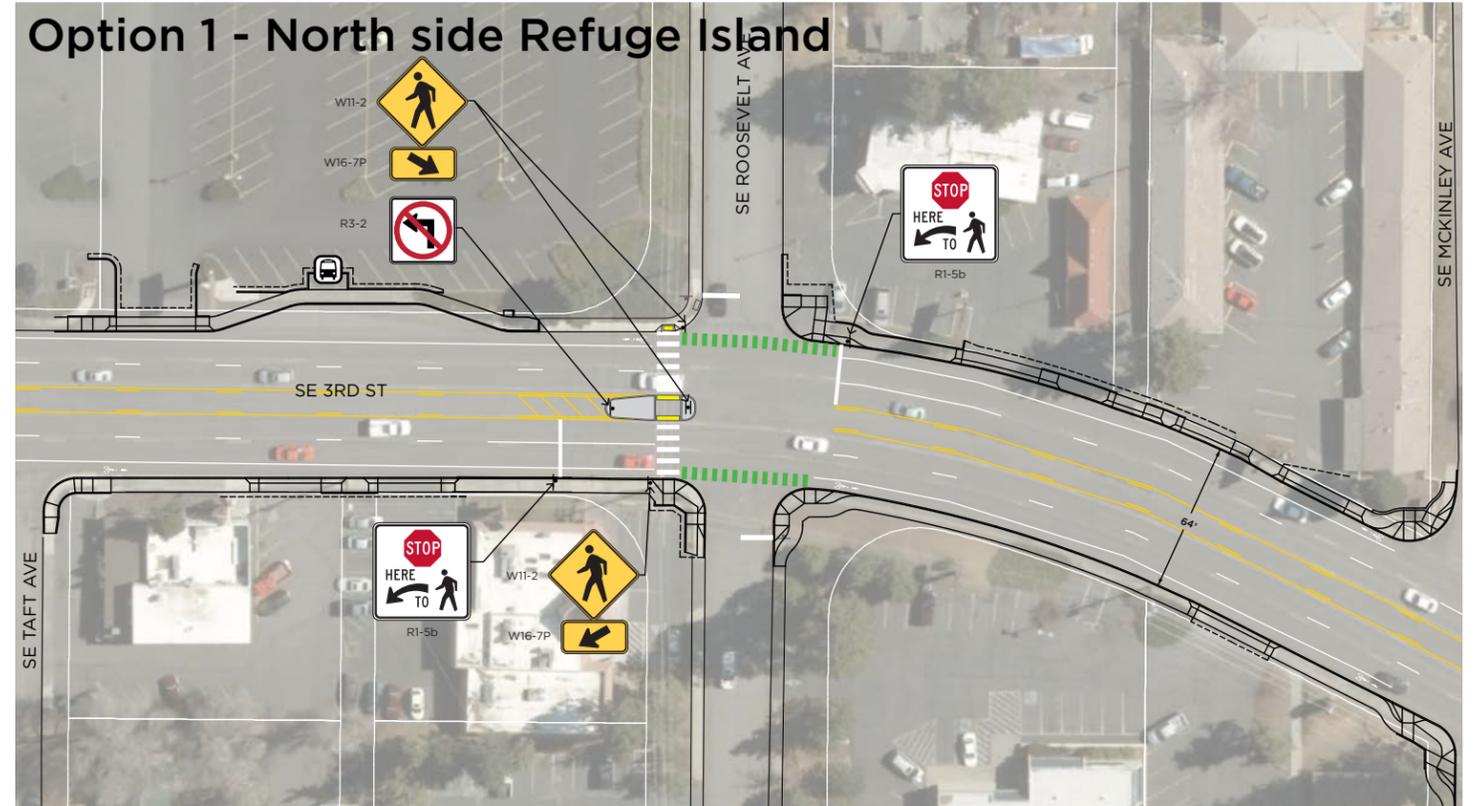
Option 1 features a marked crosswalk, median refuge island and warning signage on the north end of the intersection. Option 2 features a marked crosswalk, median refuge island, pedestrian crossing warning and Rectangular Rapid Flash Beacons (RRFB) on both the south and north sides of the intersection.

Summary of Recommended Improvements

- Add marked crosswalks, with refuge islands at Roosevelt
- Add median refuge island on north and south legs of intersection
- Add Rectangular Rapid Flash Beacons (RRFB)
- Add pedestrian crossing warning signage
- Add continuous bike lane line extension through intersection. Supplement with green fill between dashed line extensions

Next Steps

- Additional traffic study needed for RRFB



3rd Street & Hawthorne Avenue

TAC Preferred Concept Plan : Option 1B

Countermeasures

Option 1A features a median refuge island on the North side of the intersection. Option 1B features a median refuge island on the south side of the intersection. Option 2 features a full median refuge/diverter. Additionally, Option 1B features a Rectangular Rapid Flash Beacon (RRFB). Option 1B is preferred by CET for current bus turning movements.

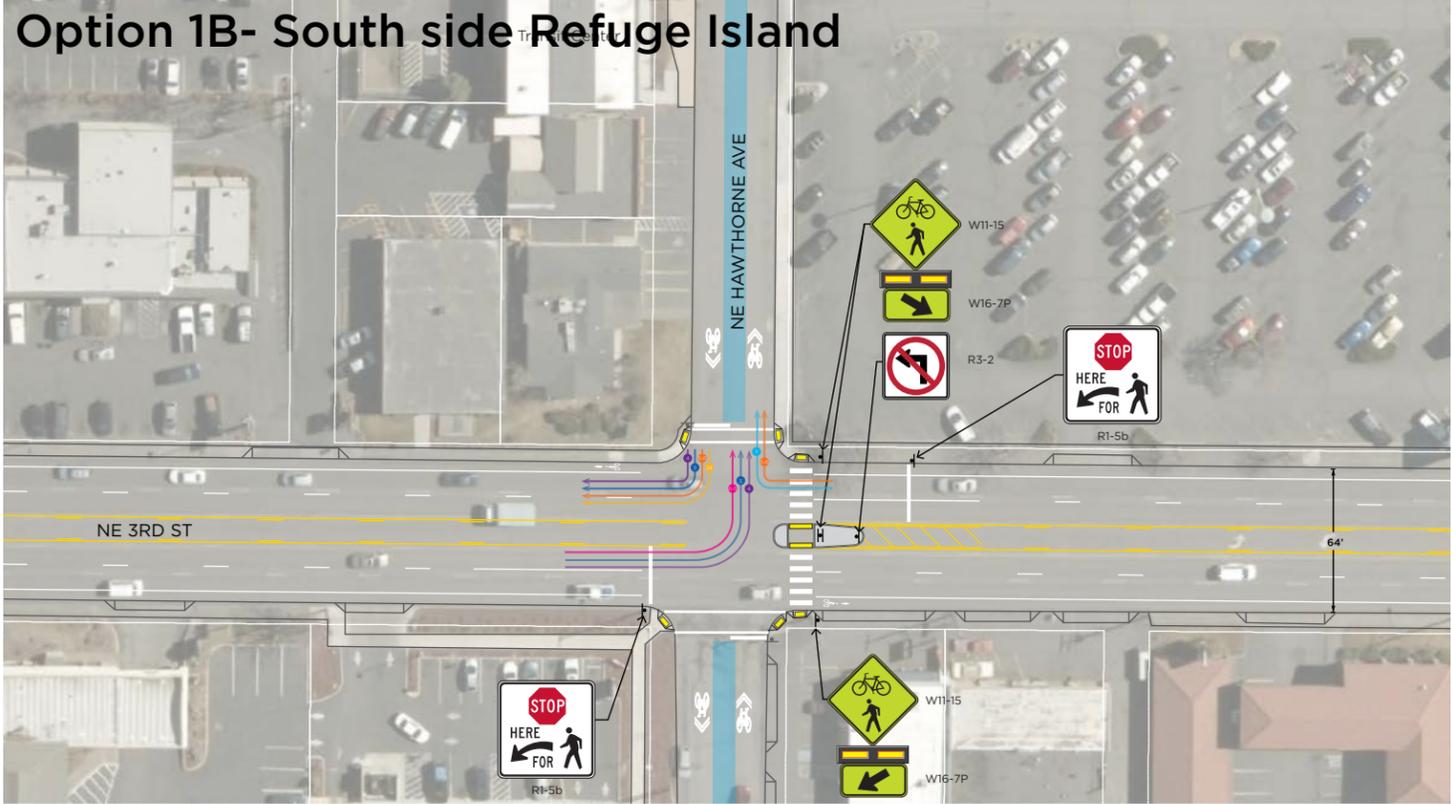
Summary of Recommended Improvements

- Add marked crosswalk, with refuge island at Hawthorne
- Add median refuge island on south leg of intersection
- Add Rectangular Rapid Flash Beacon (RRFB)
- Add pedestrian crossing warning signage
- Add shared lane markings for Hawthorne Avenue Bike Boulevard

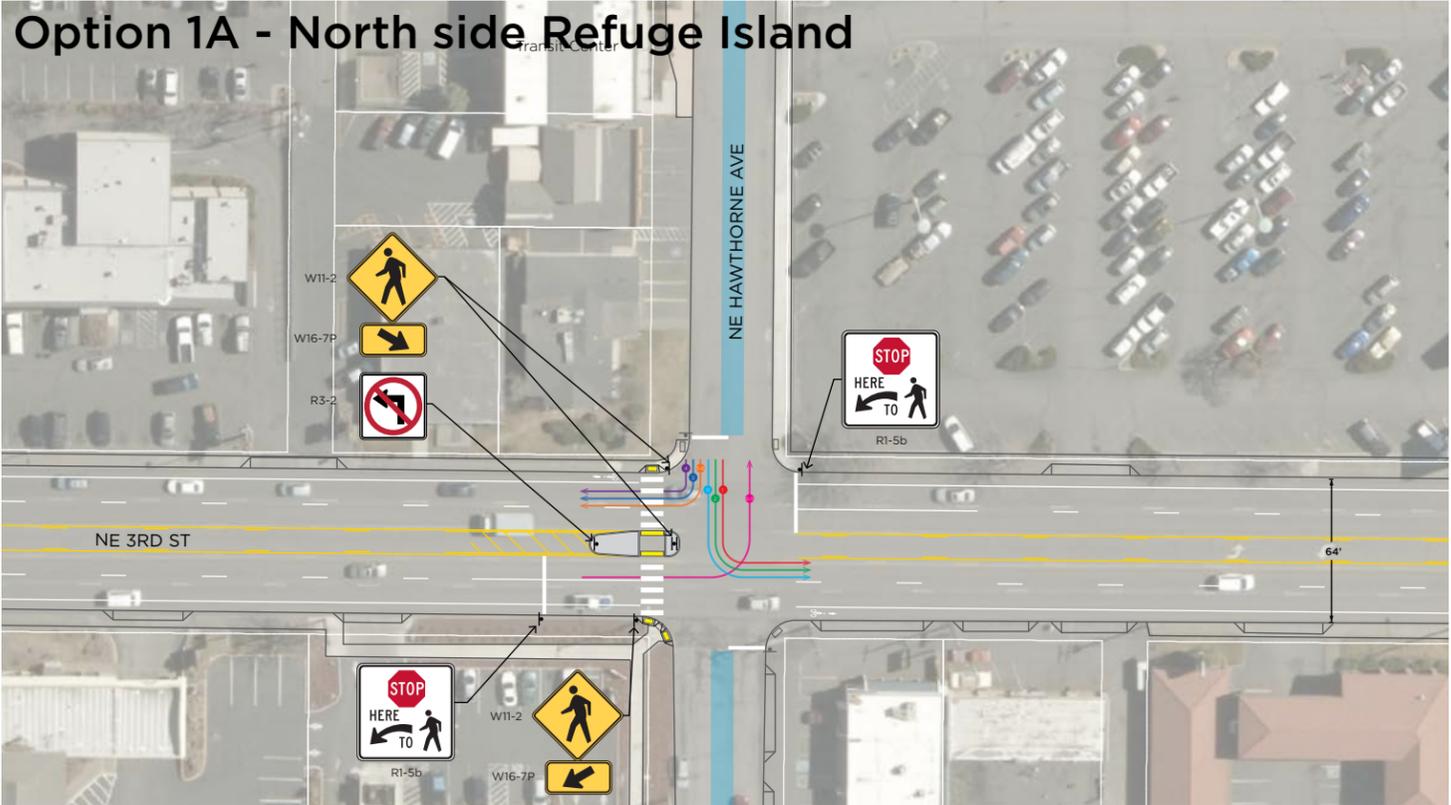
Next Steps

- Additional traffic study needed for RRFB

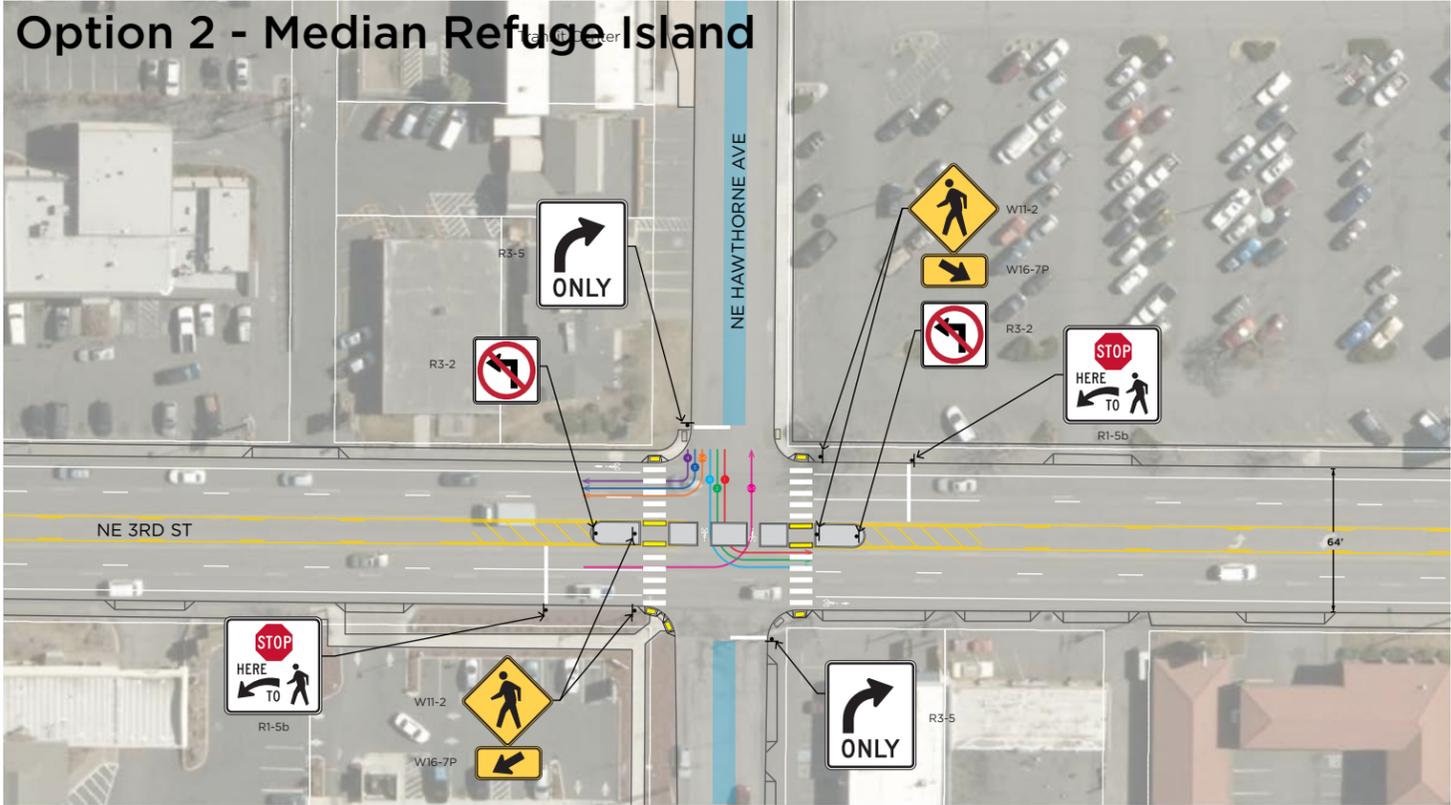
Option 1B- South side Refuge Island



Option 1A - North side Refuge Island



Option 2 - Median Refuge Island



Colorado Avenue & Bend Parkway Ramps

TAC concept Plan : Option 1

Countermeasures

Option 1 features a bike signal for the diagonal intersection crossing and the addition of curb extensions to facilitate shorter pedestrian crossing distances and improved visibility. Option 1 also brings southbound cyclists onto the sidewalk path as they approach the intersection. Option 2 is a simpler version of Option 1 without a bike signal for the diagonal crossing or rerouting the bike lane to the sidewalk path. Option 2 also channelizes the bike lane with a concrete island at the west end the intersection.

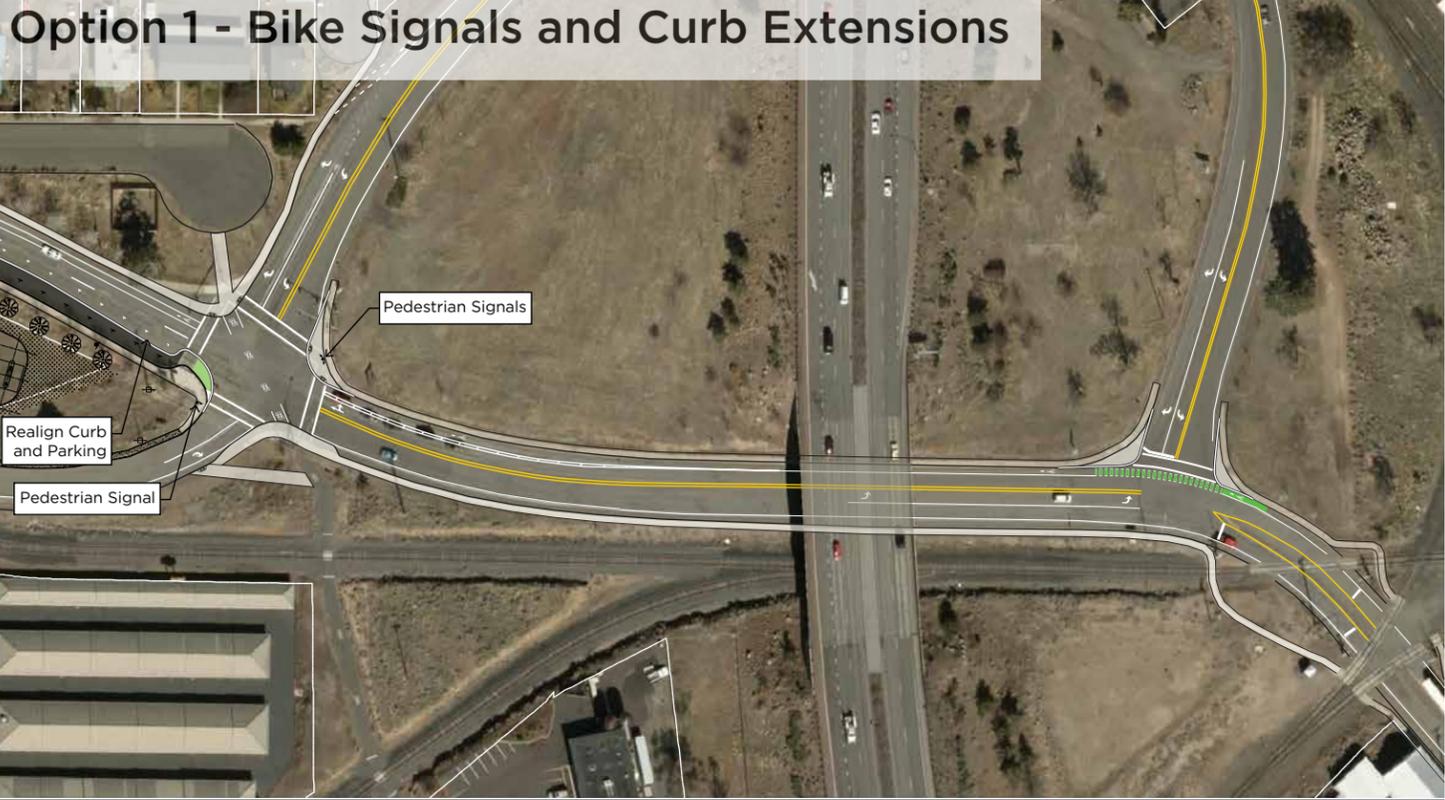
Summary of Recommended Improvements

- Improve bicycle and pedestrian safety for crossing of Colorado Avenue and Parkway Ramps
- Add diagonal bike signal at NW corner of western ramp
- Tighten radius of SW corner and shorten diagonal crossing distance
- Move stop bars up, extend curbs to reduce crossing distances and increase visibility
- Add continuous bike lane line extension through intersection. Supplement with green fill between dashed line extension
- Add pedestrian signals to intersection
- Realign curb and parking

Next Steps

- Additional traffic analysis of freight mobility, signal design and change approvals needed

Option 1 - Bike Signals and Curb Extensions



Option 2 - Curb Extensions



Colorado Avenue - Bond Street to Bend Parkway

TAC Preferred Concept Plan : Option 2

Countermeasures

Option 1 features a 7 ft buffered bike lane with one parking lane on the south side of the street. Option 2 features a protected bike lane with an additional row of parking adjacent to the protected bike lane.

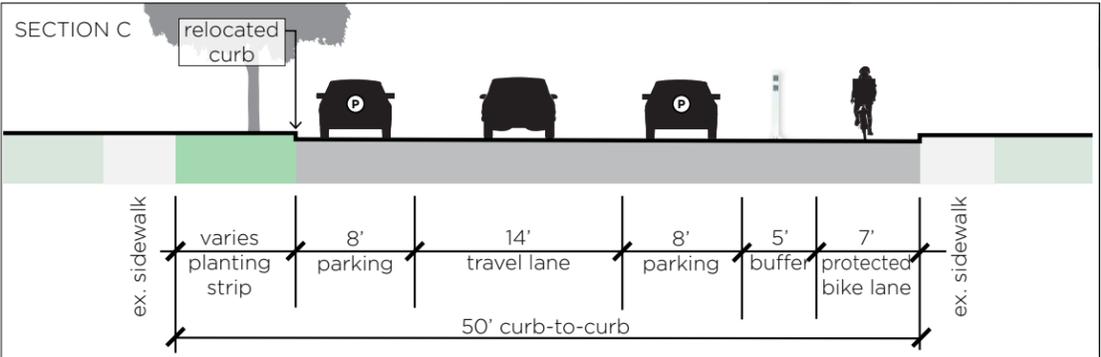
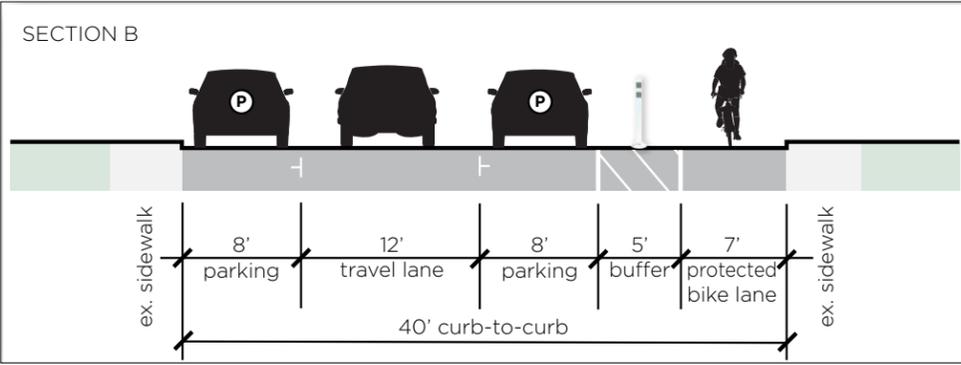
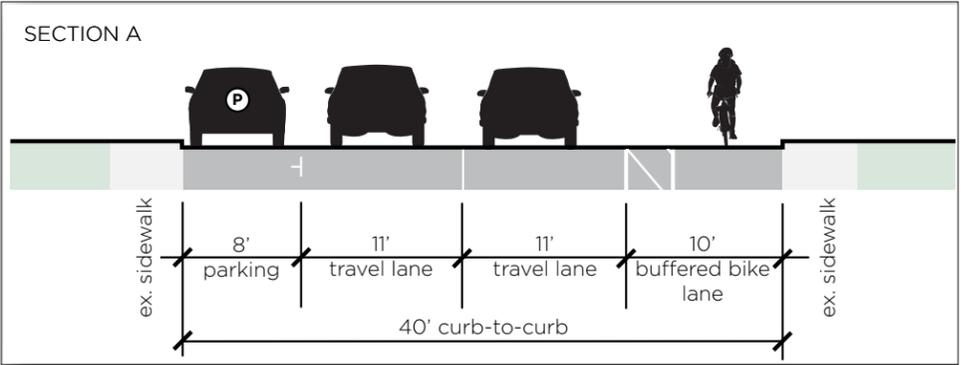
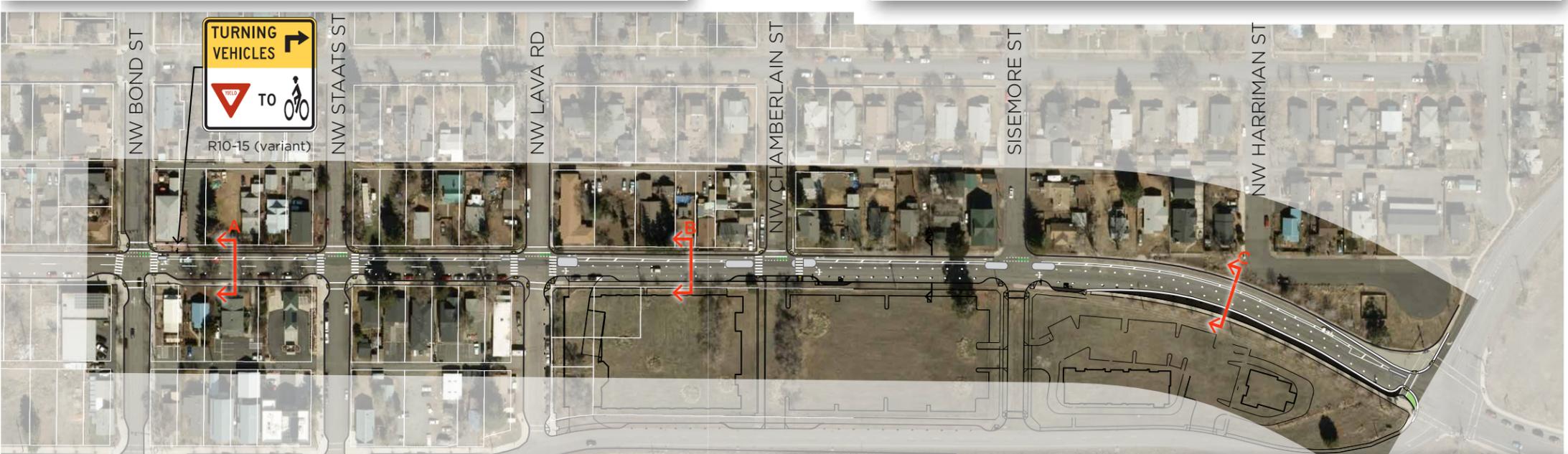
Summary of Recommended Improvements

- Add protected bike lane on north side of Colorado Ave
- Add marked continental crosswalks and median refuge islands at all intersections
- Add continuous bike lane line extension through intersection. Supplement with green fill between dashed line extension
- Reduce posted speed limit from 30mph to 20-25 mph

Next Steps

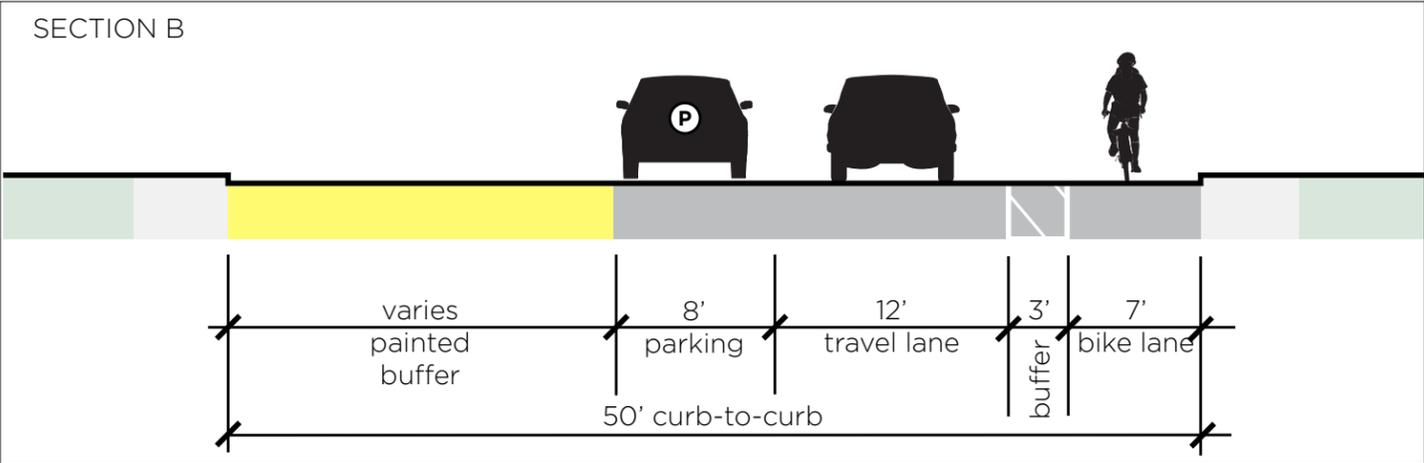
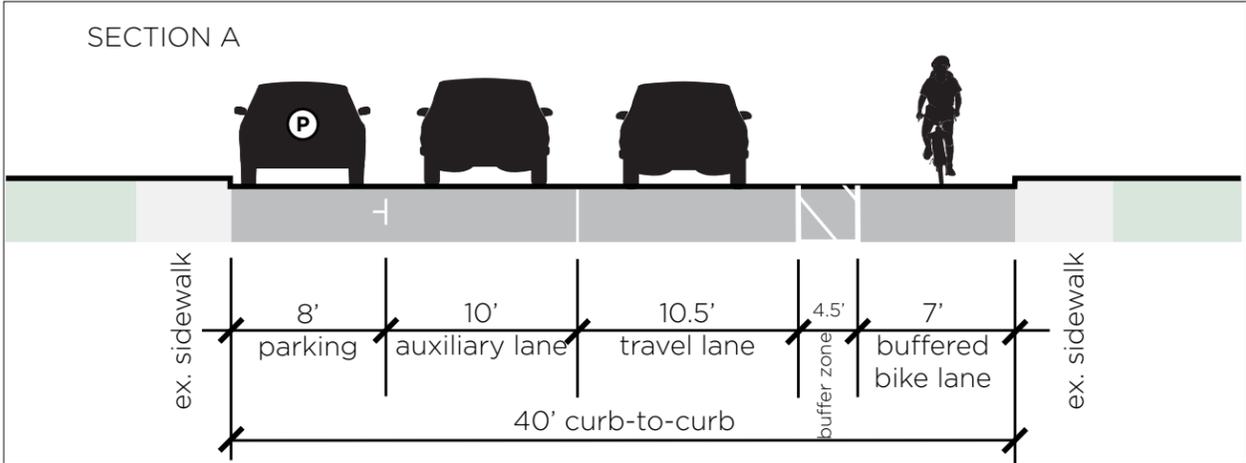
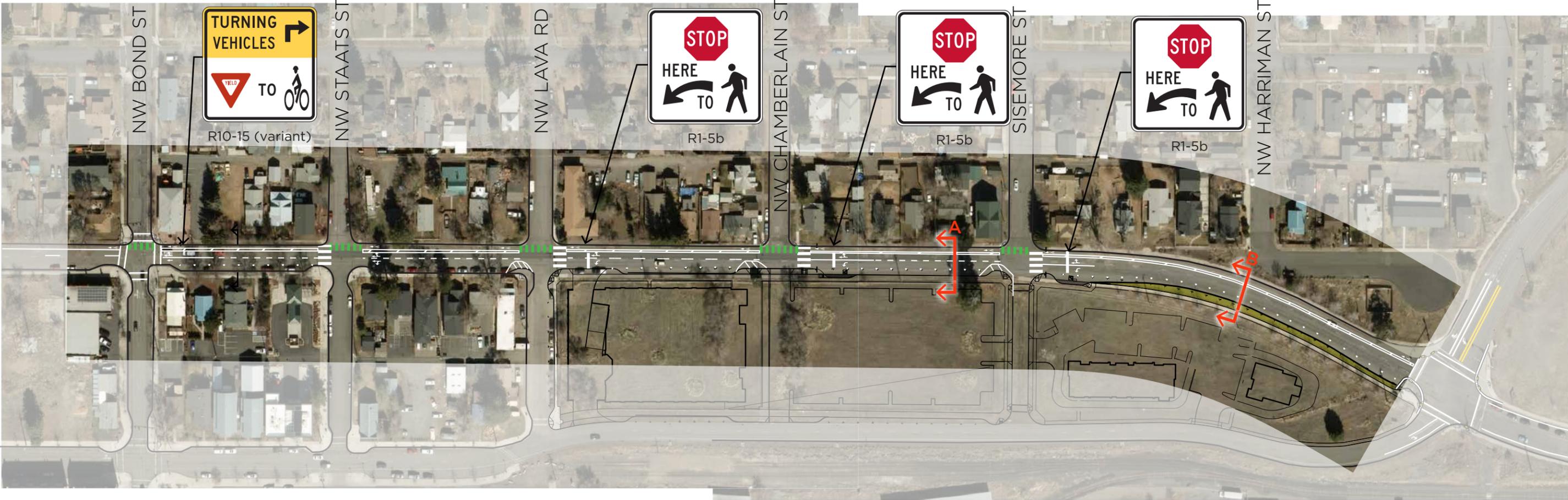
- Additional traffic analysis to study freight mobility
- Consider mixing zones for protected bike lane and right turning vehicles at east leg of each intersection

Option 2 - Protected Bike Lane/Buffered Bike Lane



Colorado Avenue - Bond Street to Bend Parkway

Option 1 - Buffered Bike Lane



Purcell Boulevard & Neff Road

TAC Preferred Concept Plan : Option 1

Countermeasures

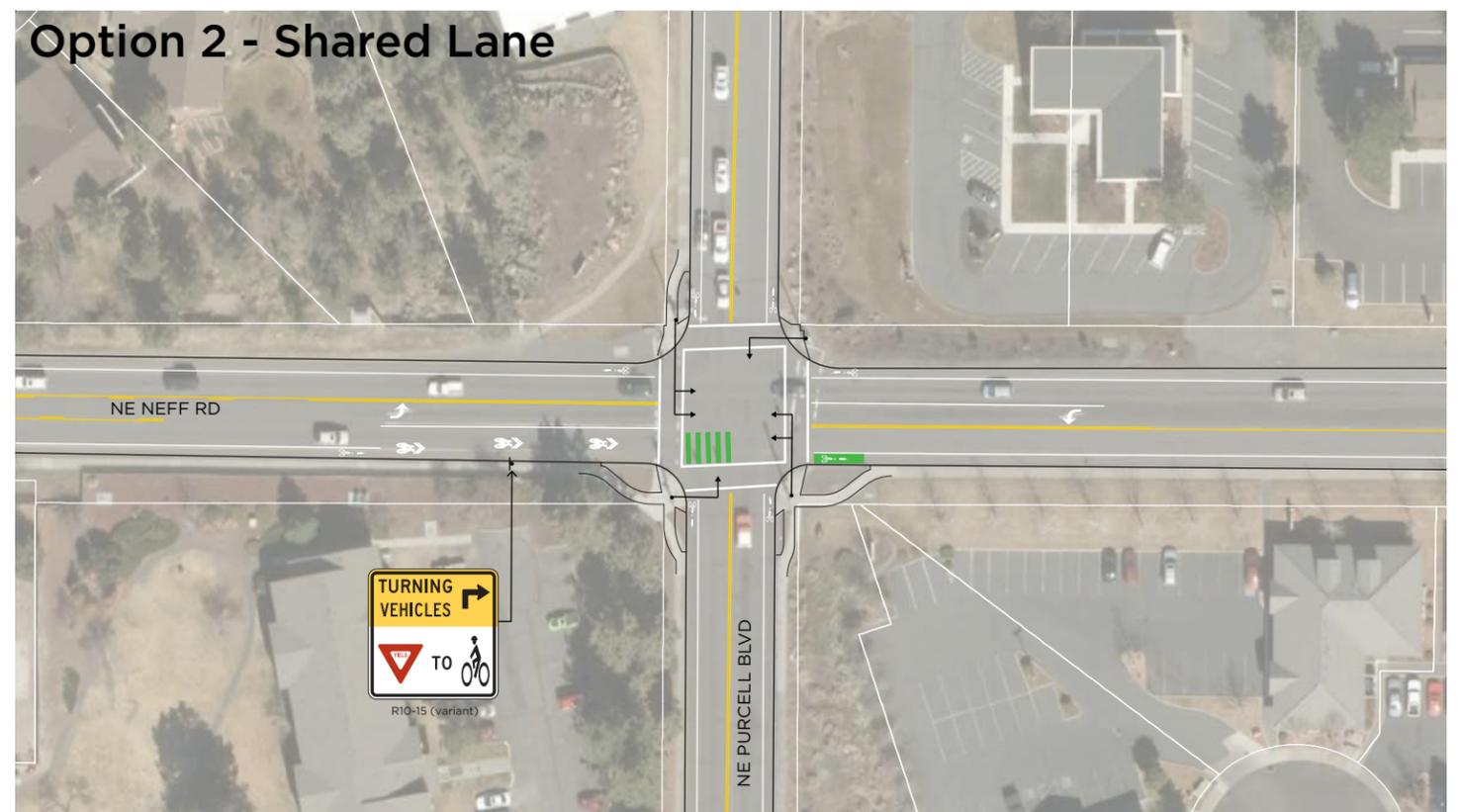
Option 1 features a bike lane on all four legs of the intersection in each direction. The eastbound approach on the west leg of the intersection features a green bike box. Green bike lane line extensions are used in the intersection to draw attention to conflict areas. A static warning sign is posted to alert right turning motorists of the presence of bicycles proceeding straight through the intersection. Option 2 features a shared turn lane on the eastbound approach of the west leg of the intersection, and bike lanes in all other directions.

Summary of Recommended Improvements

- Add Green bike boxes on North and South legs of intersection only
- Add continuous bike lane line extension through intersection. Supplement with Green fill between dashed line extension.
- Add Stop Here on Red Signage (R10-6a) on SW corner of intersection
- Add No Turn on Red Signage (R10-11a) on SW corner of intersection
- Add static warning signs (R10-15 Variant) to traffic signal mass arms and intersection approaches

Next Steps

- Additional traffic analysis: Intersection Form Evaluation



Franklin Avenue & 3rd Street

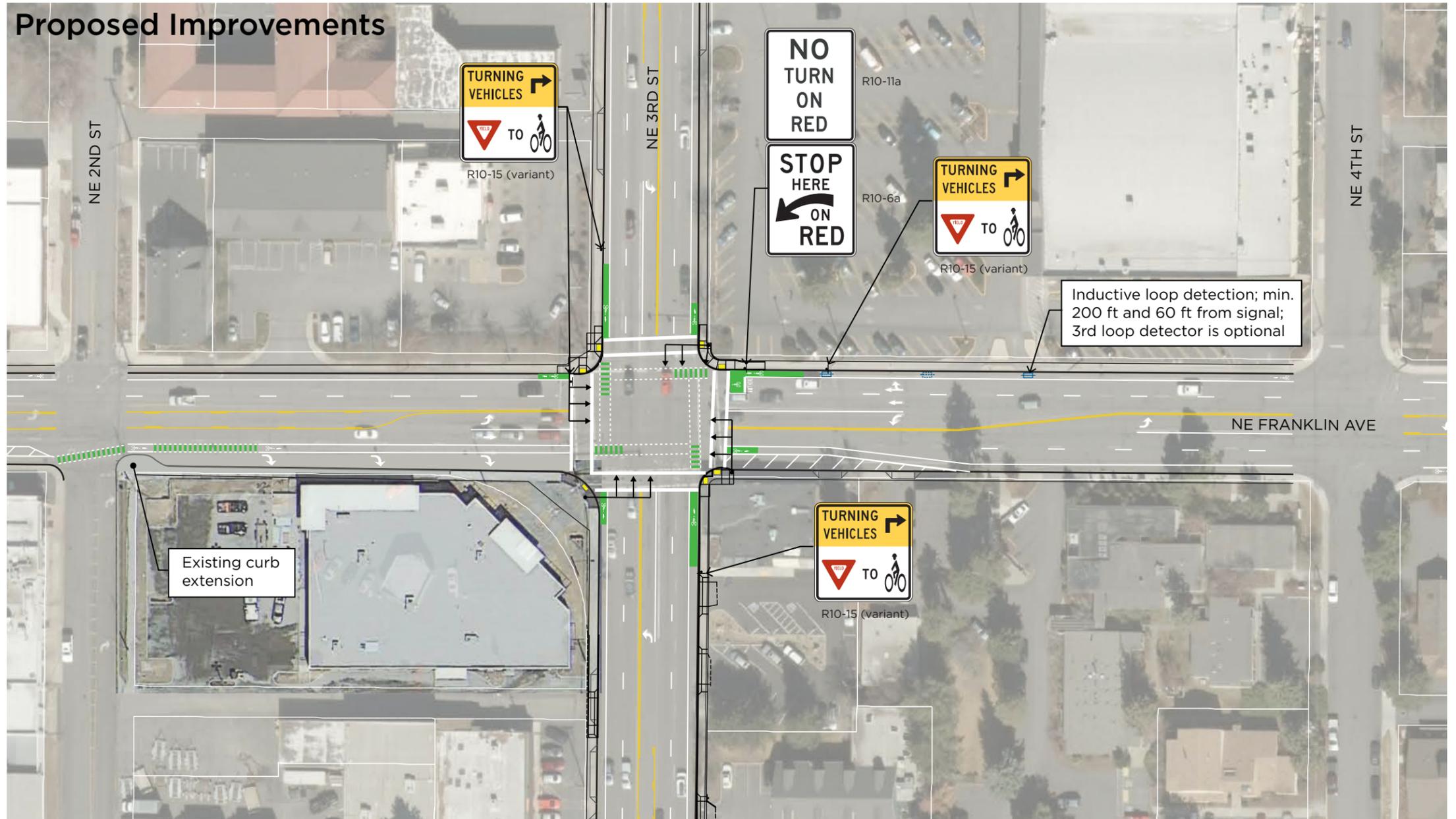
TAC Preferred Concept Plan

Countermeasures

The proposed improvements include features bike lanes on all four legs of the intersection in each direction. The westbound approach on the east leg of the intersection features a green bike box. Green bike lane line extensions are used in the intersection and along Franklin Ave to draw attention to conflict areas. Static warning signs are posted to alert right turning motorists of the presence of bicycles proceeding straight through the intersection.

Summary of Recommended Improvements

- Bicycle safety improvements through the intersection to reduce the potential for “right hook” crashes
- Add inductive loop detection; min. 200ft and 60 ft from signal; 3rd loop detector is optional
- Add continuous bike lane line extension through intersection. Supplement with green fill between dashed lane line extension
- Add continuous bike lane line extension across driveway. Supplement with green fill between dashed lane line extension
- Add static warning signs (R10-15 Variant) to traffic signal mass arms and intersection approaches



Greenwood Avenue and 3rd Street

TAC Preferred Concept Plan : Option 2

Countermeasures

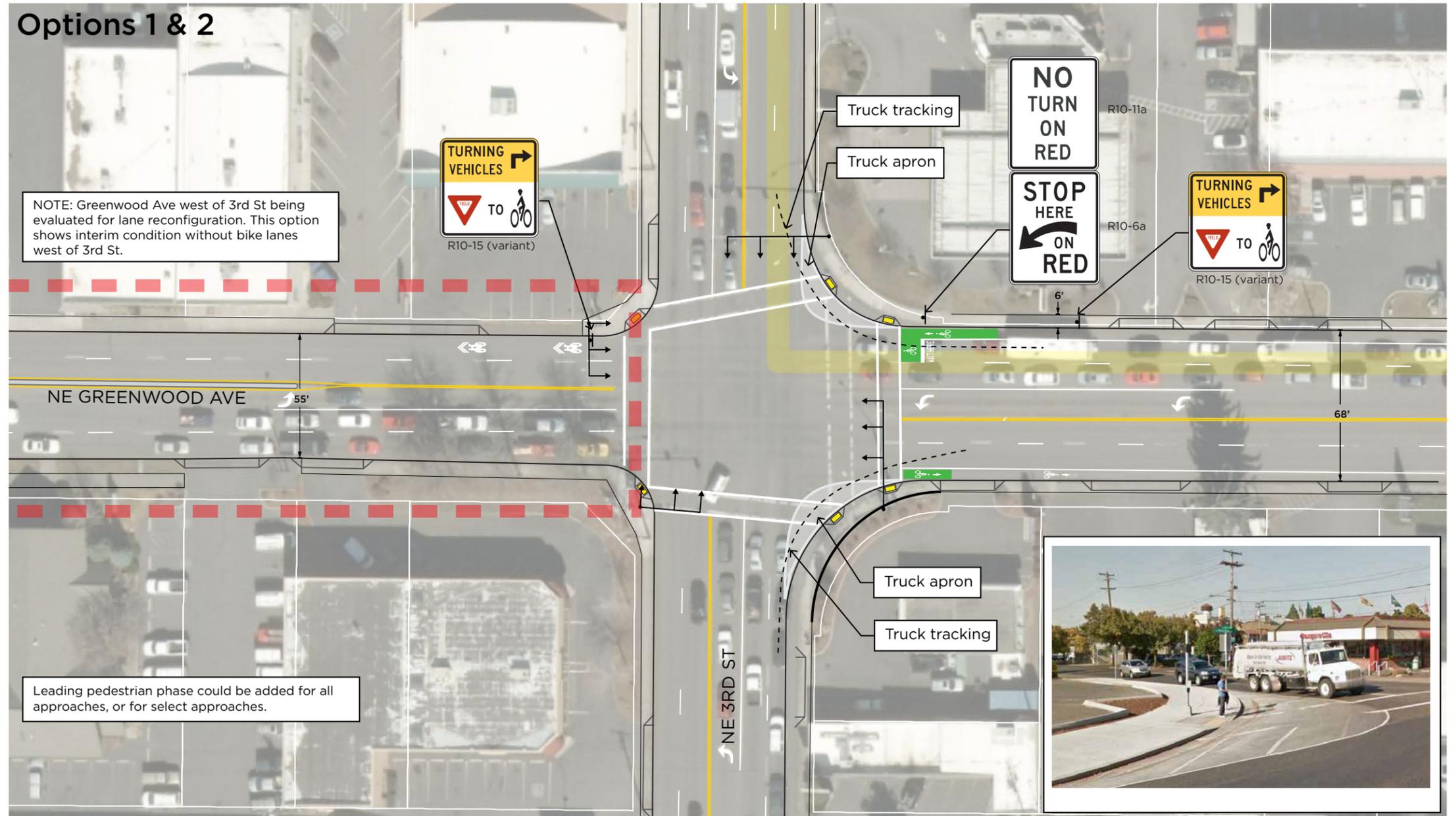
Option 1 features truck turning aprons on the NE and SE corners of the intersection to allow larger freight access while still providing a tighter turn radius for other vehicles. It also provides a bike lane on the east leg of the intersection. On the NE corner of the intersection (eastbound approach) is a bike box to provide cyclists a headstart after a red light and improve visibility. Option 2 is similar to Option 1 but also provides a leading pedestrian interval to give pedestrians a headstart and make them more visible to turning vehicles.

Summary of Recommended Improvements

- Modify intersection to improve safety for pedestrians while allowing for freight access and turning movements.
- Add truck turning aprons
- Add No Right Turn on Red signage (R10-11a)
- Add Leading Pedestrian Interval
- Add Stop Here on Red (R10-6a) and Turning Vehicles to Bicycles (R10-15 Variant) signage

Next Steps

- Additional traffic analysis including: freight mobility, crosswalk marking, queuing
- Perform traffic analysis for No Right Turn on Red movements



Greenwood Avenue & 4th Street

TAC Preferred Concept Plan : Option 2

Countermeasures

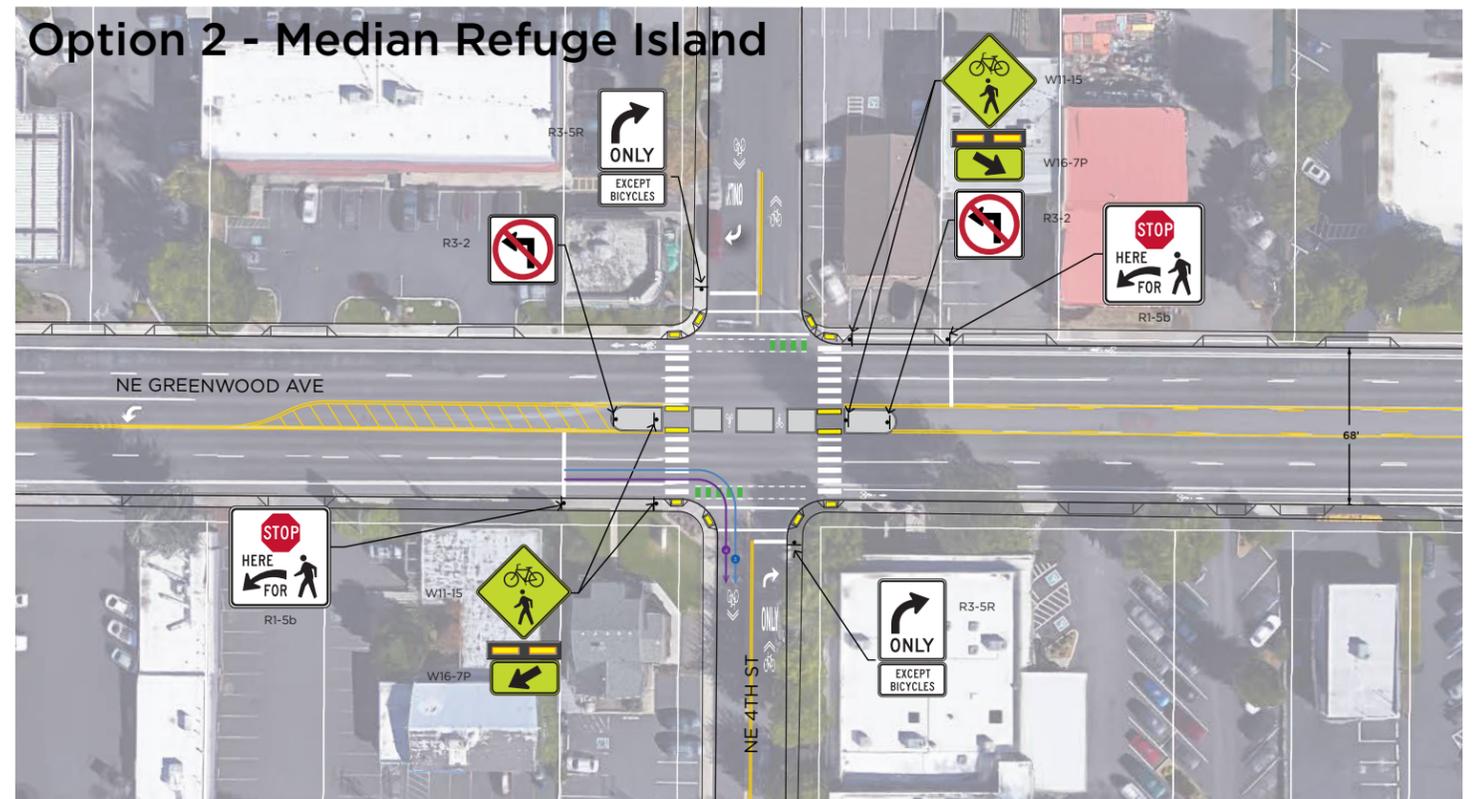
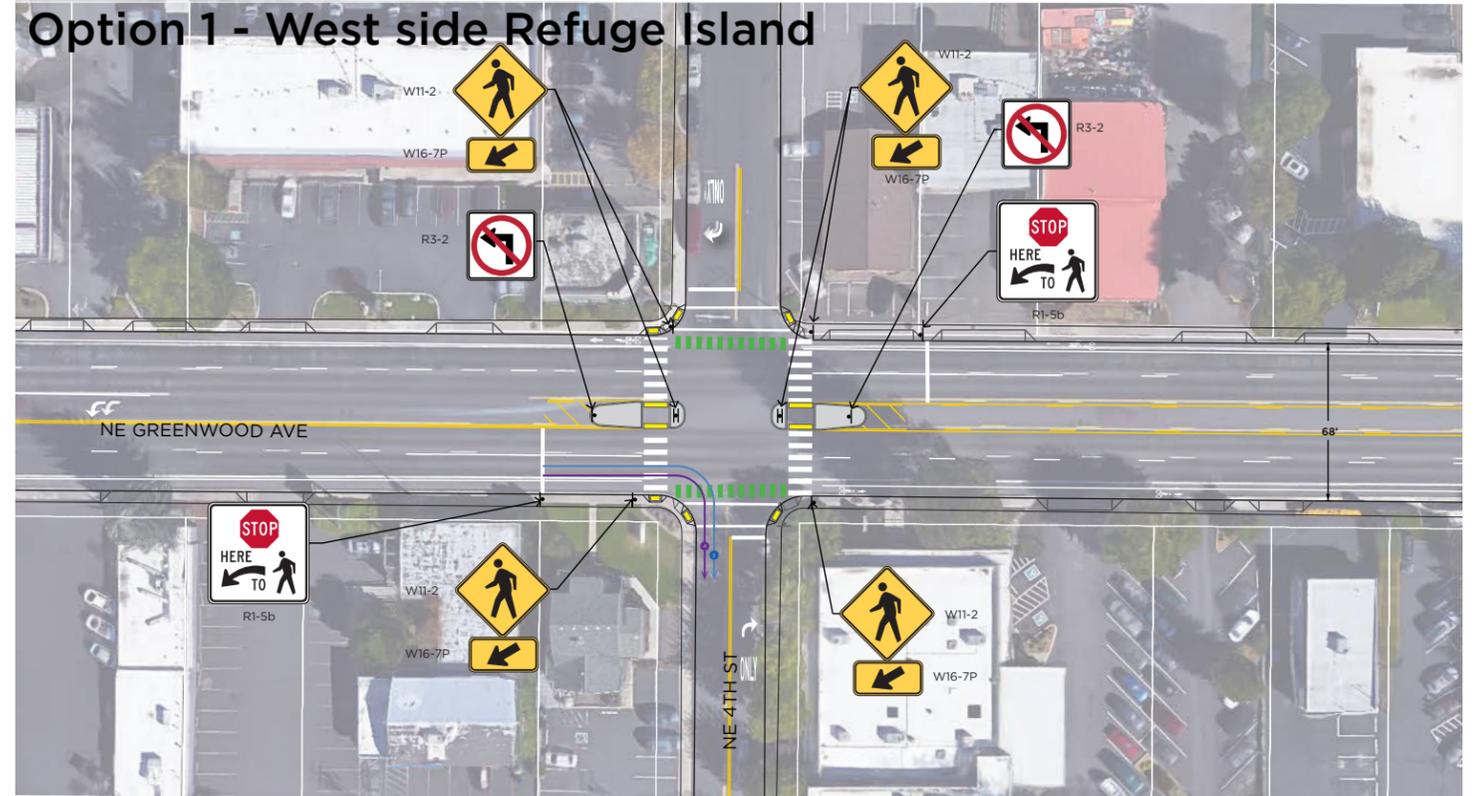
Option 1 features median islands on the east and west legs of the intersection. Option 2 features a full median refuge island/diverter prohibiting left turns and through traffic on 4th Street. The traffic diverter also has bicycle cut throughs for bicycle traffic on 4th Street.

Summary of Recommended Improvements

- Add traffic diverter to prevent N-S through travel. Also add cut throughs for pedestrian refuge and N-S bike movements
- Add bike push buttons
- Add continuous bike lane line extension through intersection. Supplement with green fill between dashed line extension
- Add marked crosswalks at all intersection legs
- Add Rectangular Rapid Flash Beacons (RFFB) and pedestrian/bike warning signage (W11-15, W16-7P)
- Add No Right Turn on Red signage (R3-2)
- Add Stop Here for Pedestrians signage (R1-5b)

Next Steps

- Additional traffic analysis needed, including freight mobility, crosswalk marking, queuing, and the need for a Rectangular Rapid Flash Beacon (RRFB)



Greenwood Avenue & 6th Street

TAC Preferred Concept Plans

Countermeasures

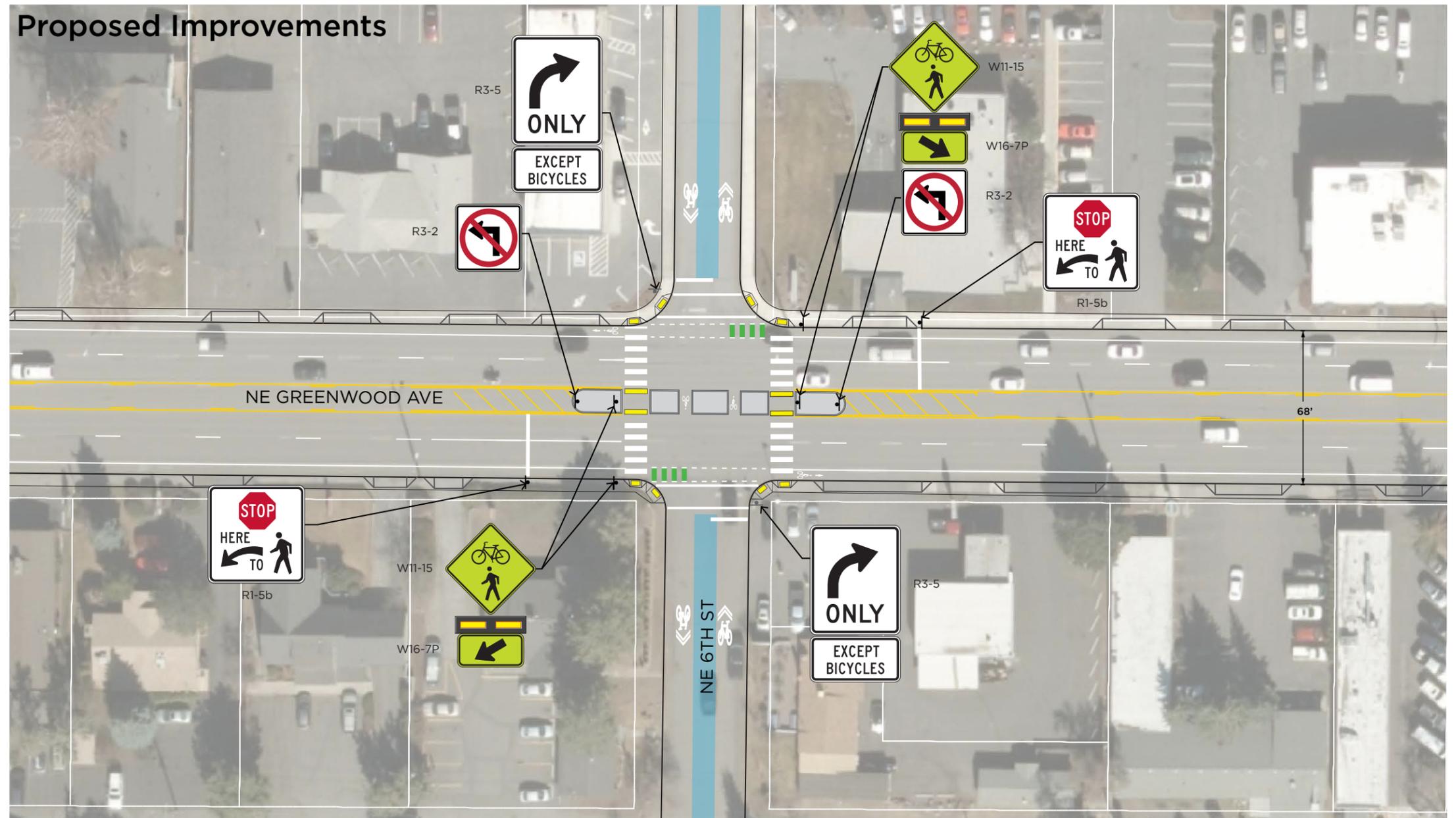
The proposed improvement includes the addition of a full median refuge island/traffic diverter prohibiting through vehicle travel on 6th Street. The diverter features cut throughs allowing bikes to continue traveling in the N-S direction. The median refuge island also features Rectangular Rapid Flash Beacons (RRFB) to warn drivers of pedestrians/bikes attempting to cross the street.

Summary of Recommended Improvements

- Add traffic diverter to prevent N-S through vehicle travel. Also add cut throughs for pedestrian refuge and N-S bike movements
- Add continuous bike lane line extension through intersection. Supplement with green fill between dashed line extension
- Add marked crosswalks at all intersection legs
- Add Rectangular Rapid Flash Beacons (RRFB) and pedestrian/bike warning signage (W11-15, W16-7P)
- Add No Right Turn on Red signage (R3-2)
- Add Stop Here for Pedestrians signage (R1-5b)
- Add Right Turn Only signage (R3-5) on NW and SE corners of intersection

Next Steps

- Additional traffic analysis needed including; freight mobility, crosswalk marking, queuing, and the need for a Rectangular Rapid Flash Beacon (RRFB)



Neff Road and Williamson Boulevard

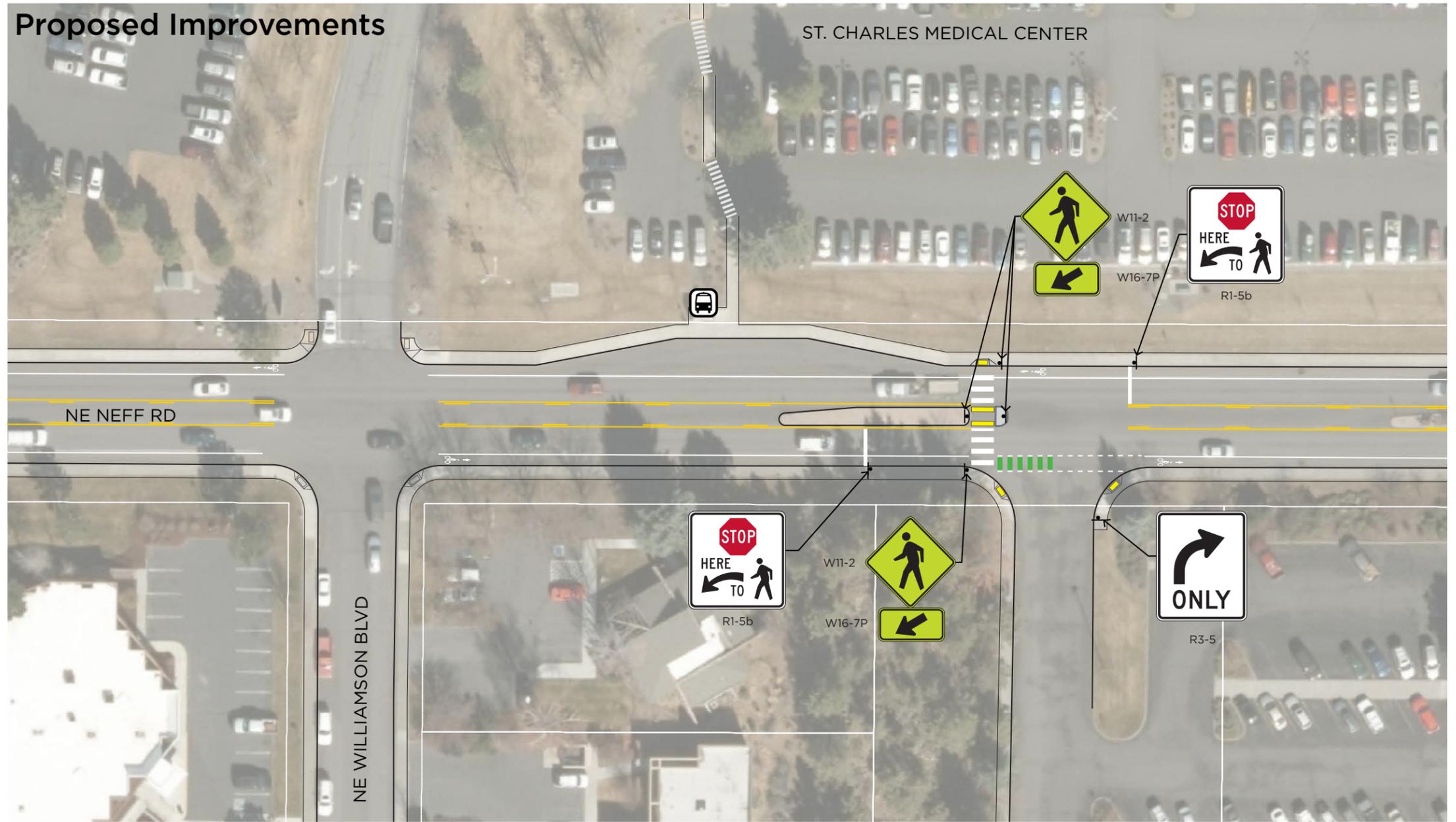
TAC Preferred Option Proposed Improvements

Countermeasures

The proposed improvement includes the addition of a full median refuge island/traffic diverter prohibiting through vehicle travel on 6th Street. The diverter features cut throughs allowing bikes to continue traveling in the N-S direction. The median refuge island also features Rectangular Rapid Flash Beacons (RRFB) to warn drivers of pedestrians/bikes attempting to cross the street.

Summary of Recommended Improvements

- Add median refuge island and marked crosswalk on the west leg of intersection
- Add Pedestrian crossing warning signage (W11-2, W16-7P)
- Add Stop Here for Pedestrian signage (R1-5b)
- Add Right Turn Only signage (R3-5) on SE corner of intersection
- Add continuous bike lane line extension through intersection. Supplement with green fill between dashed line extension



Cost Estimate Summary

Prepared by Century West

City of Bend Safety Implementation Plan

Conceptual Cost Estimate Summary of Options

Construction Cost Estimate

3rd St. & Hawthorne Ave.

Option 1a - North Side Refuge Island	\$140,500
Option 1b - South Side Refuge Island	\$139,200
Option 2 - Median Refuge Island	\$198,300

3rd St. & Roosevelt Ave.

Option 2 - North & South Side Refuge Islands	TBD
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Greenwood Ave. & 4th St.

Option 1 - West Side Refuge Island	\$153,000
Option 2 - Median Refuge Island	\$182,300

Greenwood Ave. & 6th St.

Option 1 - Median Refuge Island	\$178,400
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Greenwood Ave. & 3rd St.

Option 1 - Truck Apron	\$293,000
Option 2 - Leading Pedestrian Interval	\$2,600

Colorado Ave. - Bond St. to Chamberlain St.

Option 1 - Protected Bike Lane / Buffered Bike Lane	\$273,100
Option 2 - Raised Bike Lane	\$440,400.00

Colorado Ave. - Chamberlain St. to Bend Parkway

Option 1 - Protected Bike Lane	\$358,600.00
Option 2 - Raised Bike Lane	\$339,100.00

Purcell Blvd. & Neff Rd.

Option 1 - Dynamic Warning Sign	\$155,300.00
Option 2 - Shared Lane	\$16,800.00

3rd St. & Franklin Ave.

Option 1 - Reconfigure Lanes/Dynamic Warning Sign	\$188,000.00
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3rd St. & Reed Market Rd.

Option 1 - Dynamic Warning Sign	\$190,800.00
Option 2 - Protected Intersection	

Neff Rd. & Williamson Blvd.

Option 1 - West Side Refuge Island	\$56,200.00
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27th St. & Conners Ave

Option 1 - Mid-Block Crossing	\$176,200.00
Option 2 - Signalized Crossing	\$847,600.00

Colorado Ave. & Bend Parkway Ramps

Option 1 - Bike Signals and Curb Extensions	\$514,700.00
Option 2 - Curb Extensions	\$495,400.00