



TECHNCIAL MEMORANDUM 5 - DRAFT

DATE: July 19, 2023

TO: Project Team

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SUBJECT: US 97 at Reed Market Road Operations and Safety Study
Preferred Alternatives - DRAFT

Project #22129-001

This memorandum documents the process of developing and evaluating the preferred alternatives within the study area for the US 97 at Reed Market Road Operations and Safety Study. A set of preferred alternatives was selected for each of the study intersections based on input from the project advisory committees. These alternatives were then evaluated using a microsimulation model to assess the compatibility and effectiveness of the study intersection improvements within the overall network. The network performance of the evaluated alternatives and key findings from the analysis are discussed in more detail below.

PROCESS FOR DEVELOPING AND EVALUATING CONCEPTS

Based on the needs identified in *Technical Memoranda #1-3* and prior planning project recommendations, the project team developed an initial set of concepts at each of the study intersections. An initial screening against the goals, objectives, and evaluation criteria from *Technical Memorandum #1: Study Background and Goals and Objectives* resulted in a set of alternatives selected for further refinement and evaluation. Additionally, alternatives that either have few merits based on the full range of evaluation criteria or have costs that would likely exceed current funding expectations were removed from further consideration. Based on the refinement and evaluation documented in *Technical Memorandum #4: Alternatives Development and Evaluation*, a set of preferred alternatives was then recommended by the Technical Advisory Committee and Stakeholder Advisory Committee.

PREFERRED ALTERNATIVES

Table 1 summarizes the preferred alternatives recommended at each of the study intersections. For concept figures and more details about the preferred alternatives, see the attached prospectus sheets in Appendix A.

TABLE 1: PREFERRED ALTERNATIVES AT EACH STUDY INTERSECTION IN THE REED MARKET ROAD CORRIDOR

INTERSECTION	RECOMMENDATION	KEY CONSIDERATIONS FOR FUTURE DESIGN TEAM
REED MARKET RD & BROOKSWOOD BLVD	Multilane Roundabout (Alt 1)	<ul style="list-style-type: none"> • Include a conduit to support future implementation of roundabout metering (Alt 2) • Install rectangular rapid flashing beacons (RRFBs) to facilitate pedestrian crossings on the dual entry lanes.
REED MARKET RD & US 97 SOUTHBOUND RAMP	Add Exclusive Southbound Right-turn Lane and Improve Westbound Bike Travel (Alt 1)	<ul style="list-style-type: none"> • Dedicated westbound bicycle signal. • Include a blank-out sign^A for right turn on red (RTOR) restrictions in conjunction with considering bicycle signal indications. • Investigate opportunities for a multiuse path for westbound people biking who are approaching the intersection.
REED MARKET RD & US 97 NORTHBOUND RAMP	Signalized Intersection (Alt 1)	<ul style="list-style-type: none"> • Investigate access modifications at the north end of Division St to begin US 97 on-ramp acceleration earlier. • Design the signal to allow for a future phase where Alt 2 (on-ramp realignment) can be implemented.
REED MARKET RD & 3RD ST	Protected Intersection with Eastbound and Westbound Left Turn Lanes (Alt 2A)	<ul style="list-style-type: none"> • Remove the southbound right-turn lane from the proposed design to reduce costs and limit right-of-way impacts. • Consider a multiuse path approaching the intersection (instead of bike lanes) to limit right-of-way impacts. • Consider access management on all approaches at the intersection, particularly the east leg between 3rd St and 4th St. • Explore other cost-saving measures through design.
3RD ST & BROSTERHOUS RD^B	Protected Intersection with Lane Reconfiguration (Alt 2)	<ul style="list-style-type: none"> • Consider how this treatment functions with future improvements along Brosterhous Rd and Parrell Rd to support the implementation of a key walking and biking route (such as widening over the canal bridge for better facilities for people walking and biking). • Consider speed limit reduction along Brosterhous Rd.
REED MARKET RD & CHAMBERLAIN ST	Crossing Enhancement	<ul style="list-style-type: none"> • Install a pedestrian crossing on the east leg and implement median cutouts and green pavement marking for people biking. • Install wayfinding and warning signage for people walking and biking. • Remove vegetation in the median and add enhanced lighting for better visibility. • Preserve space for future bus stops.

^AThe blank out sign is an automated warning sign activated according to different times and conditions.

^BThe intersection has limited funding available for improvements, and the City has planned to implement short-term enhancements at the intersection utilizing all available funding. For more detail on the short-term improvements, see Technical Memorandum #4.

This study also identified that opportunities are limited for people walking and biking to cross US 97 in the vicinity of the Reed Market Road overcrossing. While Reed Market Road is not a designated low-stress route, it is required by the City of Bend standard cross-section to provide low-stress walking and biking facilities when the street is reconstructed. Providing low-stress walking and biking facilities along Reed Market Road would require reconstruction to widen the overall cross-section. However, there currently is no planned or funded reconstruction project. Through the planning process, it is recommended that short-term improvements be compatible with the existing cross-sections while also maintaining forward compatibility with any potential future cross-section changes. Several long-term cross-section designs that may be considered along Reed Market Road in the future are documented in Technical Memorandum #4.

PREFERRED ALTERNATIVES EVALUATION

The following sections document the safety improvements and operations evaluation for the preferred alternatives.

SAFETY IMPROVEMENTS

The preferred alternatives are expected to improve overall safety performance within the study area. Potential safety improvements at each of the study intersections with preferred alternatives include:

- Reed Market Road/Brookwood Boulevard
 - The multilane roundabout introduces more conflict points and potentially increases speeds on the approaches. However, the preferred alternative maintains single lane exits at the roundabout, reducing conflicts for people crossing the intersection and facilitating crossings for people with vision impairments.
 - The addition of meters could incorporate emergency vehicle preemption to facilitate emergency response during congestion.
 - The multilane roundabout results in shorter queueing on the westbound approach, which mitigates the problem where queues block the US 97 interchange ramps causing ramp queues onto the US 97 mainline.
- Reed Market Road/US 97 Southbound Ramp
 - The preferred alternative significantly reduces the risk of queues spilling back to the US 97 mainline.
 - Eliminating the crossing of the westbound bike lane and right turn lane, providing a bike signal coupled with RTOR restrictions, and potentially putting people biking westbound on a multiuse path significantly reduces conflicts between people biking and westbound right-turning vehicles, improving bicycle safety and comfort.
 - Adding a southbound right-turn lane has the potential to reduce all types of crashes by four percent¹. However, it lengthens the crossing distance, increasing exposure for people walking

¹ ODOT Crash Reduction Factor List, 2023, ID: H4.

and biking. A sensitivity test was performed to assess the necessity of adding the exclusive lane and the results are discussed later in this memorandum.

- Reed Market Road/US 97 Northbound Ramp
 - Installing a traffic signal provides a new enhanced crossing for people walking and biking across Reed Market Road, which reduces angle crashes by 67 percent², but increases rear-end crashes by 143 percent³.
 - Converting Division Street to right-in, right-out operations reduces conflict points and prevents left-turning vehicles from blocking through movements. It has the potential to reduce overall crashes by 45 percent⁴.
 - The future phase (Alternative 2) that realigns the northbound on-ramp would improve the acceleration distance onto US 97 and mitigate access management conflicts that exist on Division Street with the current ramp placement.
- Reed Market Road/3rd Street
 - The protected intersection design enhances the quality of walking and biking facilities in the following ways:
 - > Provides traffic calming via smaller curb radii.
 - > Minimizes pedestrian crossing distances and provides a protected bicycle crossing.
 - > Improves the level of stress for people walking and biking.
 - > Provides extra crossing time associated with leading pedestrian intervals (LPIs) or leading bicycle intervals (LBIs), where LPIs/LBIs have the potential to reduce walking and biking related crashes by up to 37 percent⁵.
 - > Mitigates conflicts with right-turning vehicles by applying RTOR restrictions, which could reduce walking and biking related crashes by up to 41 percent⁶.
- 3rd Street/Brosterhous Road
 - The eastbound road widening lengthens the crossing distance and increases exposure for people walking and biking. However, adding a right-turn lane has the potential to reduce all crashes by up to four percent⁷.
 - The protected eastbound and westbound left-turn phase reduces eastbound and westbound left-turning conflicts and ensures protected phasing for people walking and biking. It has a potential to reduce left-turning crashes by up to 99 percent⁸.

² ODOT Crash Reduction Factor List, 2023, ID: H22.

³ ODOT Crash Reduction Factor List, 2023, ID: H23.

⁴ Crash Modification Factors (CMF) Clearinghouse, US DOT Federal Highway Administration, CMF ID 9821. Note: This CMF is based on a study of three-leg intersections.

⁵ ODOT Crash Reduction Factor List, 2023, ID: BP3.

⁶ ODOT Crash Reduction Factor List, 2023, ID: BP25.

⁷ ODOT Crash Reduction Factor List, 2023, ID: H4.

⁸ ODOT Crash Reduction Factor List, 2023, ID: I9.

- The protected intersection improves the quality of walking and biking facilities as previously mentioned under the Reed Market Road/3rd Street discussion.
- Reed Market Road/Chamberlain Street
 - The installation of enhanced lighting and median vegetation removal improve visibility at the intersection.
 - The new pedestrian crossing on the east leg, as well as the median cutouts and green pavement markings for people biking, provide protection and increase crossing comfort for people walking and biking.
 - The implementation of additional crossing warning signs may further improve safety for people walking and biking.

OPERATIONS ANALYSIS ASSUMPTIONS

The preferred alternatives were evaluated using Vissim microsimulation to assess the compatibility and effectiveness of the treatments along the entire corridor. The project *Methodology Memorandum*⁹ and *Vissim Protocol Calibration and Validation Report*¹⁰ documented the details of model development assumptions. As with the existing conditions model, the Vissim analysis presented in this memorandum used the Oregon Department of Transportation (ODOT) Vissim Protocol as a developing guideline.

Several operational assumptions were made to enhance the system performance and evaluate the impact of the improvements when combined along the corridor:

- Analysis documented in Technical Memorandum #4 indicated that westbound queues were longer at the Reed Market Road/Brookwood Boulevard roundabout with metering. Therefore, the modeling included metering at Reed Market Road/Brookwood Boulevard roundabout to provide a more conservative estimate of potential queueing impacts along Reed Market Road.
- The signalized study intersections were assumed to be coordinated with other signalized intersections within the study area, all using a cycle length of 120 seconds, to enhance corridor operations. Note that the 120 seconds of cycle length is an in-practice cycle length that is commonly used to balance vehicle and non-motorist operations. Some other signal timing strategies were employed, including:
 - Placing the westbound roundabout metering advanced detector closer to Silver Lake Boulevard to keep the westbound queue moving at the Brookwood Boulevard roundabout, limiting queue spillback to the US 97 southbound ramp.
 - Prioritizing northbound and eastbound movements at Reed Market Road/3rd Street to prevent queue spillback into Brosterhous Road and the US 97 ramps. This was achieved by increasing northbound and eastbound green time and implementing leading/lagging left-turn phasing at Reed Market Road/3rd Street and Brosterhous Road/3rd Street intersections.
- The protected intersection design was assumed to include LPIs or LBIs, giving an extra five seconds to people walking and biking to enter the crosswalk before vehicles are given a green

⁹ US 97 at Reed Market Road Operations and Safety Study - Technical Memorandum #1, Appendix A - Methodology Memorandum, November 2022.

¹⁰ US 97 at Reed Market Road Operations and Safety Study - Vissim Protocol Calibration and Validation, March 2023.

signal indication. LPIs/LBIs are only activated when detecting people walking and biking. Note that a total number of 10 people walking and 15 people biking per hour are assumed on each leg in the future conditions to account for the anticipated improvements in facilities.

- A bike signal was implemented for bike lanes that are adjacent to dedicated right-turn lanes at the US 97 ramp terminals to ensure protected phases for people biking. This could be implemented in conjunction with a dynamic blank-out sign. Note that bike signals are considered experimental at the time of this study at ODOT intersections, and the implementation will require State Traffic Engineer approval.
- RTOR movements were restricted at protected intersections and approaches with bike signals to remove conflicts between motorists and people walking and biking. However, to help clear the westbound queues at 3rd Street/Brosterhous Road, a dynamic RTOR was implemented that allows vehicles to turn right on a red signal when there are no conflicting pedestrian calls, mimicking a dynamic blank-out sign.

OPERATIONS EVALUATION RESULTS

The model evaluates the future year (2040) average weekday conditions during the p.m. peak period (4 p.m. to 6 p.m.). Several measures of effectiveness (MOEs) were obtained, including GEH¹¹, congestion speed plots, average and 95th percentile motor vehicle queue length, and vehicle delay. A summary of system performance compared to a No-Build scenario and MOEs are reported below. A summary of key findings is also provided at the end of this section to discuss key findings for system performance and performance at each of the study intersections.

SYSTEM PERFORMANCE COMPARED TO NO-BUILD SCENARIO

Under No-Build conditions, several intersections operate over capacity, as documented in *Technical Memorandum #3: Future Baseline (No-Build) Transportation System Conditions*. Given this level of congestion, the No-Build scenario was not evaluated in detail in microsimulation but system performance measures (latent demand, vehicle hours of delay and latent delay) were evaluated for comparison against the preferred alternatives scenario.

Compared to the No-Build scenario, the preferred alternatives:

- Significantly increase system capacity, serving over 1,000 additional vehicles in the network during the peak two-hour period.
- Result in savings of over 1,500 vehicle-hours of delay over the two-hour period.
- Resolve significant queueing on the ramp terminals that spill back onto mainline US 97, as discussed below in more detail.

¹¹ The GEH statistic is a universal measure to compare model inputs and outputs. This continuous volume tolerance formula was developed to avoid the pitfalls associated with using a simple percentage comparison of a wide range of volumes. ODOT has a criteria/threshold lower than 5.0. GEH results for the modeled area with preferred alternatives can be found in Appendix E.

CONGESTION

The microsimulation model was used to measure queueing and delay relative to desired speed as an indicator of congestion. Figures 1 and 2 represent the relative delay averaged over 10 simulation runs for the peak 15 minutes under No-Build conditions and with the preferred alternatives, respectively. The colors shown in the figure indicate the following approximate queue states:

- Dark green represents free-flow conditions with no delay.
- Light green represents slight slowing.
- Yellow represents increased slowing, but not yet at the “stop and go” state.
- Orange represents the furthest extent of stop and go queues at any point during the entire 15-minute period (a rough approximation of 95th percentile queues).
- Red represents fluctuation between low-speed flow and stopped queues.
- Dark red represents continuous stop and go queues during the entire 15-minute period.

As shown in the figures, the overall congestion improved with the implementation of the preferred alternatives compared to the No-Build scenario, especially at the US 97 ramp terminals. Even with improvements, substantial congestion is still expected at the Reed Market Road/Brookwood Boulevard roundabout and on the southbound approach at Reed Market Road/3rd Street. However, that congestion is expected to have limited impact on congestion at the US 97 ramp exit approaches. Appendix B includes congestion plots for each 15-minute interval over the two-hour simulation period for the model with preferred alternatives.

QUEUEING

Table 2 lists the weekday evening peak (from 4:30 p.m. to 5:30 p.m.) average and 95th percentile queues by approach under the future (2040) build network with preferred alternatives for major study intersections. Queueing results for specific movements for the modeled area with preferred alternatives can be found in Appendix C. Similar to the discussion in the Congestion section of this technical memorandum, average and 95th percentile queues are expected to be extensive at Reed Market Road/Brookwood Boulevard and the southbound approach at Reed Market Road/3rd Street.

As analyzed and discussed in Technical Memorandum #4 for the Reed Market Road/Brookwood Boulevard roundabout, the southbound and westbound approaches experienced relatively short queueing, whereas the northbound approach experienced extremely long queueing. The implementation of metering helps distribute the queues more evenly across each approach, reducing queues on the northbound approach but increasing queues on southbound and westbound approaches. However, even with the roundabout metering included in the analysis, the average westbound queues shown in this analysis are still able to stay well clear of the ramp terminals (extending 450 feet). Even with spikes in the 95th percentile queues in the westbound direction just extending to the ramp terminal, the queues on the ramp approaches are able to stay less than 325 feet long, well short of the 670 feet of queue storage available before encroaching on the safe stopping distance.

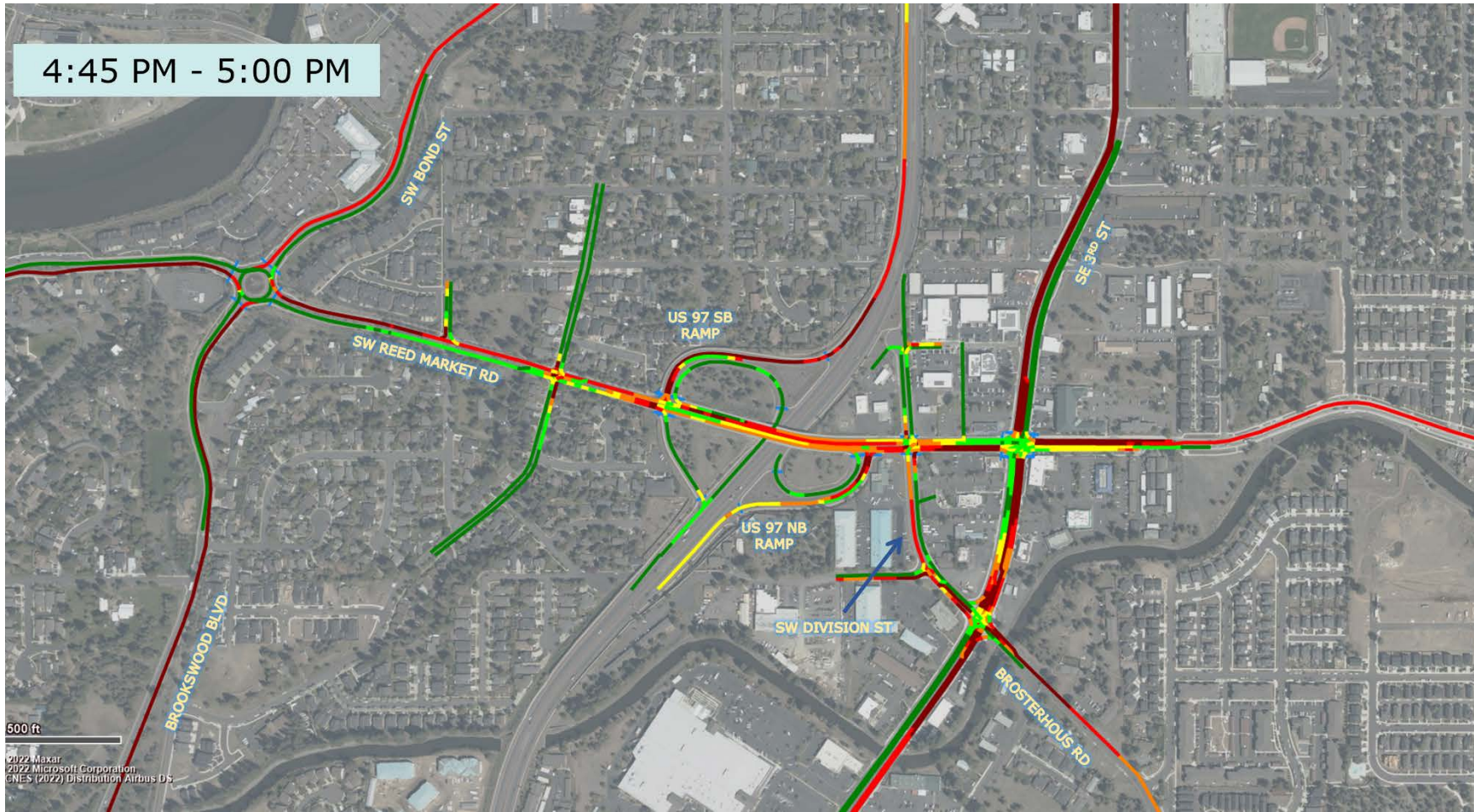


FIGURE 1. FUTURE NO-BUILD PEAK 15 MINUTE (4:45 P.M. TO 5:00 P.M.) CONGESTION PLOT WITHIN THE STUDY AREA

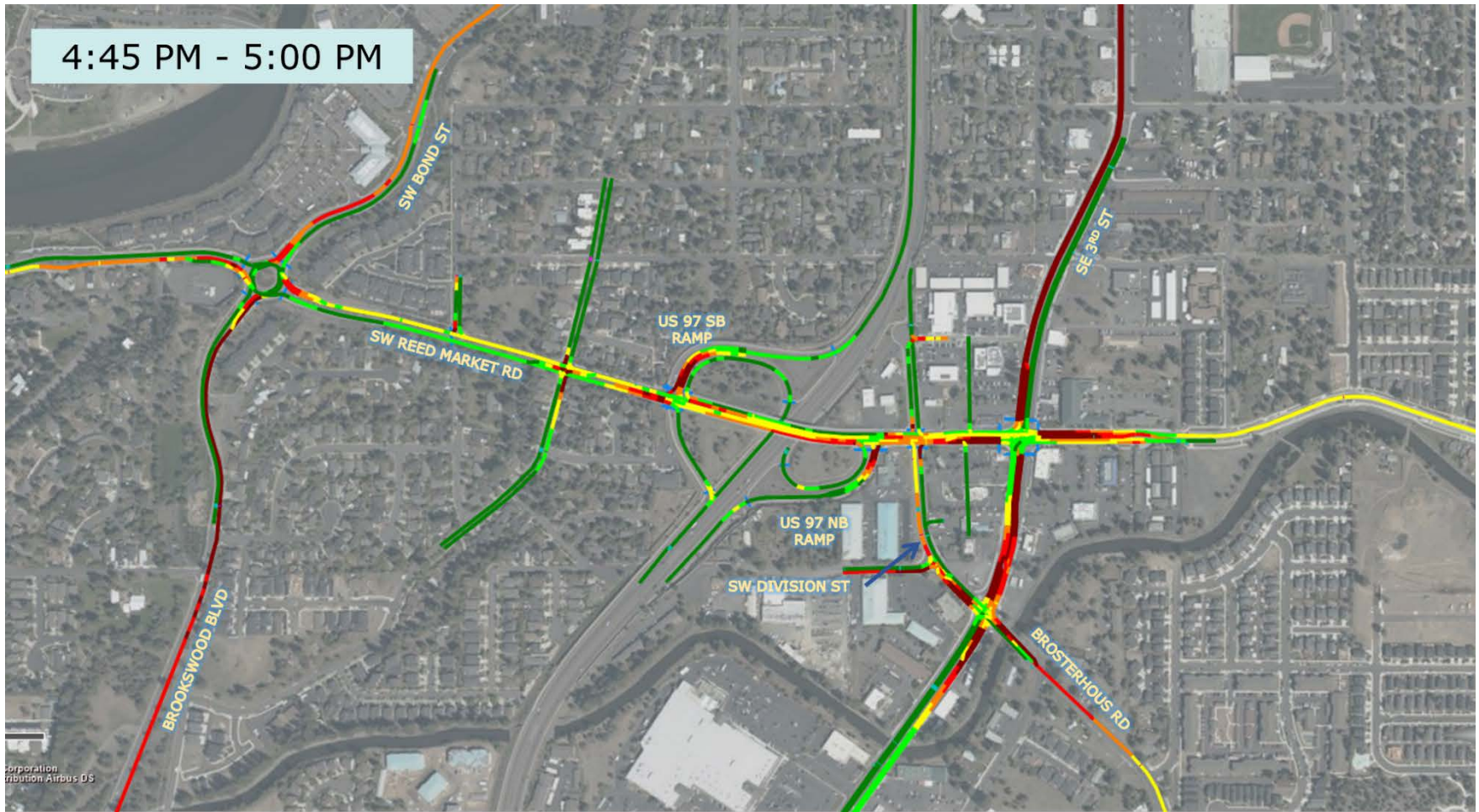


FIGURE 2. PEAK 15 MINUTE (4:45 P.M. TO 5:00 P.M.) CONGESTION PLOT WITHIN THE STUDY AREA WITH PREFERRED ALTERNATIVES

TABLE 2. AVERAGE AND 95TH PERCENTILE QUEUE LENGTHS AT MAJOR STUDY INTERSECTIONS WITH PREFERRED ALTERNATIVES

INTERSECTION	APPROACH	APPROXIMATE DISTANCE TO NEXT MAJOR INTERSECTION	QUEUE (FT) ^A	
			Average	95 th Percentile
REED MARKET RD & BROOKSWOOD BLVD	NB	550' to Blakely Rd	>2500	>3000
	SB	450' to Columbia St	>2000	>3500
	EB	1175' to Alderwood Cir	750	>2000
	WB	775' to Chamberlain St	450	1850
REED MARKET RD & US 97 SOUTHBOUND RAMP	SB	675' to the safe stopping distance	200	325
	EB	425' to Silver Lake Blvd	275	625
	WB	725' to US 97 NB Ramp	425	875
REED MARKET RD & US 97 NORTHBOUND RAMP	NB	800' to the safe stopping distance	100	175
	EB	725' to US 97 SB Ramp	650	875
	WB	550' to 3 rd St	275	700
REED MARKET RD & 3 RD ST	NB	650' to Brosterhaus Rd	650	800
	SB	675' to Cleveland Ave	>2500	>3500
	EB	550' to US 97 NB Ramp	425	650
	WB	800' to 4 th St	675	>2500
3 RD ST & BROSTERHOUS RD	NB	1700' to Meyer Dr	450	1375
	SB	650' to 3 rd St	300	475
	EB	750' to Reed Market Rd	600	>1000
	WB	275' to Parrell Rd	775	>1000

^A **Bold** numbers indicate that the queue exceeds the approximate distance to the next major intersection.

DELAY

As discussed above, the average vehicle hours of delay within the simulation network significantly decrease (more than 1,500 vehicle-hours) with the preferred alternatives compared to No-Build conditions. Detailed vehicle delay results for the modeled area with preferred alternatives can be found in Appendix D. With the preferred alternatives:

- Average delay at the US 97 northbound and southbound ramp terminals is relatively limited (less than 35 seconds on any approach).
- Average delay is higher at the intersections on 3rd Street, which are closely spaced (leading to queue spillback) and include leading pedestrian intervals, which increase delay for all movements. However, the average delay for all approaches (except the southbound approach at Reed Market Road/3rd Street) is expected to be less than 80 seconds. Significant delay (greater than 5 minutes) occurs on the southbound approach at Reed Market Road/3rd Street.
- Northbound and southbound approaches at the Reed Market Road/Brookwood Boulevard roundabout still experience long delays (greater than 5 minutes) with improvements but, as discussed in Technical Memorandum #4, **delays are reduced by over 80 percent compared to No-Build conditions** with the multilane roundabout compared to the single lane roundabout.

KEY OPERATIONS ANALYSIS FINDINGS

The following summarizes key analysis findings for the overall system and for individual intersections.

SYSTEM PERFORMANCE

Based on the analysis results, the preferred alternatives at each of the intersections can operate well together as a system, greatly improving traffic operations along Reed Market Road compared to the No-Build condition while simultaneously improving conditions for people walking and biking (as noted in the evaluation in Tech Memo #4). However, queueing and congestion are still significant in the area, given Reed Market Road serves as a key east-west connection through Bend and provides a direct crossing of the Deschutes River, US 97, and the railroad.

To help reduce vehicle demand along Reed Market Road, other system-wide improvements could be considered:

- Bend's Transportation System Plan (TSP) identifies the need to study a new southern river crossing between Powers Road and Murphy Road to improve connectivity. This would help relieve vehicle demand on Reed Market Road by providing an alternate route for motor vehicle travel.
- 3rd Street is identified as a key walking and biking route and is designated as part of the City's low-stress bicycle network. While the protected intersection design with leading pedestrian intervals enhances protection for people walking and biking, it can result in more vehicle delay. However, investments in the multimodal transportation network on 3rd Street and other City facilities in the area have the potential to encourage people to choose a different mode, reducing vehicle demand.

- As noted in *Technical Memorandum #3: Future Baseline (No-Build) Transportation System Operations Memorandum*, many of the goals and policies in the City's TSP are intended to reduce vehicle miles traveled by encouraging the use of bicycling, walking and transit. Other citywide policies and investments could result in less growth in vehicle demand on Reed Market Road in the future.

REED MARKET ROAD AND BROOKSWOOD BOULEVARD

As previously described in *Technical Memorandum #3: Future Baseline (No-Build) Transportation System Operations Memorandum*, the intersection operates significantly over capacity under No-Build conditions (worst approach volume-to-capacity [v/c] ratio of 1.16), leading to queues spilling back to nearby major intersections. With the preferred alternative, there is still significant congestion and queuing approaching the roundabout; however, the alternative using a multilane roundabout with metering provides better flexibility to control queueing on specific approaches and to account for different travel patterns during the a.m. and midday peak periods. The longest queues occur with northbound and southbound movements under 95th percentile conditions. This is due to the high volume of conflicting traffic circulating the roundabout that prevents traffic from being fully served. These queues are also slightly impacted by the roundabout meter operation assumption in this analysis, which was designed to prioritize keeping westbound queues away from the US 97 interchange.

While the 95th percentile westbound queue extends just into the US 97 southbound ramp, reducing the throughput at that intersection and leading to longer westbound queue spillback through the interchange area and towards 3rd Street, the queues on the ramp exits are able to remain shorter than the safe stopping distance. This westbound queueing could be managed by prioritizing the westbound approach at the roundabout even more heavily when metering.

Based on the analysis results documented above and in *Technical Memorandum #4*, the implementation of the multilane roundabout will significantly reduce delay and reduce the risk of queue spillback impacting the US 97 southbound ramp. The implementation of metering in the future can be considered as the City and ODOT monitor congestion and queueing on Reed Market Road.

REED MARKET ROAD AND US 97 SOUTHBOUND RAMP

Overall, there are minimal delays at this intersection. While 95th percentile queues in the future spillback on the eastbound and westbound approaches, no significant queues are expected on the ramp approach (less than 350 feet). Southbound queues do not spill back into the US 97 mainline and do not exceed the safe stopping distance of 670 feet. The eastbound queue spills beyond Silver Lake Boulevard but does not extend to the Brookwood Boulevard roundabout. The 95th percentile westbound queue spills beyond the US 97 northbound ramp to Division Street, due in part to occasional queue spillback at the Brookwood Boulevard roundabout and friction associated with last-minute merging due to the right-turn lane drop at the intersection.

The improvements at adjacent study intersections (particularly at Brookwood Boulevard) have the potential to reduce the risk of queue spillback into the US 97 southbound ramp, reducing the need for widening the southbound right-turn lane. To better understand the need for it, a sensitivity test

was conducted without the southbound right-turn lane. The results indicated that the southbound movement without the right-turn lane experienced an average queue length of 350 feet (compared to 200 feet) and a 95th percentile queue length of 475 feet (compared to 325 feet). This is approximately 150 feet before extending into the safe stopping distance, indicating that **widening to add a southbound right-turn lane to manage queueing on the ramp may not be needed under Year 2040 average weekday conditions.**

ODOT should continue to monitor queueing to assess when widening for a right-turn lane may be needed. It should be noted that improvements to bicycle facilities (realigning the bike lane adjacent the curb to move the conflict with the westbound right-turn lane to the signal) at the Reed Market Road/US 97 Southbound Ramp intersection should still remain a priority. This portion of the preferred alternative could be implemented concurrently with the improvements at the Reed Market Road/ US 97 Northbound Ramp intersection.

REED MARKET ROAD AND US 97 NORTHBOUND RAMP

As noted in Technical Memorandum #4, the signal at Reed Market Road/US 97 Northbound Ramp intersection significantly reduces delay on the ramp approach and will improve safety for northbound left-turning vehicles (crash reduction factor of 67 percent for angle crashes). The intersection experiences some queueing on the eastbound and westbound approaches, but overall vehicle delays at the intersection are minimal. The eastbound queue is primarily caused by queues spilling back from Reed Market Road/3rd Street and friction associated with the high volume of traffic turning right onto Division Street, with queues at Brosterhous Road/3rd Street occasionally spilling back onto Reed Market Road. It should be noted that the 95th percentile westbound queues spill beyond 3rd Street but average queues do not.

REED MARKET ROAD AND 3RD STREET

As noted in Technical Memorandum #4, the improvements at Reed Market Road are expected to result in a significant improvement in intersection capacity. However, even with improvements, the intersection is expected to operate just under capacity (v/c ratio of 0.96). This results in substantial queueing on all approaches to the intersections, with particularly long queues on the southbound and westbound approaches (>3,500 feet). It should be noted that the GEH statistic threshold was met at all locations except for the entry southbound movement at this study intersection. This indicates that the demand for that approach will exceed the capacity with the high growth in future traffic volumes, preventing southbound vehicle demand from being fully served. This could be improved slightly with the addition of a southbound right-turn lane, particularly since through-moving vehicles would no longer be delayed by a leading pedestrian interval. But long queues would still be expected without broader system improvements to help reduce vehicle demand as discussed above in the system performance key findings.

3RD STREET AND BROSTERHOUS ROAD

At 3rd Street/Brosterhous Road, there is substantial queuing on the eastbound and westbound approaches. The implementation of a protected intersection design with a leading pedestrian interval is expected to result in longer vehicle queuing and delays. In addition, the northbound left-turn queues spill back to Brosterhous Road, resulting in longer queues at 3rd Street and Brosterhous Road. However, the additional eastbound right-turn lane helps mitigate eastbound queuing so that queues rarely extend back to Reed Market Road. The westbound movement experiences a long queue, primarily due to the high right-turn volume.

APPENDIX

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APPENDIX A: PROSPECTUS SHEETS

APPENDIX B: VISSIM MODEL QUEUE PLOTS FOR THE PREFERRED ALTERNATIVES

APPENDIX C: VISSIM MODEL VEHICLE QUEUE TABLE FOR THE PREFERRED ALTERNATIVES

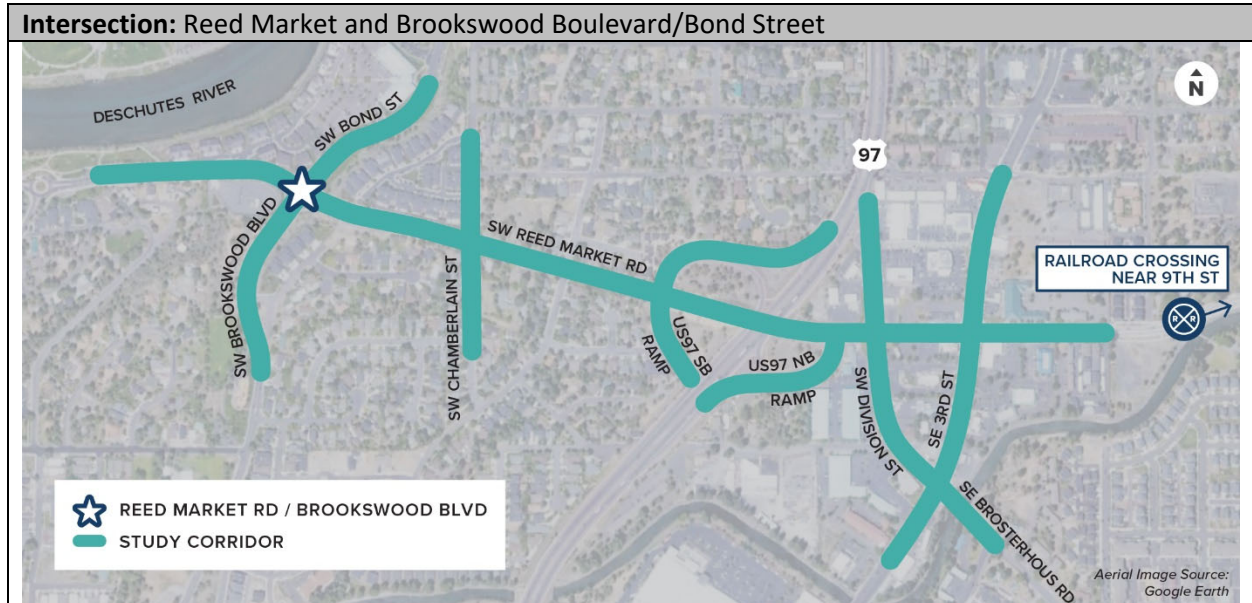
APPENDIX D: VISSIM MODEL AVERAGE DELAY TABLE FOR THE PREFERRED ALTERNATIVES

APPENDIX E: VISSIM MODEL GEH STATISTICS TABLE FOR THE PREFERRED ALTERNATIVES

APPENDIX A: PROSPECTUS SHEETS



Prospectus Sheets



Problem Statement: The existing single-lane roundabout at SW Brookwood Boulevard/SW Bond Street/SW Reed Market Road experiences capacity deficiencies during the average weekday morning, midday, and evening peak hours, resulting in queues and delays. These deficiencies are due, in part, to the highly directional flow of traffic during these time periods. Vehicle queues resulting from these deficiencies impact adjacent roadways (e.g. SW Columbia Street and US 97 Southbound Ramps). In the future (year 2040), assuming the existing single-lane configuration, the intersection fails to meet mobility targets and vehicle queues are forecast to grow exponentially longer.

As an example of the existing capacity deficiencies, the yellow line in the following figure shows the heavy and relatively unimpeded movement from northbound SW Brookwood Boulevard during the morning peak period, which makes it challenging for drivers entering the roundabout from westbound SW Reed Market Road to find an adequate gap in conflicting traffic.



Preferred Alternative Description

Widen roundabout (with option to meter in the future):

- Alternative 1 (Short-Term): Converting existing single-lane roundabout to a multilane roundabout by adding left-turn lanes on the northbound and southbound approaches and right-turn lanes on the eastbound and westbound approaches.
- Alternative 2 (Long-Term): Converting to the multilane geometry in Alternative 1 plus the addition of metering signals. The metering signals are placed upstream of the lane additions and are intended to operate independently from the roundabout

Rough Cost Estimate Summary (2023 Dollars)¹

Alternative 1: 4.0 Million

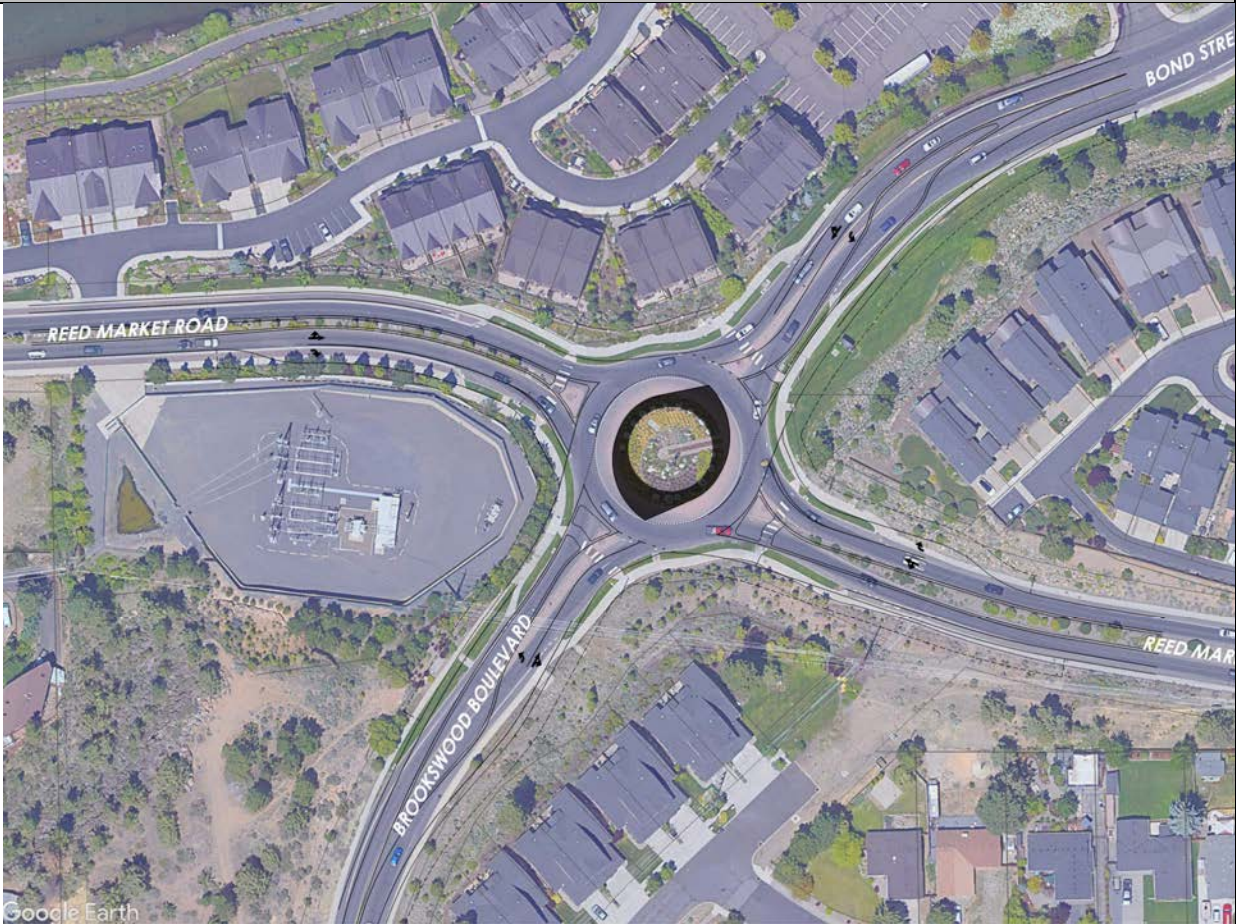
Alternative 2: 4.7 Million *(inclusive of costs associated with Alternative 1)*

¹Cost estimate includes design and construction management, mobilization, and contingency. Cost does not include right-of-way costs.

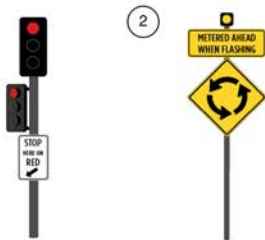
Summary of Benefits or Tradeoffs of Preferred Alt

- While it does not address all congestion at the intersection, this alternative significantly reduces delay and queuing through intersection widening.
- This alternative was selected to maintain single lane exits at the roundabout, reducing conflicts for people crossing the intersection while limiting right-of-way impacts.
- The alternatives summarized in this analysis allow for phasing with the option to construct the multilane alternative and then add metering when the incremental operational benefits justify the additional cost.

Preferred Alternative



Google Earth
Alternative 1



- (S) Install stop bar
- (YLD) Install YIELD legend
- (EX) Maintain existing YIELD sign
- Install conduit and wiring
- ☒ Install signal control cabinet and controller
- 📡 Install radar or video detection unit



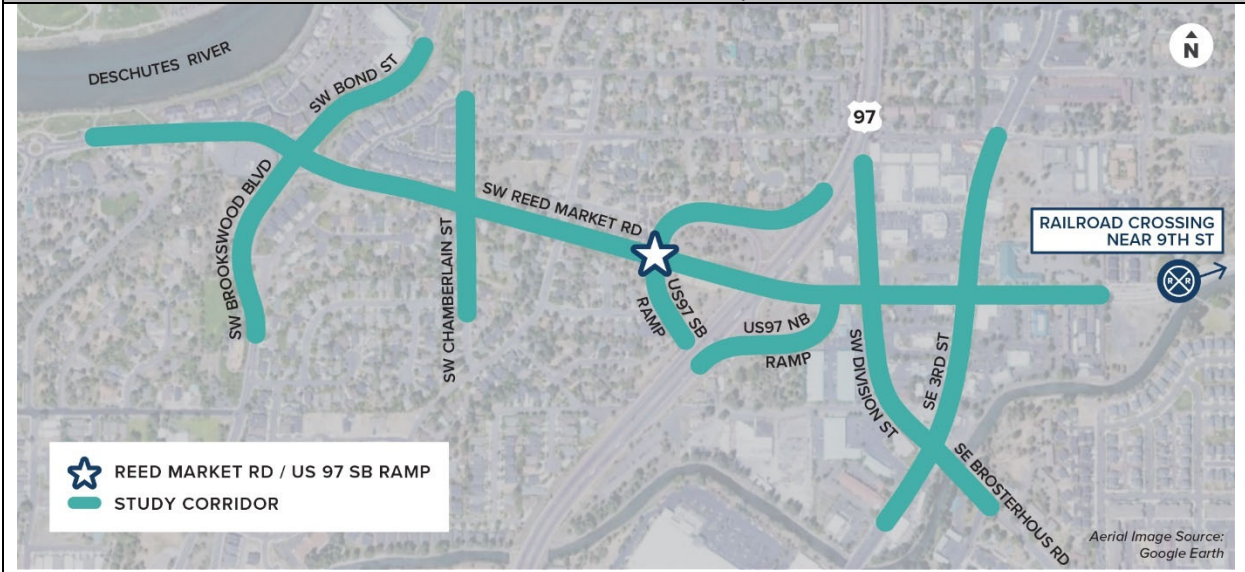
Alternative 2 (Example of potential metering concept originally developed for April 2020 evaluation. Additional development of concept needed to place queue detection and operational zones.)

Design/Construction Constraints and Opportunities

- If the roundabout is expanded to include multilane approaches and active treatments (i.e. pedestrian signals or beacons) are added to the pedestrian crossings, consideration should be given to potential interaction with future metering signals.
- The metering alternative will require further development of the operational logic and queue detection strategies developed from the April 2020 pilot test.
- The addition of meters could incorporate emergency vehicle preemption to facilitate emergency response during queued conditions.

Prospectus Sheets

Intersection: Reed Market Road and US 97 Southbound Ramps



Problem Statement: The Reed Market Road and US 97 southbound ramp terminal is currently signalized and has a southbound left turn lane and shared left-through-right turn lane. Congestion at the intersection is projected to exceed the adopted mobility target, with the intersection operating near capacity. In addition, even today, westbound queues from the Reed Market Road/Brookwood Boulevard intersection spill back through the southbound ramp terminal, making the actual level of congestion experienced worse than calculated. If these conditions are not mitigated, the southbound exit ramp queue could spill back into the portion of the ramp needed for safe deceleration and stopping. Other issues to be addressed include conflicts with the westbound right turn lane drop and the westbound bike lane crossover, and some reported challenges for heavy vehicles attempting to make the westbound right turn to the southbound loop ramp.

Preferred Alternative Description

Signal and bicycle improvements:

- Provide an additional southbound dedicated right turn lane and improve westbound bicycle safety by shifting the bike lane adjacent to the curb and adding a bike signal at the intersection, with blank out signs for no right turn on red.

Rough Cost Estimate Summary (2023 Dollars)¹

Preferred Alternative: \$5.7 Million

¹Cost estimate includes design and construction management, mobilization, right-of-way, and contingency.

Summary of Benefits or Tradeoffs of Preferred Alternative

- Adding a southbound right turn lane would require widening along the US 97 off-ramp, but would fit within the existing ROW. This would greatly reduce the overall intersection v/c ratio and delay for the eastbound and westbound movements.
- Providing a bike signal and either a multiuse path or bike lane would minimize conflicts at the westbound right turn.
- Bicycle safety and comfort would be improved with buffered bike lanes and multi-use path on the ramp.
- The crosswalk on the east leg of the intersection is recommended to remain closed (as existing).

Preferred Alternative

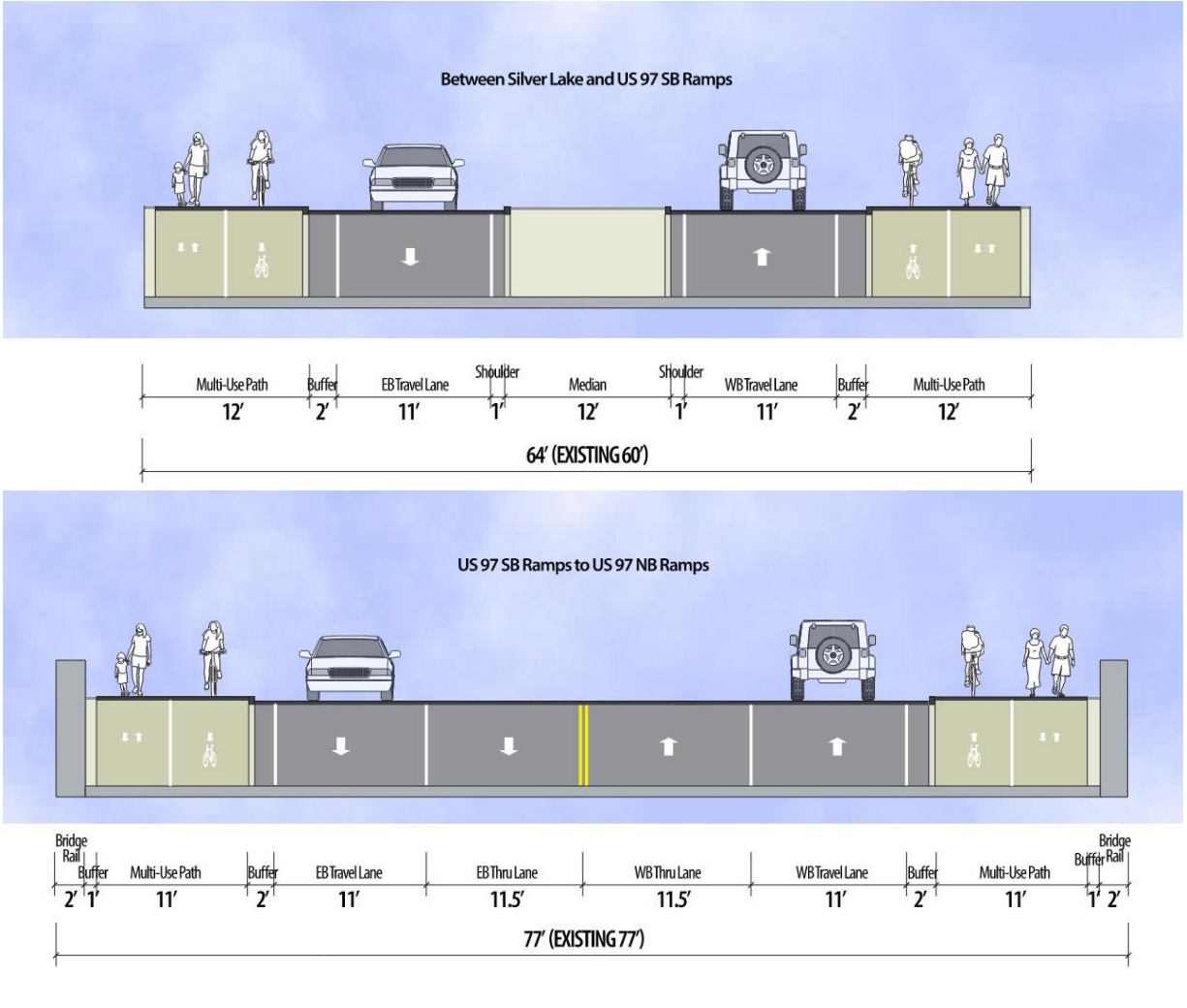


Design/Construction Constraints and Opportunities

- Widening may not be needed until later in the planning horizon if improvements are made at Reed Market Road/Brookwood Boulevard. Consider phasing the bicycle improvements with the US 97 Northbound Ramp and/or cross section improvements across the US 97 overpass in the short-term.
- Consider multi-use path approaching intersection to provide greater protection for people walking and biking.
- Consider additional improvements to make the westbound right turn movement easier for trucks while protecting people walking and biking.
- Any green striping is subject to ODOT traffic approval and funding to maintain.

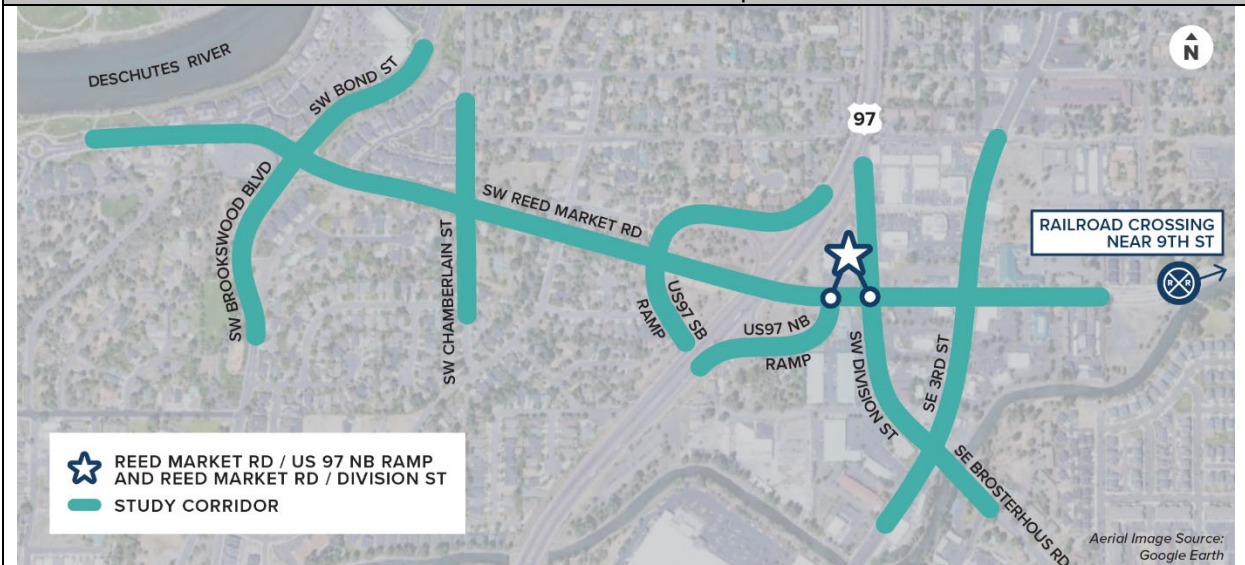
Typical Street Sections

The following cross section is not currently funded and represents a potential, ultimate road cross section. The preferred alternative utilizes short term restriping to reduce vehicle travel lane widths and provide a buffered bike lane, as shown in the concept figures. MAC coordination will be required for narrowing through lanes at this location.



Prospectus Sheets

Intersection: Reed Market Road and US 97 Northbound Ramps



Problem Statement: The Reed Market Road/US 97 northbound ramp terminal intersection is currently two-way stop controlled. It can be challenging to turn northbound left during peak hours due to traffic and geometric constraints limiting sight distance. Additionally, the sight line for right turning vehicles may be blocked by left turning traffic. The Reed Market Road and Division Street intersection, located 150 feet east of the US 97 northbound ramp terminal, is also two-way stop controlled. Division Street allows two-way traffic to serve local properties, with the US 97 northbound entrance ramp located at the north terminus of Division Street. This is inconsistent with ODOT's access spacing standards and results in a shorter than standard acceleration lane onto US 97. Currently, there are non-buffered on street bike lanes in both the east and west direction.

Preferred Alternative Description

Signalize ramp terminal (with option to realign in the long-term): The preferred alternative is a phased implementation of Alternatives 1 and 2. Phase 1 would construct the traffic signal and convert Division Street to right-in and right-out only, as shown in Alternative 1. The remaining elements of Alternative 2 would be constructed in a future phase or phases.

- Alternative 1 (Short-Term):
 - Construct a traffic signal at the US 97 northbound ramp terminal and provide a bike signal.
 - Convert Division Street to right-in and right-out only by implementing a narrow raised median.
 - Investigate any access modifications needed at the north end of Division Street to provide increased acceleration distance for the US 97 on-ramp.
- Alternative 2 (Long-Term):
 - Separate the northbound entrance ramp from Division Street and align the new entrance ramp with the Reed Market Road/US 97 northbound ramp signalized intersection.
 - Convert the south leg of Division Street to right-in and right-out only by implementing a narrow raised median.

Rough Cost Estimate Summary (2023 Dollars)¹

Alternative 1: \$4.0 Million

Alternative 2: \$9.4 Million *(inclusive of costs associated with Alternative 1)*

¹Cost estimate includes design and construction management, mobilization, right-of-way, and contingency.

Summary of Benefits or Tradeoffs of Preferred Alternative

- A traffic signal at this intersection would provide a significant improvement to traffic operations.
- Converting Division Street to right-in and right-out would reduce conflict points and prevent left turning vehicles from blocking through movements.
- The signalized intersection would reduce impacts to adjacent businesses and buildings compared to a roundabout.
- Alternative 2 would provide an acceptable acceleration distance onto US 97 and mitigate access management conflicts that exist on Division Street with the current ramp placement.

Preferred Alternative



Phase 1



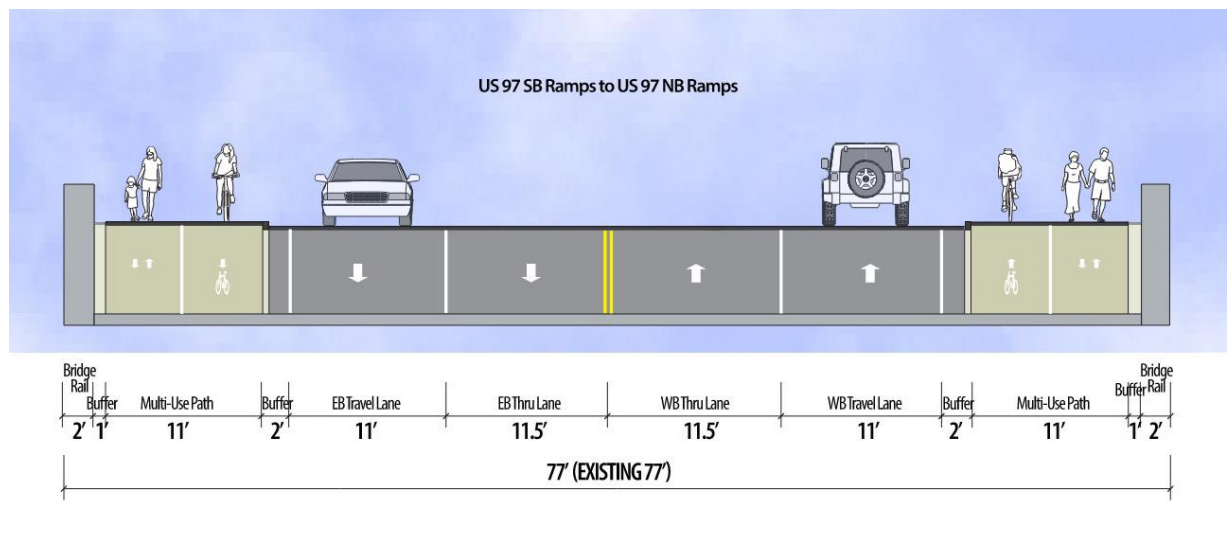
Future phase or phases

Design/Construction Constraints and Opportunities

- Existing driveway access on Reed Market Road will need to be evaluated and coordinated during design.
- Any green striping is subject to ODOT traffic approval and funding to maintain.
- Pedestrian and bicycle crossing treatments of the on-ramp acceleration lane should be refined during design.

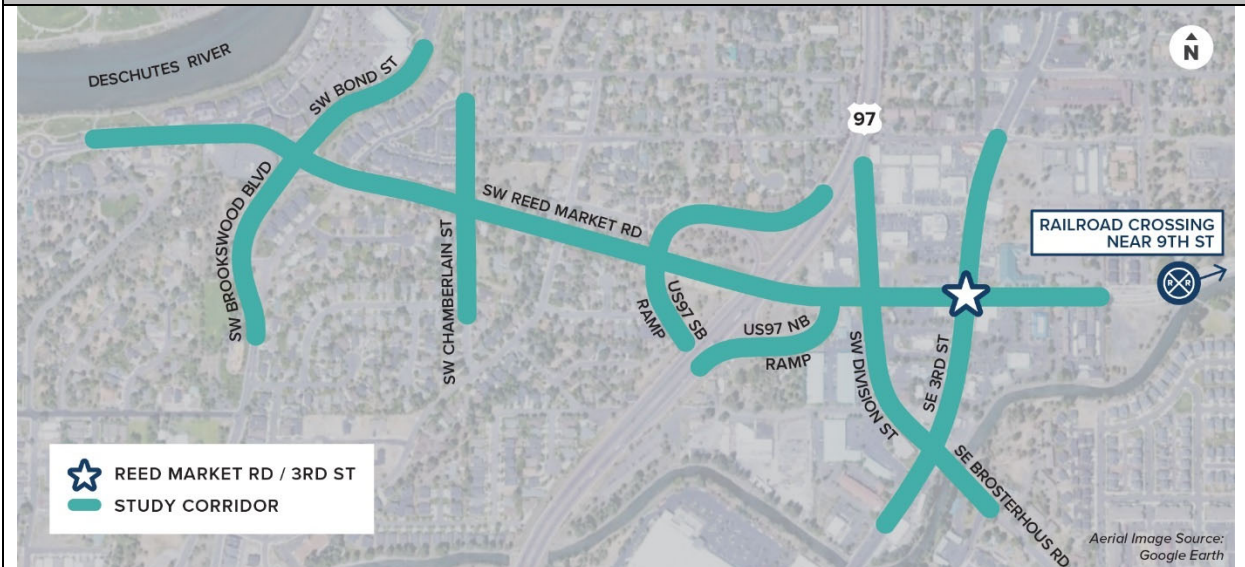
Typical Proposed Street Sections

This cross section is not currently funded and represents a potential ultimate road cross section. The preferred alternative utilizes short-term restriping to reduce vehicle travel lane widths and provide a buffered bike lane, as shown in the concept figures. MAC coordination will be required for narrowing through lanes at this location.



Prospectus Sheets

Intersection: Reed Market Road and 3rd Street



Problem Statement: The intersection of Reed Market Road and 3rd Street is at the confluence of two major arterial roadways in Bend and serves high traffic volumes on all approaches. The existing demand volumes exceed the intersection capacity (v/c ratio of 1.05), and the future demand volumes will increase the v/c ratio to 1.26 by 2040. A major contributor to this congestion is the lack of separate eastbound and westbound left turn lanes, which limits signal operations to using split phasing. The existing intersection currently has non-buffered bike lanes on the east and west approaches and buffered bike lanes on the north and south approaches. Additionally, there are several businesses and buildings built close to the right-of-way at the four corners of the intersection.

Preferred Alternative Description

Protected signalized intersection:

- Construct a protected intersection with added eastbound and westbound left turn lanes.

Rough Cost Estimate Summary (2023 Dollars)¹

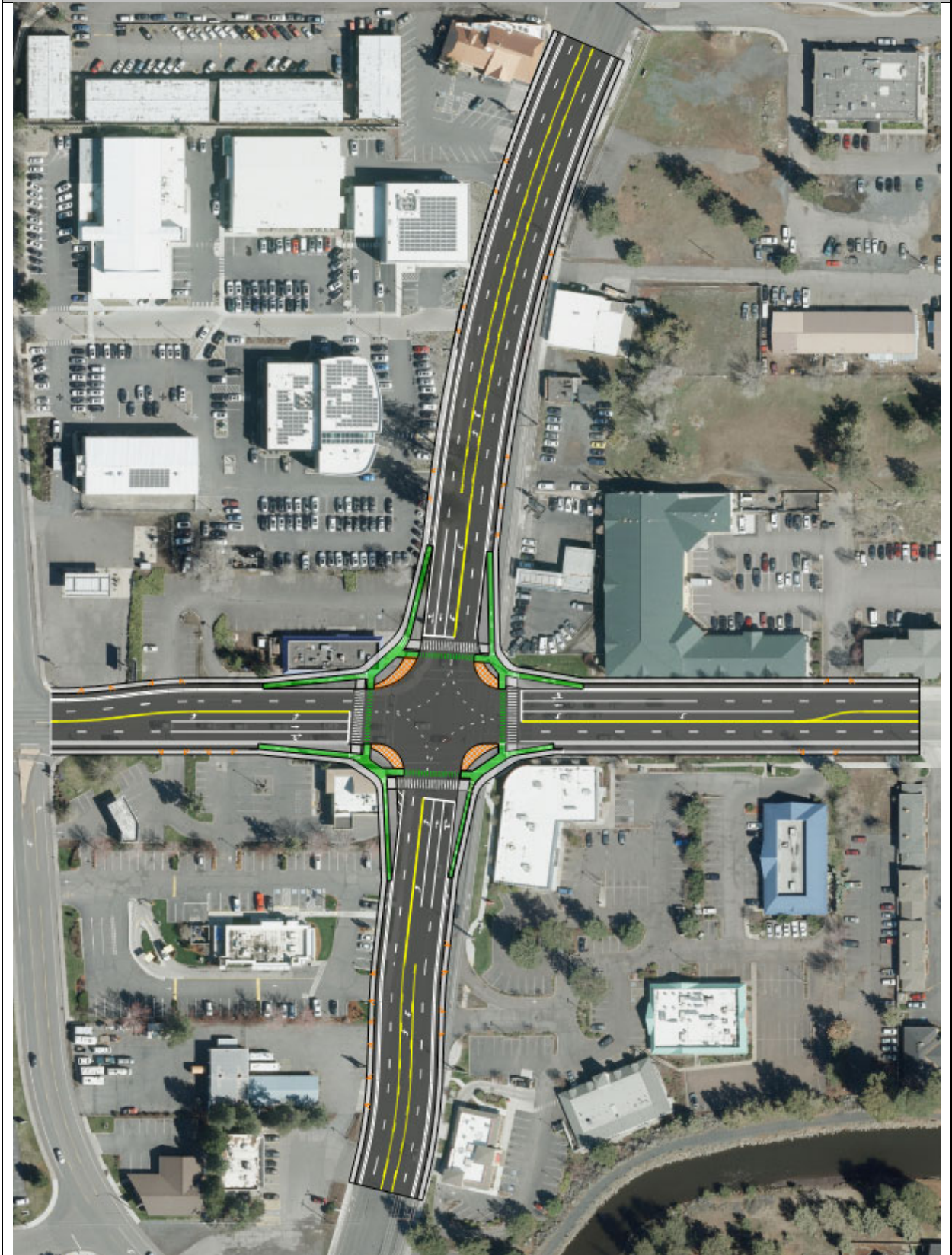
Preferred Alternative: \$10.3 Million

¹Cost estimate includes design and construction management, mobilization, right-of-way, and contingency.

Summary of Benefits or Tradeoffs of Preferred Alternative

- The protected intersection design would minimize ROW impacts while providing traffic calming via smaller curb radii, minimize pedestrian crossing distance, and provide a protected bicycle crossing.
- The protected intersection would improve the level of traffic stress for people walking and biking.
- Adding eastbound and westbound left turn lanes would provide greater flexibility in traffic signal timing and reduce overall intersection delay.

Preferred Alternative

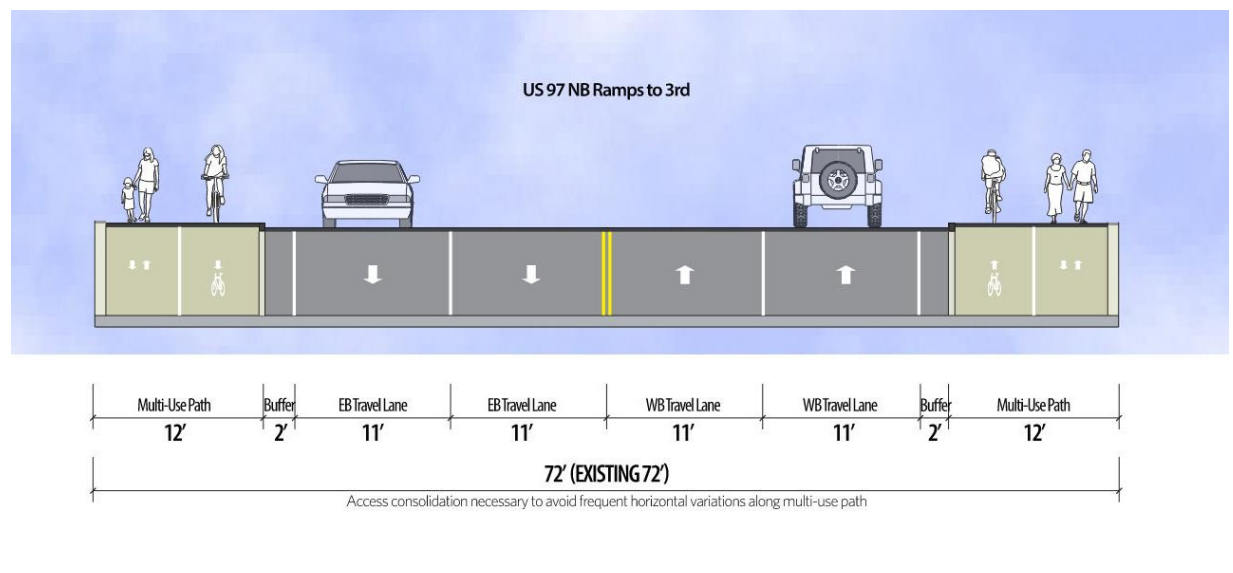


Design/Construction Constraints and Opportunities

- Intersection concept design shows roadway centerline offset to the west to avoid impacts to building in the southeast corner. This could be refined on the south approach to reduce the length of property impacts.
- Design refinements should consider treatments to reduce impacts to utility lines on the south and east side of the intersection.
- Consider utilizing multi-use paths approaching the intersection instead of at-grade bike lanes to limit ROW impacts (see example cross section below).
- Investigate and revise access management, if necessary, near the intersection – particularly on the east leg.
- Refine intersection design and explore other cost saving measures during design. For example, current cost estimates assume full depth pavement reconstruction for entire project extents shown in the concept figures.
- Adding a southbound right turn lane could improve intersection operations but was not considered as part of the preferred alternative due to costs exceeding available funding and ROW impacts.
- Any green striping is subject to ODOT traffic approval and funding to maintain.

Typical Street Sections

The following cross section is not currently funded and represents a potential ultimate cross section along Reed Market. The preferred alternative utilizes short term restriping (shown in preferred alternative figure) along Reed Market to narrow travel lanes to 11' and provide a buffered bike lane.



Prospectus Sheets

Intersection: Reed Market Road and Chamberlain Street	
<p>Problem Statement: Chamberlain Street has been identified as a key walking and biking route in the Bend TSP. The City has approximately \$250,000 in the Neighborhood Street Safety Program to pave a portion of Chamberlain Street and install crossing enhancements at Reed Market Road. Chamberlain Street is two-way stop controlled and does not have a through movement at Reed Market Road. There is a marked pedestrian crossing on the west side of the intersection.</p>	
Preferred Alternative Description	
<ul style="list-style-type: none"> • New pedestrian crossing on the east leg. • Wayfinding signage for people walking and biking. • Median cutouts for a bicycle crossing and green pavement markings. Any green striping is subject to ODOT traffic approval and funding to maintain. • Additional pedestrian and bicycle crossing warning signage. • Improve visibility of and for pedestrians by removing vegetation in the median. • Preserving space for future bus stops along Reed Market Road. • Adding enhanced lighting at the intersection. 	

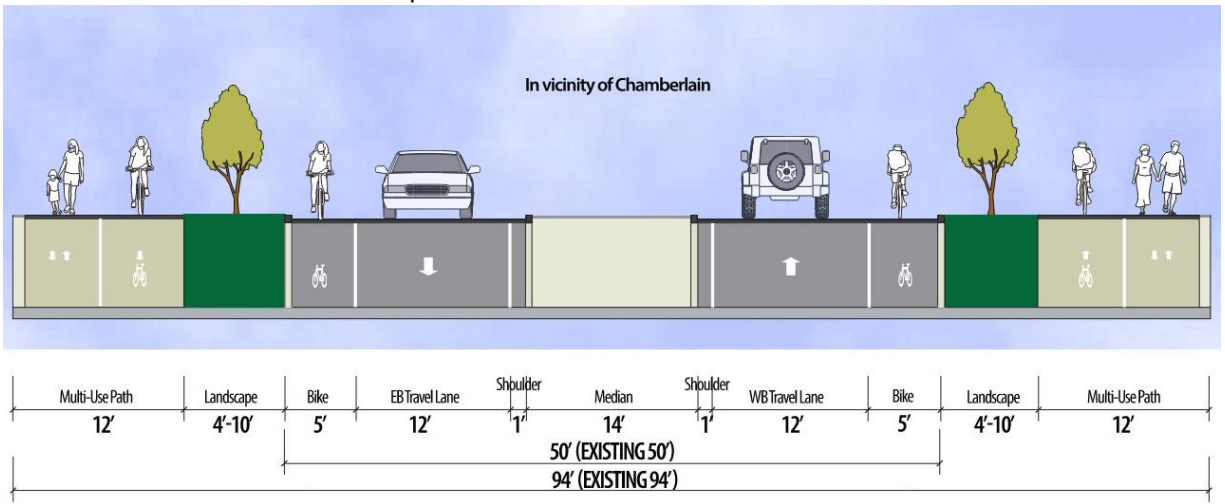
Preferred Alternative Example



Example of preferred alternative median bicycle crossing

Typical Proposed Street Sections

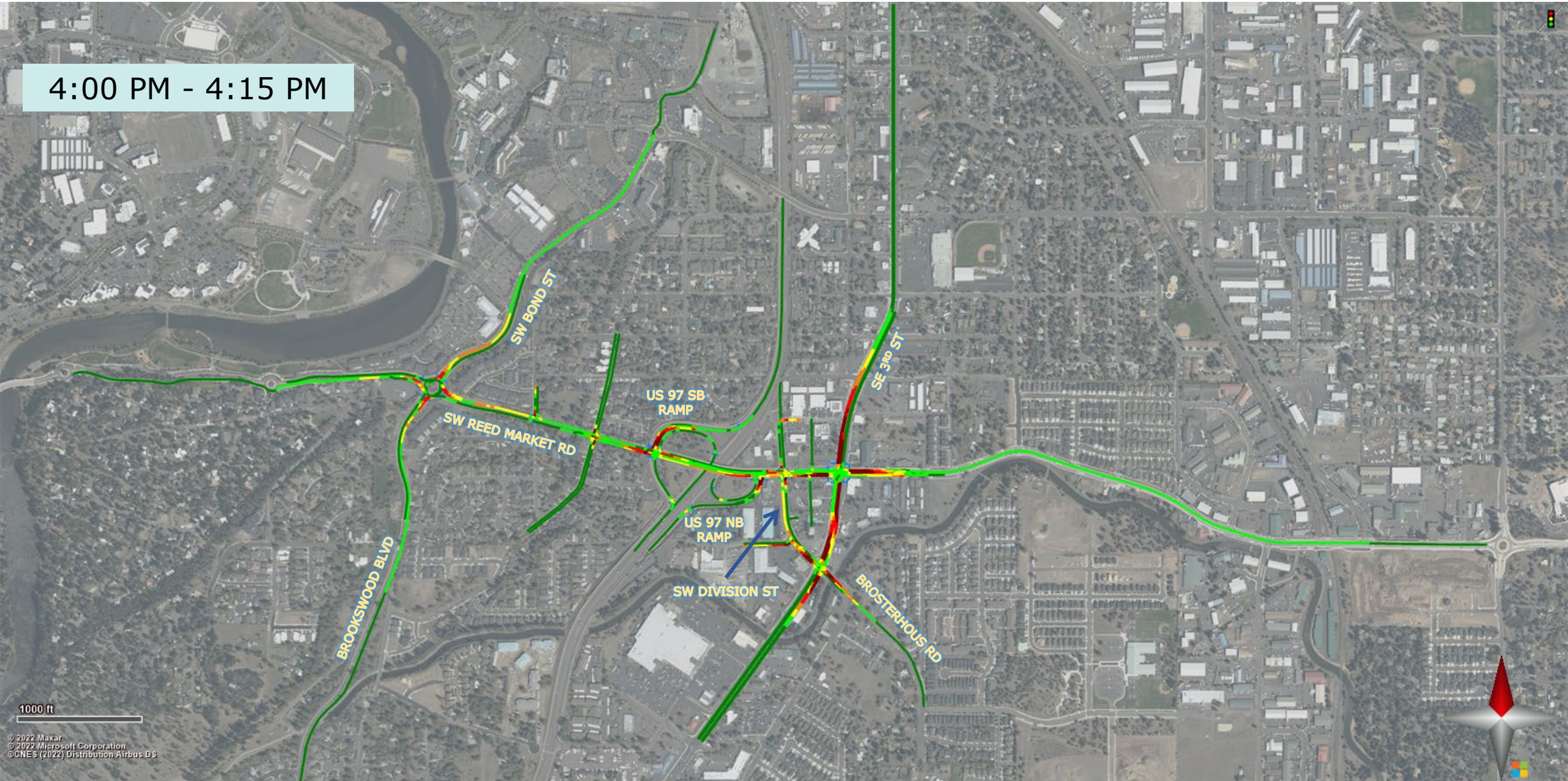
The following cross section is not currently funded and represents a potential ultimate cross section along Reed Market in the vicinity of Chamberlain Street. The preferred alternative could be constructed to be consistent with the existing cross section while maintaining forward compatibility with a future cross-section where possible.



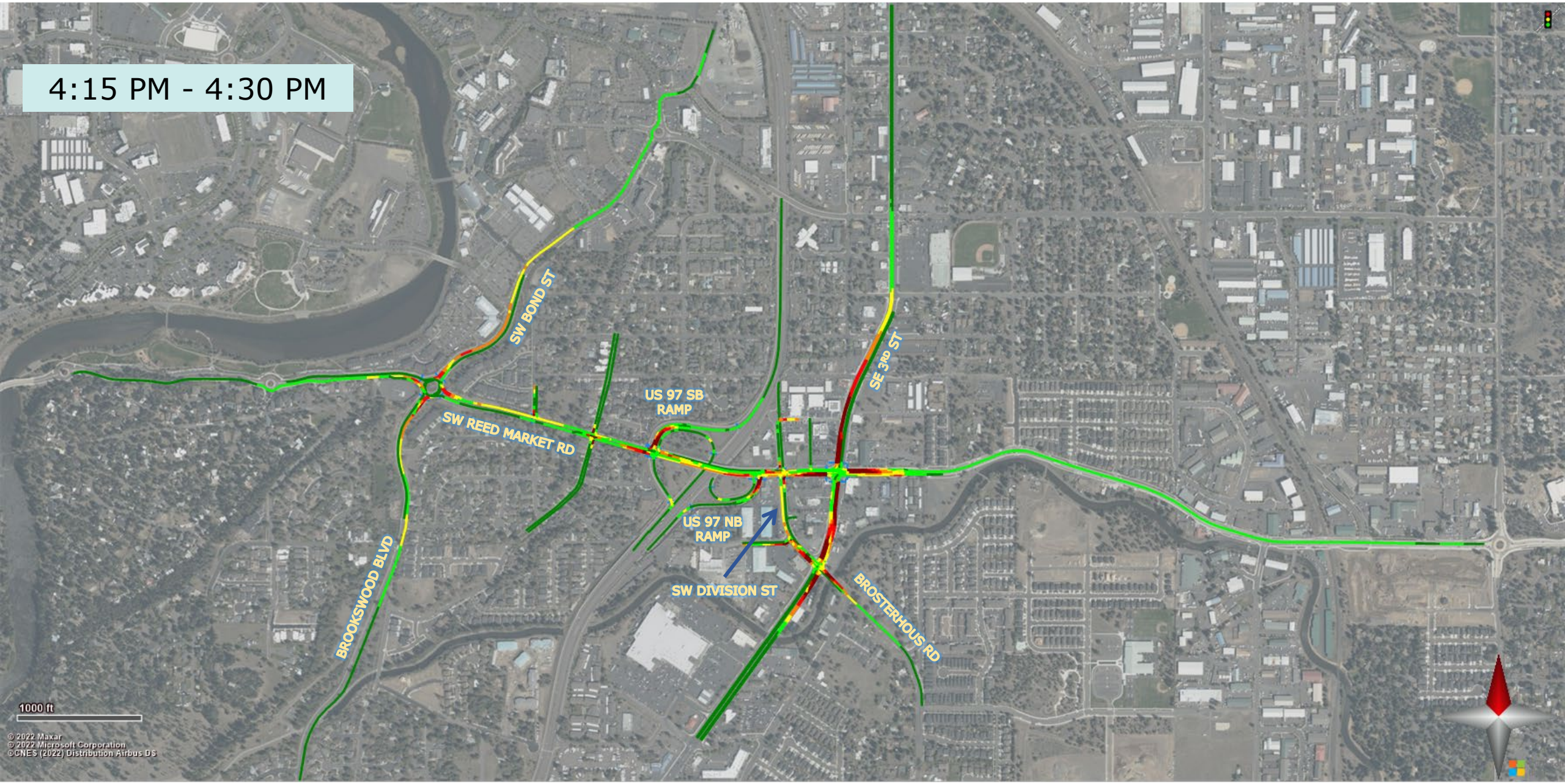
APPENDIX B: VISSIM MODEL QUEUE PLOTS FOR THE PREFERRED ALTERNATIVES



4:00 PM - 4:15 PM



4:15 PM - 4:30 PM

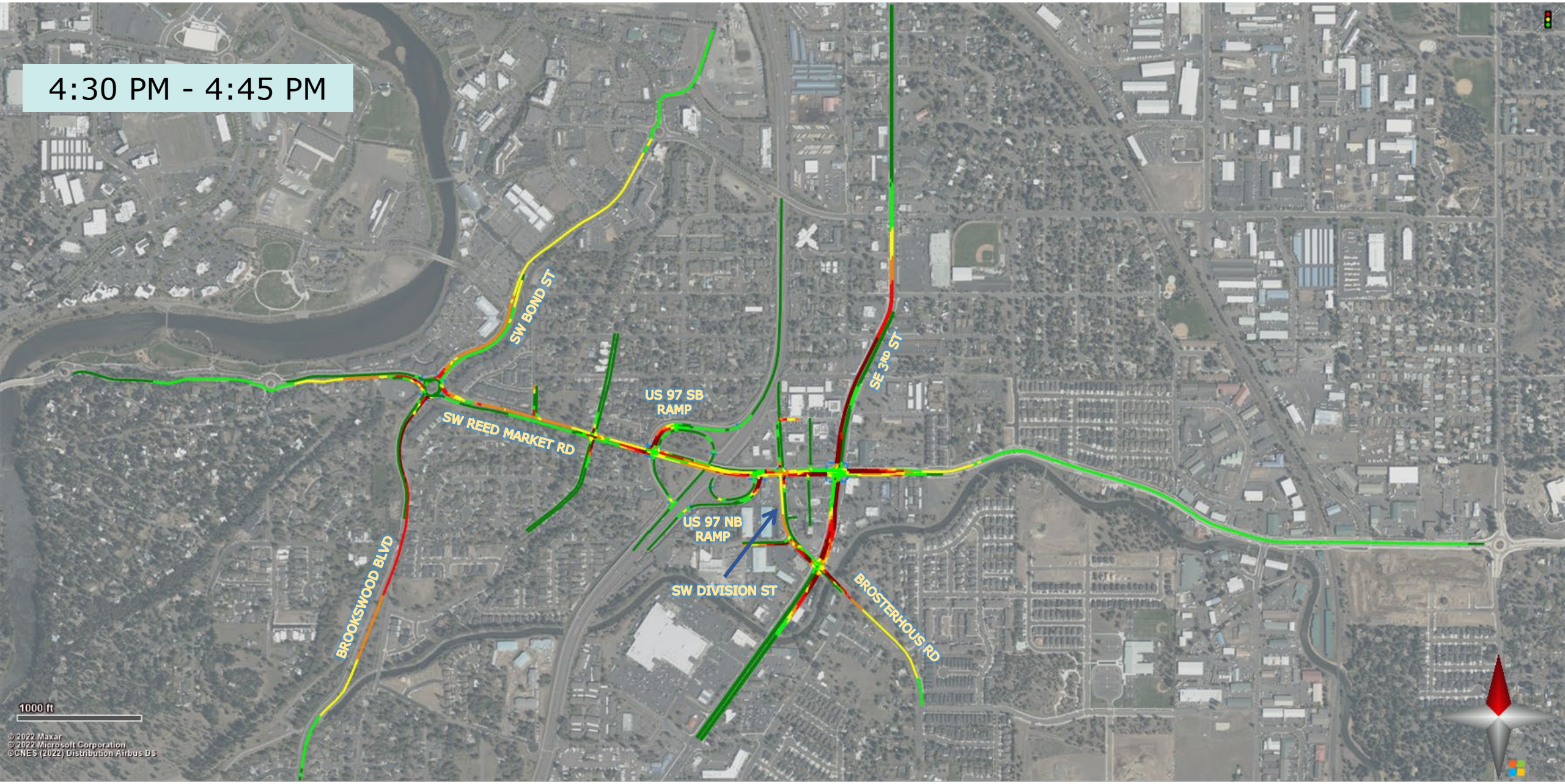


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4:30 PM - 4:45 PM

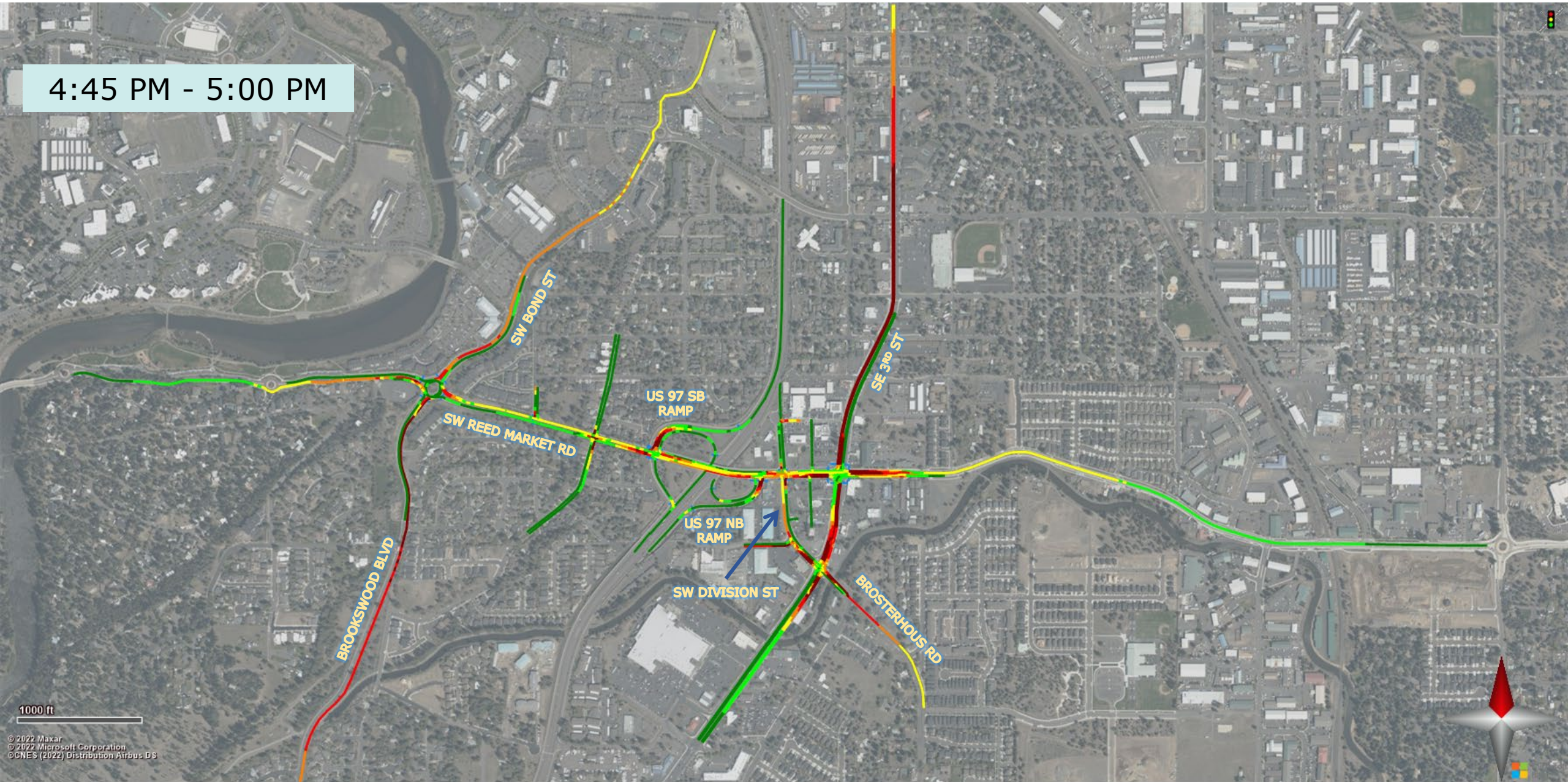


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4:45 PM - 5:00 PM

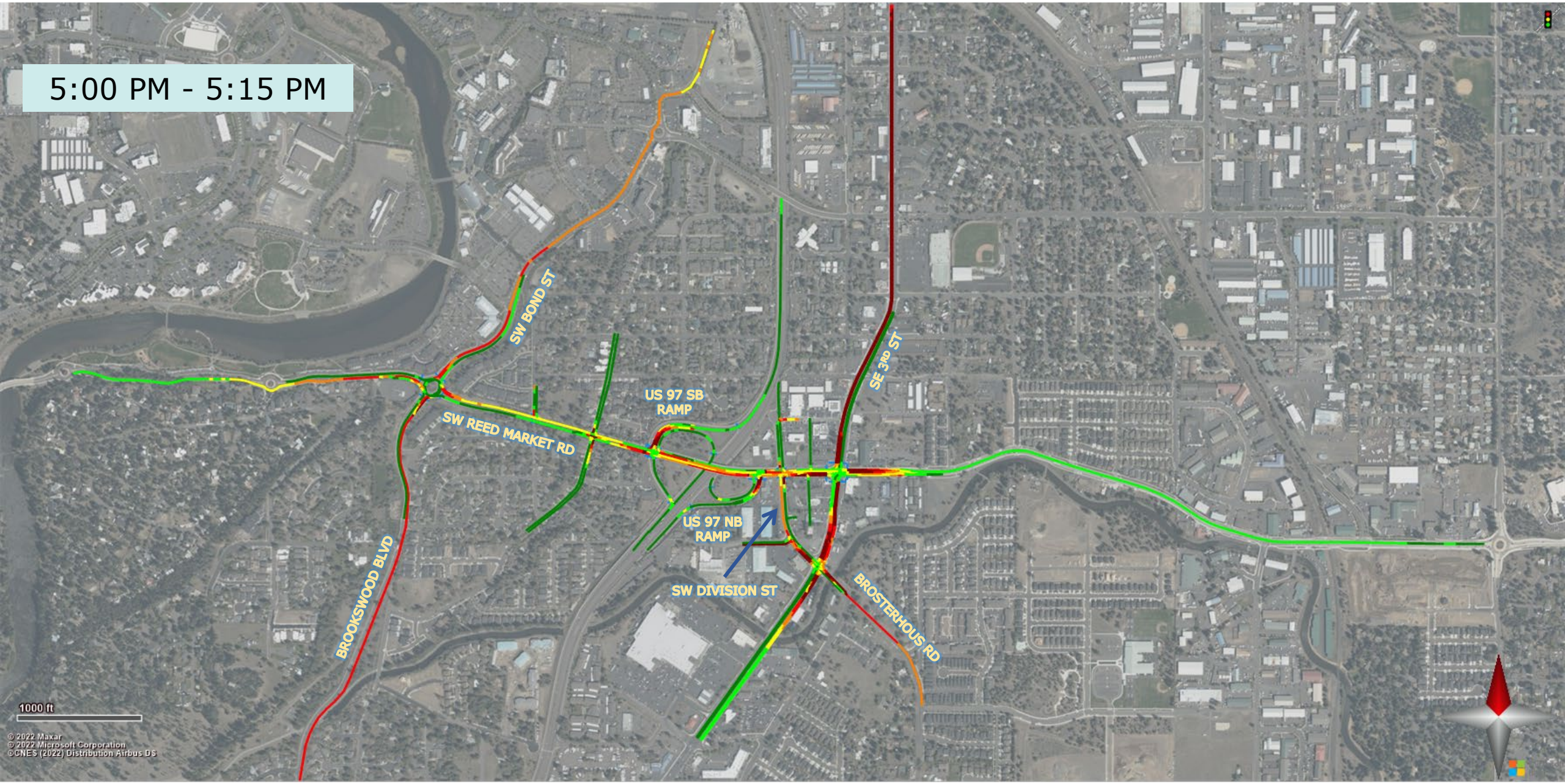


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5:00 PM - 5:15 PM

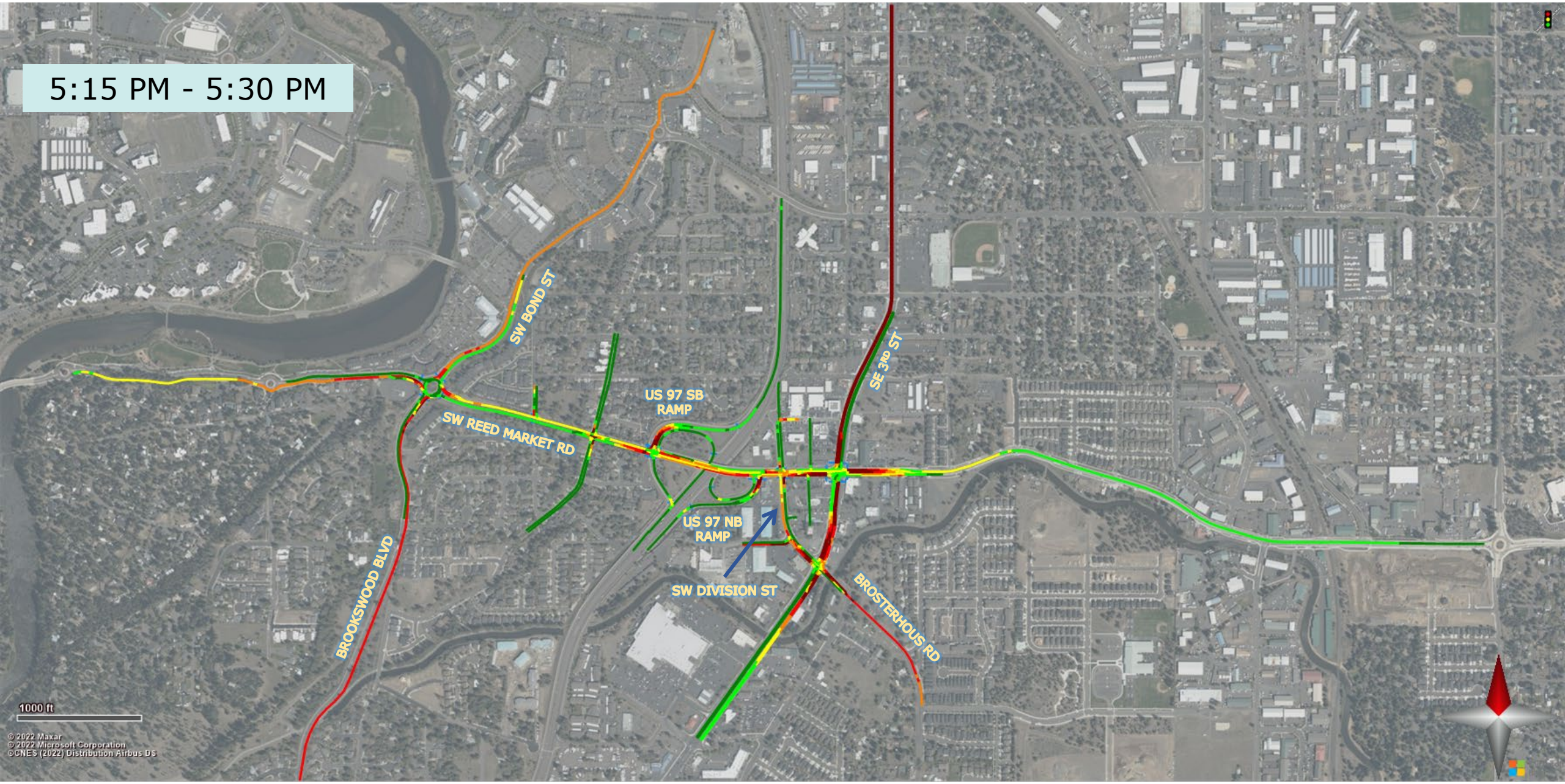


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5:15 PM - 5:30 PM

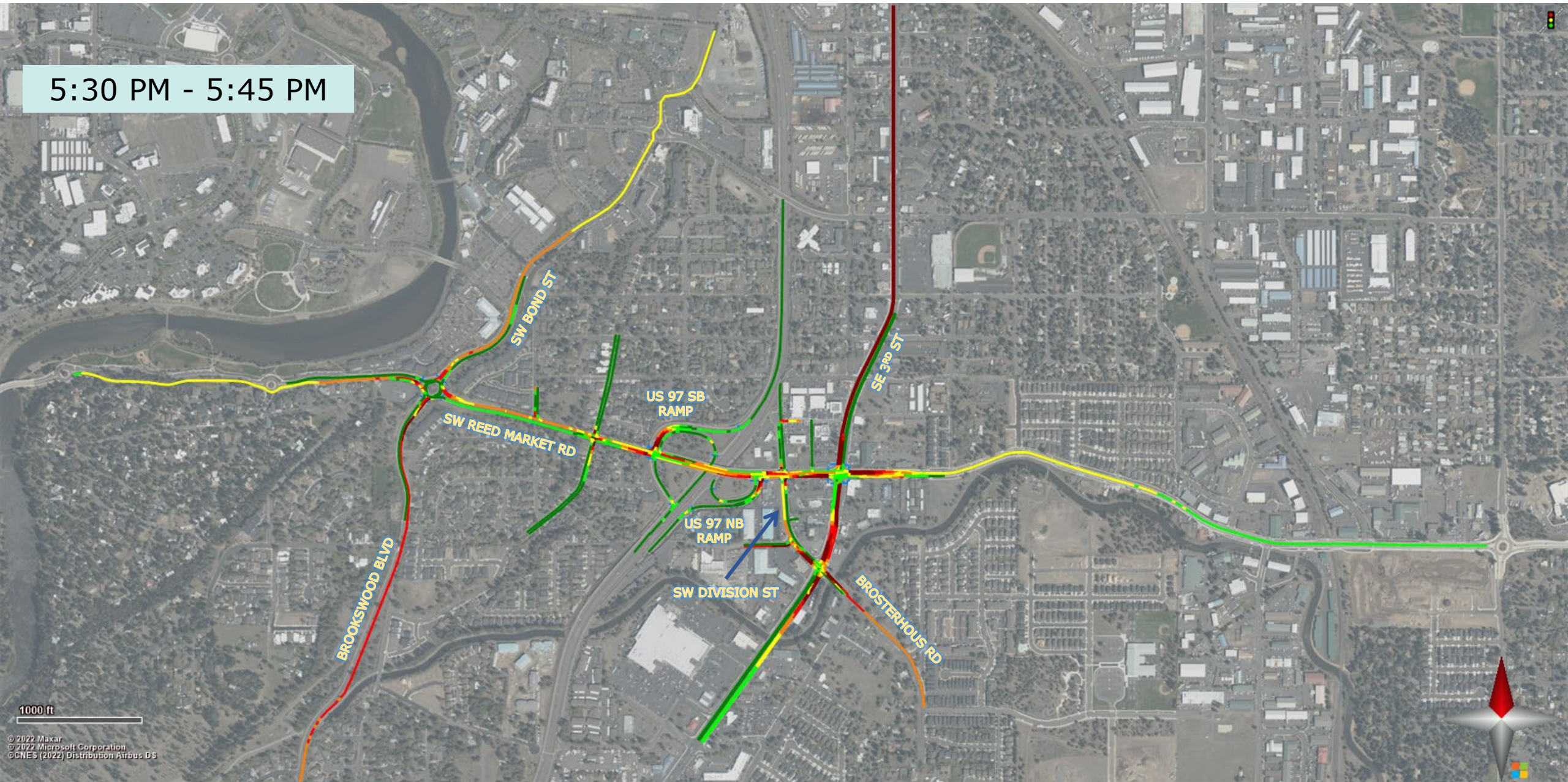


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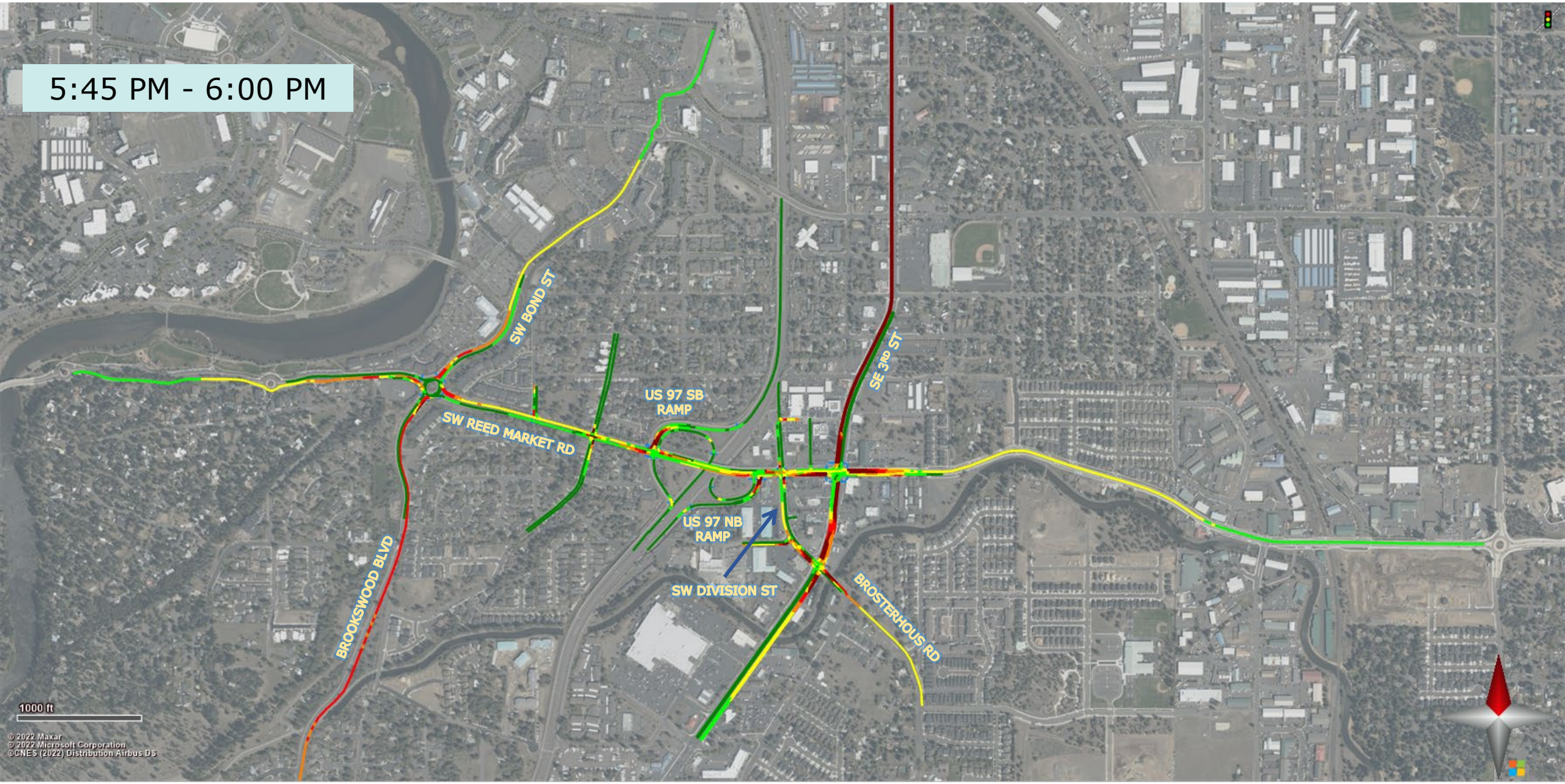
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5:45 PM - 6:00 PM



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APPENDIX C: VISSIM MODEL VEHICLE QUEUE TABLE FOR THE PREFERRED ALTERNATIVES

TABLE: QUEUE COUNTERS

Movement	Average Queue	Std Dev	Max Queue	95th Percentile Queue
Reed Market Road and Brookswood Boulevard/Bond Street:NBT	2865	796	3455	3420
Reed Market Road and Brookswood Boulevard/Bond Street:NBL	2790	945	3445	3415
Reed Market Road and Brookswood Boulevard/Bond Street:SBT	2300	1457	3890	3860
Reed Market Road and Brookswood Boulevard/Bond Street:SBL	2240	1503	3870	3840
Reed Market Road and Brookswood Boulevard/Bond Street:EBT	750	694	2915	2260
Reed Market Road and Brookswood Boulevard/Bond Street:EBR	75	121	1170	155
Reed Market Road and Brookswood Boulevard/Bond Street:WBT	445	605	1865	1865
Reed Market Road and Brookswood Boulevard/Bond Street:WBR	355	548	1855	1855
Reed Market Road and US 97 SB Ramp:SBT	215	50	385	320
Reed Market Road and US 97 SB Ramp:EBT	275	287	2045	625
Reed Market Road and US 97 SB Ramp:WBT	430	299	910	885
Reed Market Road and US 97 NB Ramp:NBR	55	37	165	145
Reed Market Road and US 97 NB Ramp:NBL	95	43	280	165
Reed Market Road and US 97 NB Ramp:EBT	640	179	870	865
Reed Market Road and US 97 NB Ramp:WBT	275	210	705	705
Reed Market Road and Division:NBR	20	18	105	60
Reed Market Road and Division:SBT	10	11	45	25
Reed Market Road and 3rd Street:NBT	645	159	830	795
Reed Market Road and 3rd Street:NBL	625	186	825	795
Reed Market Road and 3rd Street:SBT	2985	999	3835	3805
Reed Market Road and 3rd Street:SBL	2985	1002	3840	3805
Reed Market Road and 3rd Street:EBT	420	169	710	640
Reed Market Road and 3rd Street:EBL	315	210	710	640
Reed Market Road and 3rd Street:WBT	685	842	3835	2775
Reed Market Road and 3rd Street:WBL	735	861	3890	2925
3rd Street and Brosterhous Road:NBT	455	323	1670	1365
3rd Street and Brosterhous Road:NBL	270	397	1670	1365
3rd Street and Brosterhous Road:SBT	310	89	805	480
3rd Street and Brosterhous Road:SBL	320	90	815	490
3rd Street and Brosterhous Road:EBL	385	349	1080	1040
3rd Street and Brosterhous Road:EBT	600	333	1080	1045
3rd Street and Brosterhous Road:EBR	385	341	1080	1035
3rd Street and Brosterhous Road:WBT	780	520	1445	1390
3rd Street and Brosterhous Road:WBL	120	306	1385	1360

APPENDIX D: VISSIM MODEL AVERAGE DELAY TABLE FOR THE PREFERRED ALTERNATIVES

Delay Table

Future (2040) PM Peak
4:30 PM - 5:30 PM

TABLE: AVERAGE DELAY

Intersection	Approach	Movement	Volume	Average Delay (s)
Reed Market Road and Brookwood Boulevard/Bond Street	NB	Left	175	308
		Through	422	331
		Right	65	329
		U-Turn	-	-
		Total	662	324
	SB	Left	415	136
		Through	477	136
		Right	70	134
		U-Turn	-	-
		Total	962	136
	EB	Left	65	94
		Through	439	94
		Right	212	73
		U-Turn	-	-
		Total	716	88
	WB	Left	75	43
		Through	366	41
		Right	397	39
		U-Turn	-	-
		Total	838	40
Total			3178	139
Reed Market Road and US 97 SB Ramp	NB	Left	-	-
		Through	-	-
		Right	-	-
		U-Turn	-	-
		Total	-	-
	SB	Left	667	34
		Through	3	23
		Right	240	35
		U-Turn	-	-
		Total	910	34
	EB	Left	-	-
		Through	813	19
		Right	106	23
		U-Turn	-	-
		Total	919	20
	WB	Left	-	-
		Through	732	37
		Right	130	4
		U-Turn	-	-
		Total	862	32
Total			2691	29

Delay Table

Future (2040) PM Peak
4:30 PM - 5:30 PM

TABLE: AVERAGE DELAY

Intersection	Approach	Movement	Volume	Average Delay (s)
Reed Market Road and US 97 NB Ramp	NB	Left	127	39
		Through	-	-
		Right	125	22
		U-Turn	-	-
		Total	252	31
	SB	Left	-	-
		Through	-	-
		Right	-	-
		U-Turn	-	-
		Total	-	-
	EB	Left	-	-
		Through	1336	29
		Right	144	40
		U-Turn	-	-
		Total	1480	30
	WB	Left	-	-
		Through	737	10
		Right	-	-
		U-Turn	-	-
		Total	737	10
Total			2469	24
Reed Market Road and Division	NB	Left	-	-
		Through	-	-
		Right	49	67
		U-Turn	-	-
		Total	49	67
	SB	Left	-	-
		Through	-	-
		Right	26	17
		U-Turn	-	-
		Total	26	17
	EB	Left	-	-
		Through	801	4
		Right	658	4
		U-Turn	-	-
		Total	1459	4
	WB	Left	-	-
		Through	715	13
		Right	378	2
		U-Turn	-	-
		Total	1093	9
Total			2627	8

Delay Table

Future (2040) PM Peak
4:30 PM - 5:30 PM

TABLE: AVERAGE DELAY

Intersection	Approach	Movement	Volume	Average Delay (s)
Reed Market Road and 3rd Street	NB	Left	351	143
		Through	758	62
		Right	278	66
		U-Turn	-	-
		Total	1387	83
	SB	Left	172	499
		Through	701	473
		Right	167	484
		U-Turn	-	-
		Total	1040	479
	EB	Left	154	65
		Through	623	61
		Right	71	60
		U-Turn	-	-
		Total	848	61
	WB	Left	273	148
		Through	580	86
		Right	105	86
		U-Turn	-	-
		Total	958	104
Total			4233	181
3rd Street and Brosterhous Road	NB	Left	39	72
		Through	828	72
		Right	55	75
		U-Turn	-	-
		Total	922	72
	SB	Left	211	76
		Through	819	32
		Right	34	25
		U-Turn	-	-
		Total	1064	41
	EB	Left	67	296
		Through	363	53
		Right	280	55
		U-Turn	-	-
		Total	710	77
	WB	Left	50	135
		Through	27	133
		Right	485	124
		U-Turn	-	-
		Total	562	125
Total			3258	72

APPENDIX E: VISSIM MODEL GEH STATISTICS TABLE FOR THE PREFERRED ALTERNATIVES

GEH Table

Future (2040) PM Peak
4:30 PM - 5:30 PM

Intersection Number	Intersection Name	Movement	Input Volume	VISSIM Output Volume	GEH
1	Reed Market Road and Brookswood Boulevard/Bond Street	NBL	195	175	1.5
		NBT	470	422	2.3
		NBR	70	65	0.6
		SBL	395	415	1.0
		SBT	470	477	0.3
		SBR	70	70	0.0
		EBL	65	65	0.0
		EBT	445	439	0.3
		EBR	210	212	0.1
		WBL	70	75	0.6
		WBT	360	366	0.3
		WBR	425	397	1.4
		Total	3245	3190	1.0
2	Reed Market Road and US 97 SB Ramp	SBL	640	667	1.1
		SBT	0	3	2.4
		SBR	235	240	0.3
		EBT	810	813	0.1
		EBR	95	106	1.1
		WBT	740	732	0.3
		WBR	145	130	1.3
		Total	2665	2714	0.9
3	Reed Market Road and US 97 NB Ramp	NBL	115	127	1.1
		NBR	115	125	0.9
		EBT	1305	1336	0.9
		EBR	150	144	0.5
		WBT	770	737	1.2
				Total	2455
4	Reed Market Road and Division Street	NBR	50	49	0.1
		SBR	20	26	1.3
		EBT	695	801	3.9
		EBR	625	658	1.3
		WBT	750	715	1.3
		WBR	395	378	0.9
				Total	2635

GEH Table

Future (2040) PM Peak
4:30 PM - 5:30 PM

Intersection Number	Intersection Name	Movement	Input Volume	VISSIM Output Volume	GEH
5	Reed Market Road and 3rd Street	NBL	365	351	0.7
		NBT	780	758	0.8
		NBR	275	278	0.2
		SBL	205	172	2.4
		SBT	820	701	4.3
		SBR	195	167	2.1
		EBL	145	154	0.7
		EBT	610	623	0.5
		EBR	70	71	0.1
		WBL	260	273	0.8
		WBT	590	580	0.4
		WBR	110	105	0.5
		Total	4425	4285	2.1
6	3rd Street and Brosterhous Road	NBL	30	39	1.5
		NBT	855	828	0.9
		NBR	50	55	0.7
		SBL	230	211	1.3
		SBT	895	819	2.6
		SBR	35	34	0.2
		EBL	85	67	2.1
		EBT	345	363	1.0
		EBR	270	280	0.6
		WBL	55	50	0.7
		WBT	25	27	0.4
		WBR	480	485	0.2
		Total	3355	3297	1.0

Enter and Exit GEH

Future (2040) PM Peak
4:30 PM - 5:30 PM

Entry GEH (4:30-5:30 PM)					
Entry Location	Count	Vissim Throughput	Diff	%Diff	GEH
Reed Market Road and Brookwood Boulevard/Bond Street - N	935	962	27	2.9%	0.9
Reed Market Road and Brookwood Boulevard/Bond Street - S	735	662	-73	-9.9%	2.8
Reed Market Road and Brookwood Boulevard/Bond Street - W	720	716	-4	-0.6%	0.1
Reed Market Road and US 97 SB Ramp - N	875	910	35	4.0%	1.2
Reed Market Road and US 97 NB Ramp - S	230	252	22	9.6%	1.4
Reed Market Road and 3rd Street - N	1220	1040	-180	-14.8%	5.6
Reed Market Road and 3rd Street - E	960	958	-2	-0.2%	0.1
3rd Street and Brosterhous Road - S	935	922	-13	-1.4%	0.4
3rd Street and Brosterhous Road - E	560	562	2	0.4%	0.1

Exit GEH (4:30-5:30 PM)					
Entry Location	Count	Vissim Throughput	Diff	%Diff	GEH
Reed Market Road and Brookwood Boulevard/Bond Street - N	960	884	-76	-7.9%	2.6
Reed Market Road and Brookwood Boulevard/Bond Street - S	750	764	14	1.9%	0.5
Reed Market Road and Brookwood Boulevard/Bond Street - W	625	611	-14	-2.2%	0.6
Reed Market Road and US 97 SB Ramp - S	95	109	14	14.7%	1.3
Reed Market Road and US 97 NB Ramp - S	150	144	-6	-4.0%	0.5
Reed Market Road and 3rd Street - N	1035	1017	-18	-1.7%	0.6
Reed Market Road and 3rd Street - E	1090	1073	-17	-1.6%	0.5
3rd Street and Brosterhous Road - S	1220	1149	-71	-5.8%	2.1
3rd Street and Brosterhous Road - E	625	629	4	0.6%	0.2