



TECHNICAL MEMORANDUM #4

DATE: November 5, 2020

TO: Rick Williams | ODOT

FROM: John Bosket, PE; Aaron Berger, PE (WA); Kayla Fleskes, EI | DKS Associates

SUBJECT: US 97 North Bend Interchange Study: Project #20092-000
Future Baseline Systems Operations

This memorandum summarizes future baseline traffic and freight operations for the US 97 North Bend Interchange study area. This information, along with the assessment of current transportation conditions presented in Technical Memorandum #3, will be used to establish a baseline from which the impacts on the transportation system from alternative interchange solutions will be evaluated.

SUMMARY OF KEY FINDINGS

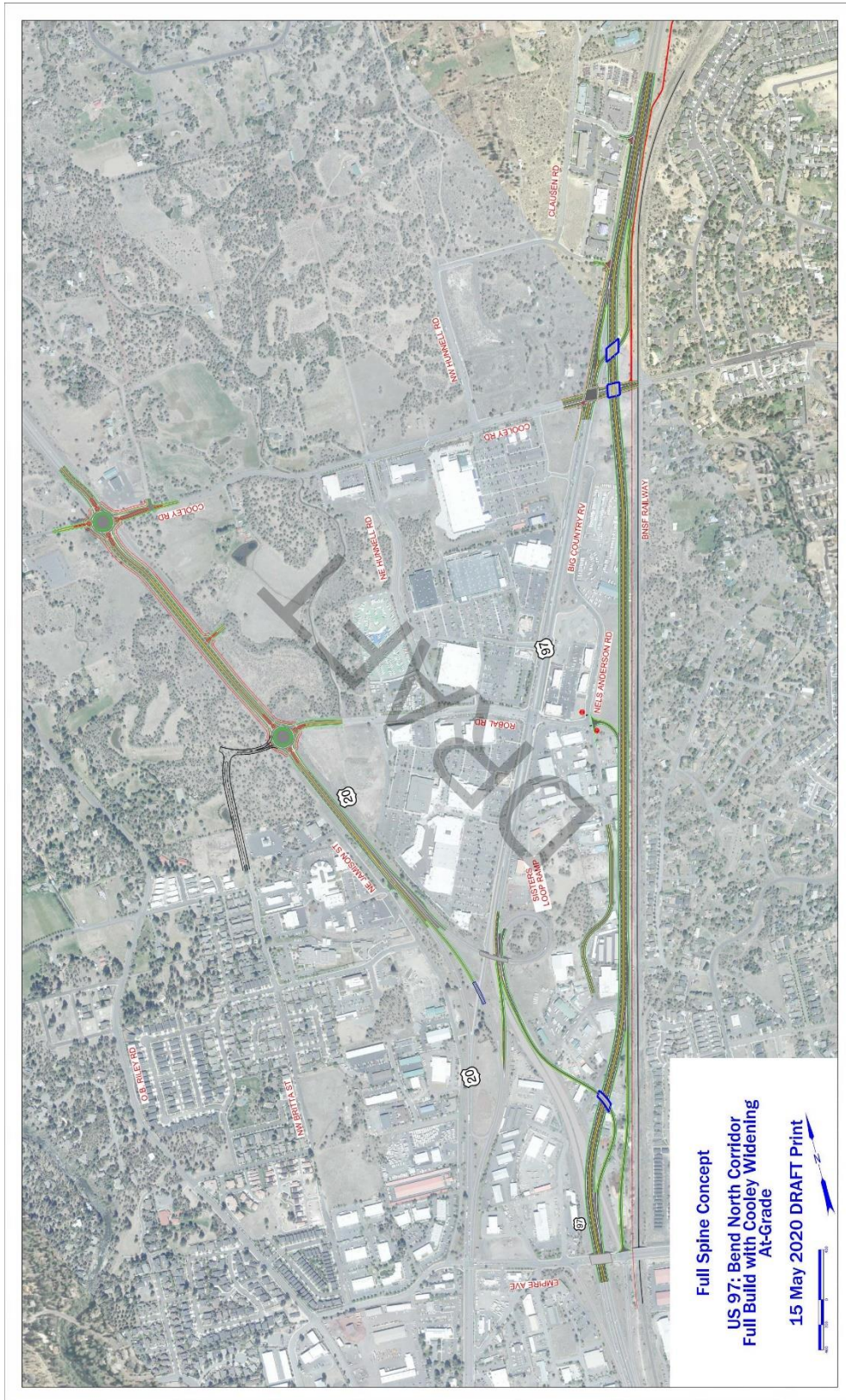
- By 2040, daily traffic on US 97 in the proximity of the proposed interchange is expected to increase by 75 percent from 27,700 to 48,500 vehicles per day. About two-thirds of this growth is related to “through” travel with origins/destinations south of US 20. The remaining one-third of the growth accesses City streets in the vicinity area with much of it related to surrounding land uses.
- Freight truck traffic currently carries over \$6.5 billion worth of commodities annually on US 97 through the study area.
- Existing significant geometric constraints for freight vehicles on US 97 are being addressed by the North Corridor Project (which includes a realignment of US 97 and grade separation at Cooley Road). Reliability and congestion will also be improved by the North Corridor Project, which will have a positive impact on freight operations.
- While a grade-separated crossing of US 97 at Cooley Road (North Corridor Project) will improve accessibility, US 97 remains a barrier to various modes traveling between potential future traffic generators both east and west of US 97.
- Cooley Road and 18th Street is expected to meet mobility targets during the 2040 weekday pm peak hour.

FUTURE (YEAR 2040) TRAFFIC VOLUMES

Future traffic volumes were forecast for the year 2040 using the Bend-Redmond Regional Travel Demand Model (BRM). The BRM transportation network included projects from the Bend Metropolitan Transportation Plan (MTP) and Deschutes County Transportation System Plan, as well as the Bend Integrated Land Use and Transportation Plan (ILUTP) (Urban Growth Boundary expansion) projects in North Bend. These projects included:

- North Corridor Project INFRA Grant improvements, which realigns US 97 between Cooley Road and Empire Avenue (Figure 1, MTP Project 13)
- Empire Avenue Extension (MTP Project 9)
- Yeoman Road Extension (MTP Project 17)
- Britta Extension (MTP Projects 20 and 21)
- Robal Road Extension between US 20 and O.B. Riley (ILUTP Project 204)
- Hunnell Road Extension (ILUTP Project 205, Deschutes County Transportation Plan)
- Loco Road Extension (ILUTP Project 248)
- New collector in expansion area (ILUTP Project 206a)

FIGURE 1. NORTH CORRIDOR PROJECT CONCEPT

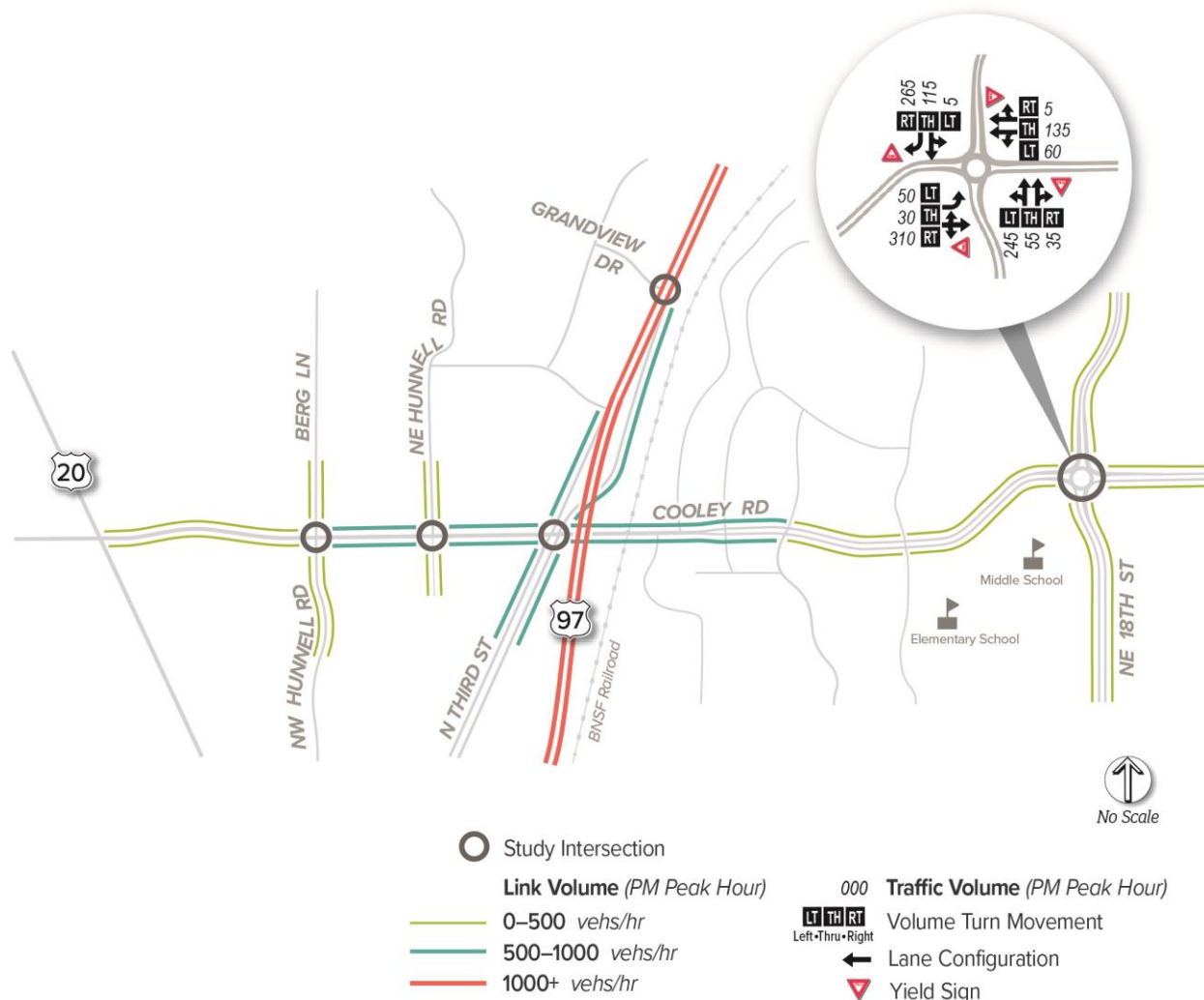


Source: <https://www.oregon.gov/odot/projects/pages/project-details.aspx?project=21229>

Figure 2 shows the approximate 2040 traffic volumes on the study area roadways during the design hour (future equivalent of the 30th highest annual hour). Peak hour traffic volumes grow by approximately 45 percent on US 97 near Grandview Drive (approximately two percent annual growth). Traffic volumes are expected to significantly decrease on North 3rd Street as the new US 97 alignment pulls through movements off of North 3rd Street.

Analysis for the North Corridor project is currently on-going to determine appropriate lane configurations and access near the study area, which could impact future traffic volumes. Therefore, intersection turning movement volumes were only forecast for the future baseline conditions at Cooley Road and 18th Street (using NCHRP Report 765¹ procedures).

FIGURE 2. FUTURE (2040) DESIGN HOUR TRAFFIC VOLUMES



¹ National Cooperative Highway Research Program (NCHRP) Report 765: *Analytical Forecasting Approaches for Project-Level Planning and Design*

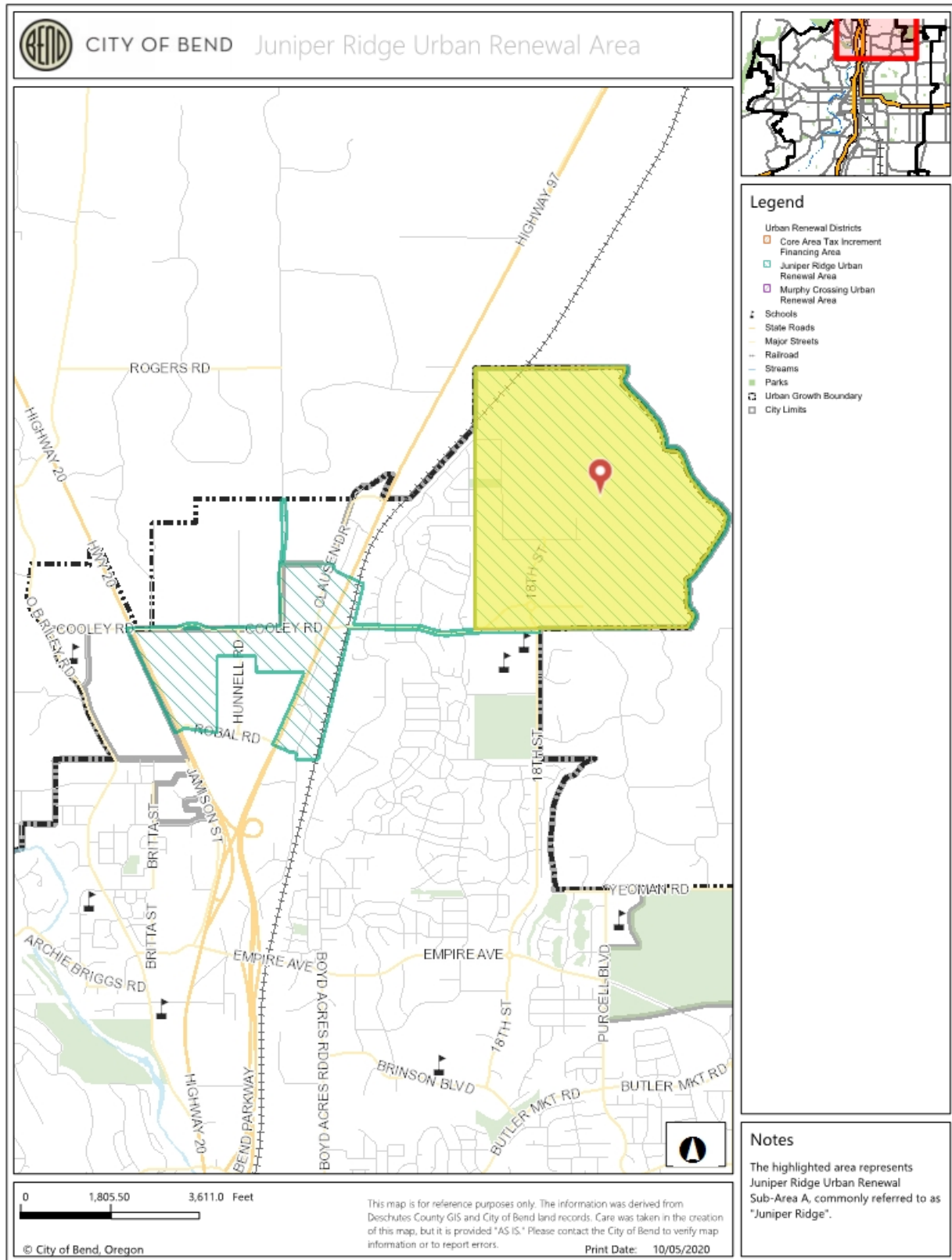
POTENTIAL FUTURE TRAFFIC GENERATORS

In the future as development continues to occur in Bend, traffic is anticipated to increase on US 97 and nearby roadways. In particular, Juniper Ridge is anticipated to be a heavy traffic generator in the vicinity area. Juniper Ridge (highlighted in Figure 3 below) is a 500-acre industrial and business park that encompasses land to the north of Cooley Road. Juniper Ridge is zoned as Industrial Limited and is anticipated to generate additional passenger vehicle and freight traffic.

Under future baseline conditions, nearly 30 percent of eastbound traffic on Cooley Road east of US 97 would be destined for Juniper Ridge and nearly 60 percent of westbound traffic on Cooley Road would be traveling from Juniper Ridge. This increase in traffic on Cooley Road would pass by Sky View Middle School and contend with an at-grade rail crossing at Cooley Road. In addition, as build out of Juniper Ridge continues to occur (beyond the 20-year planning horizon), more traffic will be funneled to Cooley Road for vehicles to access North 3rd Street, US 97 and land uses east of US 97.

There are limited routes for people to cross US 97 to access potential future traffic generators. In particular, as noted in Technical Memorandum #3, there are limited routes for people walking and biking to cross US 97 and key bike facility and sidewalk gaps exist. Under future baseline conditions, Cooley Road would be the northernmost crossing of US 97 near Bend to connect residential land uses east of US 97 with the Juniper Ridge area, with the next closest crossing to the north at Deschutes Market Road.

FIGURE 3. JUNIPER RIDGE URBAN RENEWAL AREA BOUNDARY



Source: Bend Oregon Online Mapper (BOOM) <https://maps.ci.bend.or.us/html5viewer/?viewer=publicviewer#>

FREIGHT OPERATIONS

US 97 through the study area is classified as a Statewide Highway and has been designated as a part of the National Highway System, a Federally Designated Truck Route, a State Freight Route and Reduction Review Route, and an Expressway. It serves as a crucial north-south freight route through Oregon and connects to US 20 in Bend to serve eastern Oregon.

Today, nearly 10 percent of the Annual Average Daily Traffic (AADT) is truck traffic (approximately 2,700 trucks per day)². A little over three percent of all US 97 daily traffic is multi-unit truck traffic. The value of freight traveling on US 97 through the study area is approximately \$6.5 billion annually, with the highest value commodities being food or kindred products or machinery, instruments, transportation equipment or metals³. The largest tonnage of commodities on US 97 include clay, minerals or stone and food or kindred products, followed closely by forest or wood products.

By 2040, daily traffic on US 97 in the proximity of the proposed interchange is expected to increase by 75 percent from 27,700 to 48,500 vehicles per day⁴. About two-thirds of this growth is related to “through” travel with origins/destinations south of US 20. The remaining one-third of the growth accesses City streets in the vicinity area with much of it related to surrounding land uses. Commodities traveling by freight trucks are also expected to increase in both value and tonnage on US 97, as it serves a crucial north-south route through Oregon. As general traffic and freight traffic increases, it will be critical to address any potential freight issues to ensure the efficient and reliable delivery of goods on US 97.

RELIABILITY AND CONGESTION

Reliable transportation is critically important to the freight sector to ensure on-time delivery of the billions of dollars’ worth of goods. Less reliable freight transportation can reduce the productivity of freight trucks, increase the number of trucks on the road and increase costs associated with warehousing inventory that would otherwise be on the road⁵.

Congestion and crash incidents play a key role in reliability on US 97, particularly in urban areas such as near Bend. US 97 in northern Bend between Cooley Road and the US 20 interchange to Sisters is estimated to have some of the highest levels of unreliability and delay on all of US 97 through Oregon⁶. US 97 intersects at-grade with several key arterials in Bend and provides access

² ODOT Transgis: <https://gis.odot.state.or.us/transgis/>

³ *Technical Memorandum 2: Existing and Future Conditions Addendum*, US 97 Freight Plan Phase 2, Oregon Department of Transportation Dec 2018

⁴ ODOT Transgis: <https://gis.odot.state.or.us/transgis/>

⁵ *Reliability: Critical to Freight Transportation*, Federal Highway Administration
<https://www.fhwa.dot.gov/publications/publicroads/04nov/09.cfm>

⁶ *Technical Memorandum 2: Existing and Future Conditions Addendum*, US 97 Freight Plan Phase 2, Oregon Department of Transportation Dec 2018

to commercial land uses in the Golden Triangle (area between US 97 and US 20), which generates a substantial amount of cross street traffic. The delay and unreliability at Cooley Road can spillback to the north, affecting the proposed interchange area. While this congestion and unreliability likely have a significant impact on freight delay, the North Corridor Project realigns US 97 through this section to limit at-grade access. The North Corridor Project should significantly improve congestion and reliability for freight on US 97.

However, the North Corridor Project is currently not likely to address unreliability tied to the at-grade railroad crossing along Cooley Road. Freight traffic accessing Juniper Ridge could still be delayed by an at-grade rail crossing along Cooley Road. In 2019, there were an estimated six train crossings daily (three between 6 a.m. and 6 p.m.)⁷.

GEOMETRIC CONSTRAINTS

North of Cooley Road, there are limited geometric constraints for freight vehicles. The US 97 Freight Plan noted that there is limited grade on US 97 north of Bend (2.4 percent or less) and no significant horizontal curvature⁸.

ODOT's Freight Planning Unit conducted the Highway Over-dimension Load Pinch Points (HOLPP) study, which identified over-dimension pinch points on US 97. The pinch point nearest the study area is at mile point 134.93 (near Exit 135A, just south of the Golden Triangle). The structure connecting NB US 97 traffic to US 20 has a vertical constraint of 15'10", shorter than the standard 17'4" for a High Route. While this could limit the ability of over dimension loads on US 97 and was identified by the US 97 Freight Plan as a High Priority Pinch Point, this pinch point is being addressed by the North Corridor Project, as the new US 97 alignment will not travel under the existing structure.

OPERATIONS ANALYSIS

Intersection operations were analyzed using Sidra software and the Highway Capacity Manual (HCM) 6th edition methodologies. Analysis for the North Corridor project is currently on-going to determine appropriate lane configurations and access near the study area. Therefore, intersection operations were only analyzed for the future baseline conditions at Cooley Road and 18th Street. The analysis was conducted using the future (year 2040) design hour traffic volumes shown in Figure 2.

⁷ U.S. DOT Crossing Inventory Form, *Federal Railroad Administration*, Revised 09/03/2020.

⁸ *Technical Memorandum 2: Existing and Future Conditions Addendum*, US 97 Freight Plan Phase 2, Oregon Department of Transportation Dec 2018

Performance measures used for this analysis include volume-to-capacity (V/C) ratios, seconds of control delay and levels of service (LOS). Table 1 summarizes the intersection operations results at Cooley Road and 18th Street, which meets the adopted mobility target.⁹ HCM reports are included in Appendix A.

TABLE 1: FUTURE (2040) DESIGN HOUR TRAFFIC OPERATIONS AT COOLEY ROAD AND 18TH STREET

STUDY INTERSECTION	CONTROL	JURISDICTION	MOBILITY TARGET	V/C ^a	LOS	DELAY (SEC)
COOLEY RD / 18 TH ST	Roundabout	City	v/c ≤ 1.0	0.33	A	7

^a V/C ratio, LOS and delay are reported for the worst approach lane.

⁹ Mobility standards for City facilities based on City of Bend Development Code 4.7.500.

APPENDIX A: HCM REPORTS



USER REPORT FOR SITE

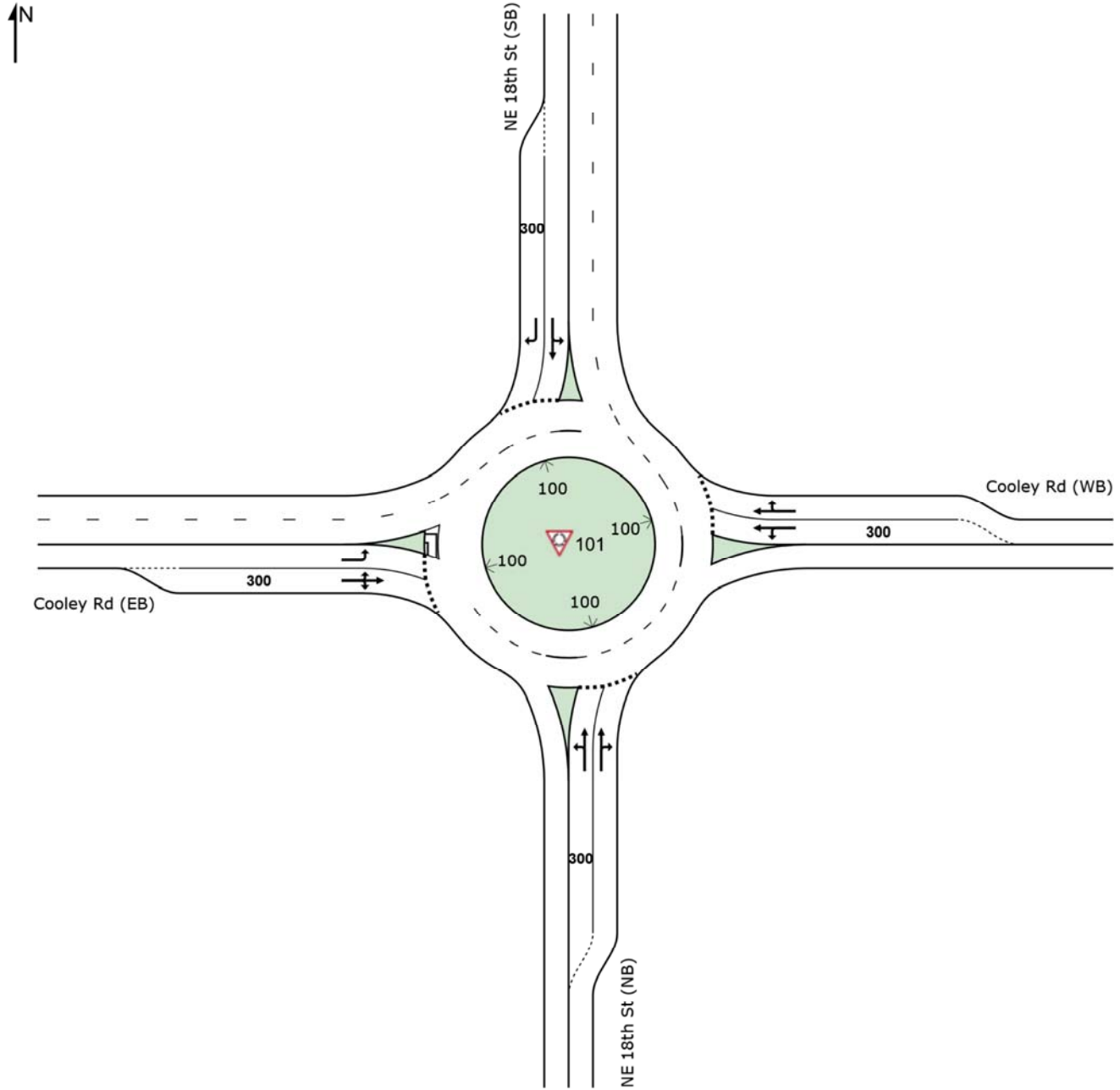
Project: North_Interchange_2040_PM

Template: Default Site User Report

Site: 101 [Cooley/18th 2040 PM - No Build]

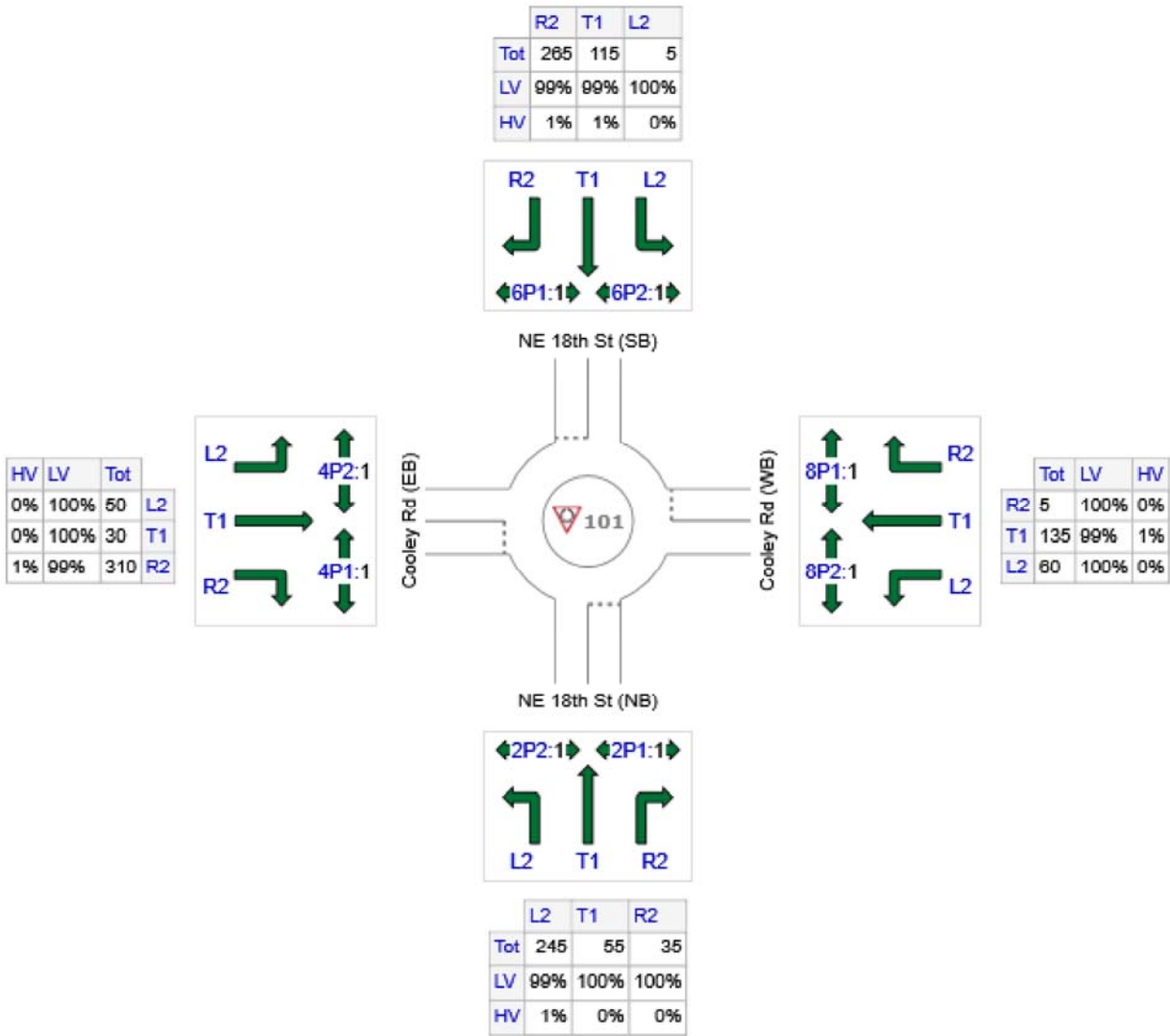
New Site
Site Category: (None)
Roundabout

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NE 18th St (NB)	335	333	2
E: Cooley Rd (WB)	200	199	1
N: NE 18th St (SB)	385	381	4
W: Cooley Rd (EB)	390	387	3
Total	1310	1299	11

Lane Use and Performance													
	Demand	Flows		Deg.	Lane	Average	Level of	95% Back of Queue		Lane	Lane	Cap.	Prob.
	Total	HV	Cap.	Satn	Util.	Delay	Service	Veh	Dist	Config	Length	Adj.	Block.
	veh/h	%	veh/h	v/c	%	sec		ft	ft		ft	%	%
South: NE 18th St (NB)													
Lane 1 ^d	272	1.0	1229	0.222	100	4.9	LOS A	0.8	21.1	Short	300	0.0	NA
Lane 2	100	0.0	1241	0.081	36 ⁵	3.6	LOS A	0.3	6.6	Full	1600	0.0	0.0
Approach	372	0.7		0.222		4.5	LOS A	0.8	21.1				
East: Cooley Rd (WB)													
Lane 1	109	0.4	985	0.111	100	4.7	LOS A	0.4	9.1	Short	300	0.0	NA
Lane 2 ^d	108	0.9	979	0.111	100	4.7	LOS A	0.4	9.0	Full	1600	0.0	0.0
Approach	217	0.7		0.111		4.7	LOS A	0.4	9.1				
North: NE 18th St (SB)													
Lane 1	130	1.0	909	0.144	100	5.3	LOS A	0.5	11.9	Full	1600	0.0	0.0
Lane 2 ^d	288	1.0	908	0.317	100	7.4	LOS A	1.2	30.2	Short	300	0.0	NA
Approach	418	1.0		0.317		6.7	LOS A	1.2	30.2				
West: Cooley Rd (EB)													
Lane 1	54	0.0	1146	0.047	15 ⁵	3.5	LOS A	0.1	3.7	Full	1600	0.0	0.0
Lane 2 ^d	370	0.9	1136	0.325	100	6.3	LOS A	1.3	34.0	Short	300	0.0	NA
Approach	424	0.8		0.325		6.0	LOS A	1.3	34.0				
Intersection	1432	0.8		0.325		5.6	LOS A	1.3	34.0				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: Same as Sign Control.

Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.

LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).

Roundabout Capacity Model: US HCM 6.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

⁵ Lane under-utilisation found by the program

^d Dominant lane on roundabout approach