Banks UGB Expansion / Transportation System Planning:
Transportation Needs, Opportunities and Constraints Report

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This memorandum provides an overview of the Future No-Build (Year 2029) traffic conditions within the Banks Transportation System Plan (TSP) study area, as well as transportation needs, opportunities and constraints. Transportation needs are based on assessment of existing and future transportation conditions. Opportunities are options to address needs identified for the Banks future transportation system. Constraints are limitations or barriers to transportation system development.

Executive Summary

The following discussion summarizes the findings from the existing transportation conditions report, which forms the basis for the development of future transportation conditions.

Existing Conditions (Year 2009)

Congestion (Year 2009)

All six identified study intersections perform well from a volume/capacity measurement in 2009, meeting Oregon Department of Transportation and Washington County mobility standards as appropriate.

Study intersections include:

- OR 47 (Main Street) & NW Oak Way
- OR 47 (Main Street) & OR 6 Interchange Ramp (south of OR 6)
- OR 47 (Main Street) & NW Trellis Way
- OR 47 (Main Street) & NW Banks Road
- NW Banks Road & NW Aerts Road
- OR 6 & NW Aerts Road

Westbound vehicle queuing at OR 47 (Main Street) and NW Banks Road blocks the nearby intersection, causing delay and inhibiting vehicle mobility. This location is identified for realignment and at-grade rail crossing consolidation in 2010 (Rural State Transportation

Improvement Program) which will help alleviate queuing and safety problems, but will not reduce delay for vehicles stopped and waiting to turn onto or cross OR 47 (Main Street) from the stop-controlled approaches. Vehicle queuing (wherein queues exceed available lane storage length) also occurs at the OR 47 (Main Street)/Oak Way signalized intersection at the eastbound right and left turn lanes, northbound right turn lane, and southbound right turn lane.

Community members have identified queuing on Main Street in the vicinity of the Banks school complex at the end of the school day as an issue. The Banks School District is working on a circulation plan to alleviate traffic in this location. Banks TSP efforts will be conducted in coordination with the school district.

Safety

ODOT uses the Safety Priority Index System (SPIS) as a method of identifying locations where safety money may be spent to the highest benefit. The SPIS score is based on three years of crash data and considers crash frequency, crash rate, and crash severity. SPIS sites are 0.10-mile sections on the state highway system.

Based on 2009 data there are no locations within the study area that are on the top 10% ODOT SPIS list. However, the Banks City Council identified one area of concern, OR 6 near NW Aerts Road. One fatality was reported in this area.

Pedestrian, Bicycle and Transit Travel

- There are limited bicycle and pedestrian facilities in Banks. Though some of Banks is well-served with pedestrian facilities there is a lack of north-south pedestrian/bicycle connectivity east of Main Street.
- Although very limited as well, bus service has recently been upgraded in Banks. The Tillamook County Transportation District (TCTD) has integrated a shuttle stop into its system. The stop is located at OR 47 (Main Street) and Sunset Avenue, at the frontage of City Park. Ride Connection has installed a bus shelter for bus riders. This bus stop will serve both the WAVE and Ride Connection transit services, described below.

  WAVE provides bus service both east and westbound from Banks at two points during the day. Eastbound service connects to the Sunset Transit Station in Beaverton as well as Union Station in Portland. Westbound service connects to downtown Tillamook (where there are connections to other coastal cities).

  Ride Connection provides transit van service back-and-forth between Banks and TriMet's Hillsboro Transit Center; the service provides one morning commute trip to Hillsboro and one afternoon commute trip from Hillsboro to Banks. Ride Connection only operates on weekdays.

Future Transportation Conditions Summary (2029)

The following is a summary of the future transportation conditions analyzed for Banks. The future transportation conditions examined traffic levels that would be expected in 2029 based on the recommended Urban Growth Boundary strategy (see Figure 1). The recommended Urban Growth Boundary (UGB) expansion will result in increased

development opportunities for the City of Banks, and hence increases in traffic. The future transportation plan will account for this growth. Results of this analysis are discussed in greater detail in the remainder of this memorandum.

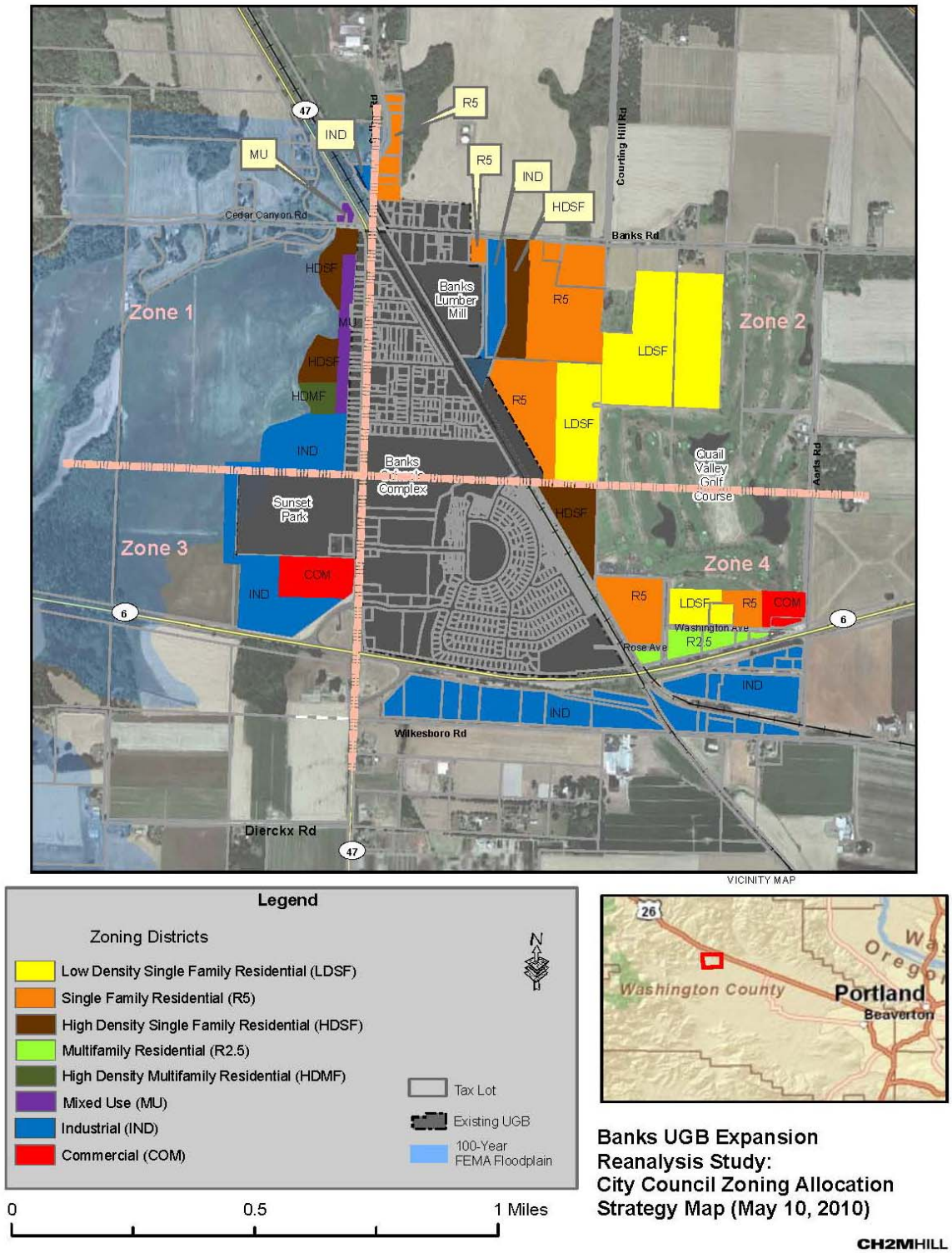


Figure 1: Proposed UGB Expansion Area

Congestion (Year 2029)

Areas of forecasted congestion in 2029 with the recommended UGB expansion are described below. The results of traffic modeling assumes that any funded transportation improvement projects are in place, and that construction of new arterial and collector connections to serve undeveloped areas proposed for inclusion in the UGB will also be in place.

- The intersection of OR 47 (Main Street) at NW Banks Road and the intersection of OR 6 at NW Aerts Road are expected to be highly congested and not meet the Oregon Highway Plan mobility standards.
- Three legs on the OR 47 (Main Street) and NW Oak Way intersection have at least one movement where the queue is longer than the available storage length. Additionally, the southbound through queues on OR 47 will extend upstream to the adjacent intersection.
- OR 6 at NW Aerts Road will experience queues in excess of 600 feet, thereby demonstrating that the intersection will not have sufficient capacity to handle forecasted volumes.

Pedestrian, Bicycle and Transit Travel

- Pedestrian and bicycle connections are needed to link the expanded urban growth boundary areas with the remainder of the city.
- UGB expansion, and its accompanying population increase, will likely result in a greater need for transit services, including demand-response service.

2029 No-Build Traffic Analysis

Context

The 2029 no-build traffic analysis presents congestion and intersection queuing results in 2029 if: (a) the urban growth boundary were to be expanded as reflected in Figure 1; and, (b) no additional roadway projects are built aside from the realignment of Sellers Road near the Banks Road/OR 47 (Main Street) intersection (which is already programmed for funding). This analysis identifies future deficiencies so that potential solutions can be developed. This memorandum discusses opportunities and constraints; defined project recommendations to address transportation deficiencies will be included in a future memorandum.

Project Study Area

The project study area for the 2029 Future No-Build traffic analysis is based on the existing traffic analysis study area outlined in *Technical Memorandum 2.4 Banks Transportation System Plan Update: Existing Conditions*. The analysis study area includes six existing intersections in and near the City of Banks. With the realignment of Sellers Road approximately 200 feet east at NW Banks Road to accommodate a Banks-Vernonia Trail trailhead, the intersection of Sellers Road and NW Banks Road will be reported as a separate intersection, increasing the number of study intersections to seven.

Analysis conducted in 2009 indicates that Banks will need to expand its urban growth boundary (UGB) by approximately 248 acres (approximately 154 acres of buildable residential land and 94 acres of commercial and industrial land) by 2029 for consistency with the 20-year population and employment forecasts consistent with the Banks Comprehensive Plan and the City's Economic Opportunities Analysis. The recommended UGB expansion area is illustrated in **Figure 1**.

Analysis Year and Time Period

The year 2029 is the horizon analysis year for the Future No-Build traffic analysis. This year provides a 20-year forecast from existing conditions. The 30th highest hour was selected as the future No-Build analysis time period because it is consistent with the existing conditions traffic analysis and ODOT methods. The 30th highest hour represents the 30th worst hourly traffic volume of the year, and generally provides a target 'design hour' for future analysis (it is uncommon to analyze and design to the very worst traffic condition of the year). The 30th highest hour can vary based on the area type as well. OR 6 is categorized as a coastal destination route by ODOT's Transportation Planning Analysis Unit (TPAU). Along a coastal destination route, the 30th highest hour traffic volumes are generally indicative of a summer weekday afternoon peak or weekend evening peak when higher volumes of vehicles travel between urban or metropolitan areas and coastal destination cities.

Future No-Build Forecasting

There is no available travel demand model for the study area; consequently, the development of future no-build turning movement volumes was performed using a two-step process. The first step was to estimate future background turning movements based on historical trends. Additionally, trip generation, trip distribution, and traffic assignment was completed for land included in the UGB expansion based on assumed land use type (e.g. residential, commercial or industrial). Traffic generated by the UGB expansion was estimated using the cumulative analysis method in the ODOT *Analysis Procedures Manual* (Section 4.6.2, Updated May 2009). It should be noted that this cumulative analysis volume forecasting methodology is somewhat conservative because it does not assume shared trips between land uses; rather, it assumes that each trip generated by a future land use has a single origin and destination. While a portion of trips are single purpose, it is also reasonable to assume that, for example, trips generated by a residential development would also stop at a retail or commercial development along the way. Under the cumulative analysis method these dual purpose trips are not allowed, which could result in a conservative estimation of trips generated.

The cumulative method also does not account for intrazonal trips. For example, although it is reasonable to assume that some trips generated by commercial uses come from residences within the same zone, all commercial trips are assumed to come from outside that zone – which could further overestimate trips.

Future Background Traffic Volumes

Historical trends provided by ODOT are used to forecast future volumes and evaluate future deficiencies within the traffic system. **Table 1** shows the forecasted growth rates calculated for the project area for state highways OR 47 and OR 6.

TABLE 1
State Highway Annual Growth Rates

Milepost	2006 ADT	2028 ADT	Source	Overall Factor	1-year growth
OR 47 – Nehalem Highway No. 102					
82.75	3,900	4,500	MODEL	1.16	0.70%
82.90	6,800	7,800	MODEL	1.16	0.67%
83.10	6,800	7,800	MODEL	1.16	0.67%
83.14	7,200	8,300	MODEL	1.16	0.69%
83.53	8,000	10,400	MODEL	1.34	1.36%
				OR 47 Annual Rate	0.67%
				OR 47, 21-Year Factor	1.19

Notes:
Source: ODOT 2028 Highway Future Volume Table
http://www.oregon.gov/ODOT/TD/TP/docs/TADR/2028FVT.pdf
ADT – Average Daily Traffic
The available growth rates are only projected to year 2028; this study assumed the AAGR to continue at the same rate through year 2029.

Volumes used to calculate the annual growth rate are chosen based on either an R-squared value from historic volume trends or a travel demand model. As shown in the table, MODEL is written as the source instead of an R-squared value. This indicates that TPAU used a travel demand model to populate the data in the table. The annual rate for OR 47 was calculated using an average of the growth rates within the study area. The annual rate for OR 6 was calculated by ODOT using historical volumes at the Gales Creek Automatic Traffic Recorder (ATR) 34-004. The difference in annual average daily traffic volumes between 1988 and 2008 were averaged to obtain a growth rate for OR 6.

The annual growth rate on OR 47 is 0.67 percent per year or about a 19 percent increase in traffic over the 20-year planning horizon (2009 to 2029). This 19 percent factor was applied to each of the existing 2009 30th highest hour intersection turn movements on OR 47 (except those accessing only a local street) to obtain 2029 background 30th highest hour intersection volumes.

The annual growth rate on OR 6 is 1.03 percent per year or about a 24 percent increase in traffic over the 20-year planning period (2009 to 2029). This 24 percent factor was applied to each of the existing 2009 30th highest hour intersection turn movements on OR 6 (except those accessing only a local street) to obtain 2029 background 30th highest hour intersection volumes.

This future traffic growth represents the growth due to trips passing through the study area (external-external trips) or trips that have one trip end outside the study area (external-internal and internal-external trips). Therefore, the forecast factors were only applied to turning movements that access streets that extend beyond the study boundary.

While background traffic growth on OR 47 and OR 6 through Banks is supported by historical data, the background traffic growth on local streets may be slightly conservative. Local street traffic along NW Banks Road was grown using an average of the above

highway growth rates (which accounts for regional growth), and possibly results in a conservative estimate of future demand on a mainly local street.

UGB Expansion Volumes

For the land included in the UGB expansion, a manual trip generation and traffic assignment process was completed.

Trip Generation

The Banks area was divided into four zones with the land use growth estimated in each zone (see Figure 1). The ITE *Trip Generation Manual (8th Edition)* was used to estimate the number of trips for each zone. In total, the assumed development resulted in 3,127 new trip ends for the study area. This information is summarized in **Tables 2 through 5**.

TABLE 2

Zone 1: Trips Generated for Projected Development in Northwest Development Zone, by Land Use Category

Zoning	Land Use Category/ITE Code*	Developable Acres	PM Peak-Hour Trips Generated
High Density Single Family	Single-Family Detached Housing (210)	7.0 (70)**	76
High Density Multifamily	Apartment (220)	1.8 (43)**	41
Mixed Use	Apartment (220) Specialty Retail Center (814)	4.6 (46)** 1.4 (29.9)**	43 93
Industrial	General Light Industrial (110), Industrial Park (130), Manufacturing (140)	12.6	102
		Total =	355 trip ends Entering = 178 Exiting = 177

Used peak hour of adjacent street traffic, one hour between 4:00 p.m. and 6:00 p.m.
*Multiple codes listed assume a blend of uses to develop

** Number in parenthesis represent dwelling units for residential developments or 1,000 building square feet for commercial developments.

TABLE 3

Zone 2: Trips Generated for Projected Development in Northeast Development Zone, by Land Use Category

Zoning	Land Use Category/ITE Code*	Developable Acres	PM Peak-Hour Trips Generated
Low Density Single Family	Single-Family Detached Housing (210)	38.8 (233)**	225
Single Family	Single-Family Detached Housing (210)	32.2 (258)**	247
High Density Single Family	Single-Family Detached Housing (210)	5.7 (57)**	63
Industrial	General Light Industrial (110), Industrial Park (130), Manufacturing (140)	6.9	56
		Total =	591 trip ends Entering = 356 Exiting = 235

Used peak hour of adjacent street traffic, one hour between 4:00 p.m. and 6:00 p.m.
*Multiple codes listed assume a blend of uses to develop

** Number in parenthesis represent dwelling units for residential developments or 1,000 building square feet for commercial developments.

TABLE 4

Zone 3: Trips Generated for Projected Development in Southwest Development Zone, by Land Use Category

Zoning	Land Use Category/ITE Code*	Developable Acres	PM Peak-Hour Trips Generated
Industrial	General Light Industrial (110), Industrial Park (130), Manufacturing (140)	13.8	111
Commercial	General Office (710), Medical/Dental Office Building (720), Specialty Retail Center (814), Shopping Center (820), Apparel Store (876), Hair Salon (918), High Turnover (sit-down) Restaurant (932), Fast Food Restaurant without Drive-Through Window (933), Auto Parts & Service Center (943)	7.5 (114.1)**	946
		Total =	1057 trip ends Entering = 469 Exiting = 588

Used peak hour of adjacent street traffic, one hour between 4:00 p.m. and 6:00 p.m.
*Multiple codes listed assume a blend of uses to develop

** Number in parenthesis represent dwelling units for residential developments or 1,000 building square feet for commercial developments.

TABLE 5

Zone 4: Trips Generated for Projected Development in Southeast Development Zone, by Land Use Category

Zoning	Land Use Category/ITE Code*	Developable Acres	PM Peak-Hour Trips Generated
Single Family	Single-Family Detached Housing (210)	9.7 (78)**	84
Low Density Single Family	Single-Family Detached Housing (210)	4.1 (24)**	29
Multifamily	Residential Condominium/Townhouse (230)	4.7 (81)**	51
High Density Single Family	Single-Family Detached Housing (210)	6.7 (67)**	73
Industrial	General Light Industrial (110), Industrial Park (130), Manufacturing (140)	42.4	343
Commercial	General Office (710), Medical/Dental Office Building (720), Specialty Retail Center (814), Shopping Center (820), Apparel Store (876), Hair Salon (918), High Turnover (sit-down) Restaurant (932), Fast Food Restaurant without Drive-Through Window (933), Auto Parts & Service Center (943)	3.7 (56.7)**	544
		Total =	1,124 trip ends Entering = 500 Exiting =624

Used peak hour of adjacent street traffic, one hour between 4:00 p.m. and 6:00 p.m.
*Multiple codes listed assume a blend of uses to develop

** Number in parenthesis represent dwelling units for residential developments or 1,000 building square feet for commercial developments.

Traffic Assignment

The assignment of the trips related to the UGB expansion (**Tables 2 through 5**) assumed no intrazonal trips. No pass-by trips for existing land uses were removed from the trip generation volumes.

These assumptions will result in a conservative analysis (higher forecasted volumes) as it assumes all trips are only to a single destination and do not include multiple purposes.

Although the two-step volume forecasting methodology provides an estimate of future demand, it does not assign trip routes (as is the case with a travel demand model). Trip assignment as described below is based on the proposed locations of future development in relation to existing land uses within Banks. This assignment process does not account for current locations or corridors with high delay times. Trips were not shifted or reassigned to other potential less congested routes, like actual trips might do to avoid existing congestion.

While this assignment methodology may result in conservative operational results (trips may be assigned to routes that are already over-capacity), it also represents the most logical trip paths to and from UGB expansion land uses, and could identify heavily used corridors where improvements are most necessary.

Based on a preliminary assessment of future circulation needs (assuming full build-out of the UGB expansion area per the proposed zoning strategy), internal connector roadways were proposed, as shown on Figure 2. As noted, these recommendations are preliminary and will be assessed further in the Transportation System Plan Alternatives Evaluation Technical Memorandum.

The traffic assignment of the trips began with the following network loading assumptions.

<u>Zone 1 (NW Quadrant)</u>

- 60% to/from new connection from the UGB expansion area east to OR 47 (Sunset Ave, north of Sunset Park)
- 20% to/from new connection from the UGB expansion area east to OR 47 south of Sunset Park (through Zone 3)
- 20% to/from new connection from the UGB expansion area north to Cedar Canyon Road

<u>Zone 2 (NE Quadrant)</u>

- 50% to/from new connection from the UGB expansion area north to NW Banks Road
- 30% to/from new north-south connection from the UGB expansion area south (through Zone 4) to NW Aerts Road
- 20% to/from Zone 4 (via new north-south connection)

<u>Zone 3 (SW Quadrant)</u>

- 85% to/from new connection from the UGB expansion area east to OR 47 south of Sunset Park
- 10% to/from new connection from the UGB expansion area north then east to OR 47 via Sunset Ave, north of Sunset Park (through Zone 1)
- 5% to/from new connection from the UGB expansion area north to Cedar Canyon Road (through Zone 1)

Zone 4 (SE Quadrant)

Trips North of OR 6:

- 60% to/from new connection east to NW Aerts Road
- 20% to/from NW Banks Road (to the north, via new north-south connection)
- 20% to/from Zone 2 (via new north-south connection)

Trips South of OR 6:

- 40% west on Wilkesboro to OR 47; then 60% south and 40% north on 47
- 10% to OR 6 via NW Aerts Road
- 50% east to US 26 via Wilkesboro/Mountaindale Road

Using these access percentages and the assumed future street network, the assignment of trips was completed using logical route choices (i.e., turning volumes were based on existing turning movement percentages) to assign trips to logical destinations or to external stations. The future turning movement volumes, including existing volumes plus the growth from historical trends, and the traffic assignment of the UGB expansion trips are summarized in **Figure A.1** in **Appendix A**.

At the signalized intersection of OR 47 (Main Street) and NW Oak Way, the signal cycle length and phase splits were updated to account for the expected growth. Because updating signal timings requires no new infrastructure or signal equipment, this is a typical change that can be expected to be completed by ODOT staff. Additionally, with a 20-year study horizon, it is reasonable to assume that signal timings will be updated within that timeframe.

It is assumed that traffic from Zone 1 of the UGB expansion would access both Cedar Canyon Road and to OR 47 (Main Street) with a new roadway connection. Zone 2 would also likely include a roadway connection north to Banks Road, between Aerts Road and Sellers Road. Between Zone 2 and 4, there would likely be a new north-south connection near the rail line, and from Zone 4 there would be a new connection to Aerts Road north of OR 6. From Zone 3, a roadway connection to OR 47 (Main Street) would likely be in place south of Sunset Park.

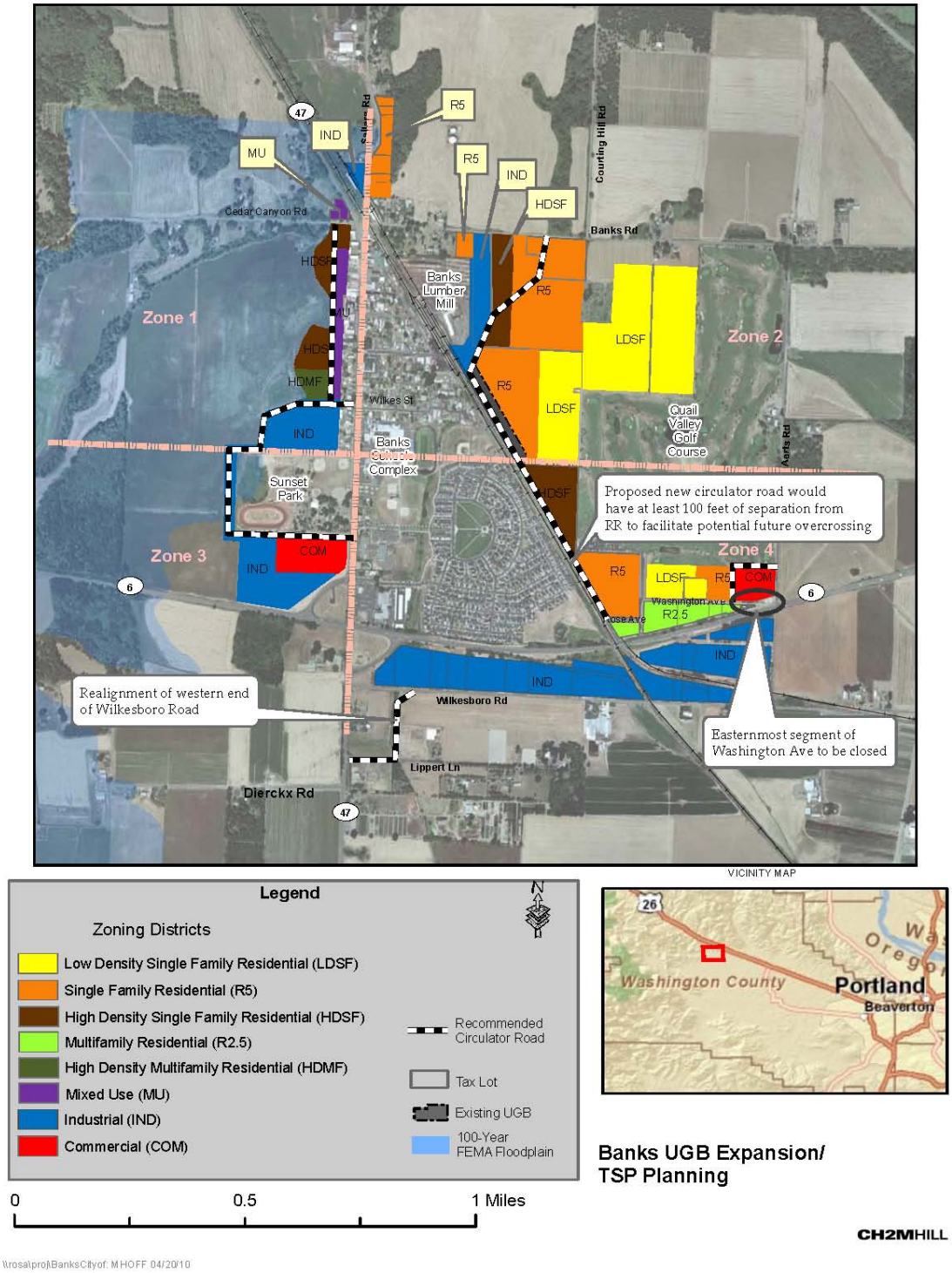


Figure 2: Proposed Roadway Circulation

Future Planned Infrastructure Projects

The traffic analysis assumes that one additional funded roadway infrastructure project will be built by 2029. The future analysis also assumes additional unfunded connection roadways within Banks will be in place by 2029. Sellers Road at NW Banks Road is the only funded project in the study area within the planning horizon. The Sellers Road realignment is currently under construction and should be completed in the autumn of 2010. This project entails realigning Sellers Road so that the intersection occurs approximately 200 feet east of the existing intersection with NW Banks Road. Each approach will be one-lane with no turn lanes, similar to the existing intersection. The traffic control assumed was a STOP approach for Sellers Road while NW Banks Road is uncontrolled.

A funded non-roadway infrastructure project, the extension of the Banks-Vernonia Linear Trail into the northern part of Banks, is also currently under construction (in coordination with the aforementioned Sellers Road realignment) and is anticipated to be completed by mid-October. The Banks-Vernonia Linear Trail serves pedestrians, bicyclists, and equestrian users. This project will extend the existing Banks-Vernonia trail from an existing state park facility located approximately 0.5-miles north of Banks to a trailhead facility to be located at the northwest corner of Banks Road and the realigned Sellers Road. The trailhead facility will provide off-street parking and other amenities for trail users.

Additionally, it was recently revealed, at a meeting of the North West Area Commission on Transportation (NWACT) on July 8, 2010, that the Portland & Western Railroad (P&WRR) "Banks Rail Connection" project (for which P&WRR had applied for funding through the ConnectOregon III Program) had been approved by the ODOT Final Review Committee and recommended for full funding to the Oregon Transportation Commission. This project will entail the construction of a "Y" track connection to be installed on trackage south of Highway 6 (near Wilkesboro Road). The project is anticipated to be constructed within two years. This project would likely result in a reduction of rail traffic on the portion of P&WRR trackage adjacent to the Arbor Village development and the Banks Lumber Mill, making existing and planned residential development in the vicinity of the existing track lines more favorable.

Methodology

Performance and Mobility Standards

For the 2029 Future No-Build conditions, the mobility standards for intersections within ODOT's jurisdiction vary based on roadway classification. **Table 6** shows the mobility standards for the intersection operational analysis.

Traffic Analysis Software Tools

A Synchro 7 computer traffic operations model was constructed for the 2029 Future No-Build analysis. The future model forecasts assumed existing truck percentages as that is the most accurate available data. In addition future geometrics and post-processed turning movement volumes were assigned to the traffic model. Peak hour factors were updated to be consistent with the guidance in TPAU's Analysis Procedures Manual (APM) Section 5.3.3, which is 0.95 for major arterials, 0.90 for minor arterials, and 0.85 for minor streets.

SimTraffic, a traffic microsimulation software program, was used to collect vehicle queuing information for all intersections. Queue results are reported as a 95th percentile expected queue length, which means that 95 percent of the time during the peak hour analyzed, the queue length should be less than or equal to the value reported. Five separate model runs of SimTraffic were averaged to obtain queuing results.

Future Intersection Operations

The volume to capacity ratios and 95th percentile queue lengths were collected from the future no-build Synchro and SimTraffic simulation models for the seven study area intersections. The post processed 2029 balanced volumes for each intersection were utilized in the analysis.

Operational Analysis Results

Results from the operational analysis indicate that two of the seven study intersections do not meet the applicable ODOT or Washington County mobility standards for the 2029 Future No-Build condition. These results indicate that the future traffic growth assumed will lead to operational problems at several locations in Banks, Oregon.

In the existing conditions analysis, all of the intersections meet mobility standards, but in the future No-Build scenario, two intersections (OR 47 & NW Banks Road and OR 6 & NW Aerts Road) are not expected to meet mobility standards. NW Banks Road approaching OR 47 and NW Aerts Road approaching OR 6 are both stop-controlled and are both expected to exceed the minor street V/C mobility standard. With the growth of through traffic on the uncontrolled approaches and the minor street traffic growth, the side street traffic that is crossing or turning left will be expected to have a difficult time finding a sufficient gap in traffic to allow them to complete their maneuver in a reasonable amount of time.

Table 6 shows the results of the 2029 Future No-Build intersection operational analysis. **Figure A.1** of **Appendix A** illustrates the volumes, channelization, and analysis results for all of the study area intersections. **Appendix B** compiles the Synchro HCM reports for each study intersection.

TABLE 6
Banks Traffic Analysis – 2029 Future No-Build Operational Results

ID	Intersection	Control Type	Future No-Build Mobility Standard	Intersection Performance					
				V/C Ratio[1]		Average Vehicle Delay (sec)[1]		Level of Service[1]	
1	OR 47 (Main Street) & NW Oak Way	Signalized	0.75	0.63		12.1		B	
2	OR 47 (Main Street) & OR 6 Interchange Ramp (south of OR 6)	OWSC	0.75	0.37	0.48	9.5	30.3	A	D
3	OR 47 (Main Street) & NW Trellis Way	OWSC	0.85	0.55	0.51	11.0	54.5	B	F
4	OR 47 (Main Street) & NW Banks Road	TWSC	0.90	0.10	**> 2.0**	2.6	>100	A	F
5	NW Banks Road & NW Aerts Road	TWSC	0.90[2]	0.04	0.29	1.7	14.7	A	B
6	OR 6 & NW Aerts Road	TWSC	0.70	0.24	**> 2.0**	6.0	>100	A	F
7	NW Banks Road & Sellers Road	OWSC	0.90[2]	0.22	0.27	3.4	14.2	A	B

Notes:
[1] At stop-controlled intersections, the first entry is the result for the uncontrolled roadway approach; the second entry is the result for the stop-controlled approach.
[2] ODOT mobility standards do not apply to the intersection since it is not located on the state highway system. Instead, the target mobility standard for the "first hour" of "Other Urban Areas" was used.
Black highlighting indicates intersection exceeds mobility standards
OWSC: One-way stop-controlled
TWSC: Two-way stop-controlled
Mobility standards are established from 1999 Oregon Highway Plan, Policy Element, Table 6

Queuing Analysis Results

The vehicle queue analysis identifies deficient vehicle storage locations and provides key information as this project advances into the alternative development stage. **Table 7** shows the forecast 2029, 95th percentile vehicle queue lengths for each movement at the study intersections. The movements that are expected to have inadequate storage are shown in the table with black highlight. The intersection of OR 47 (Main Street) and NW Oak Way (a total of seven movements) has queue lengths that exceed available storage capacity. Six of these movements are either exclusive left or right turn pockets that can accommodate 4 or 5 vehicles. Due to the expected growth in volumes, this existing storage will often be exceeded.

The remaining movement at OR 47 (Main Street) and NW Oak Way that is expected to exceed storage capacity is the southbound through movement. This queue is expected to spill back to (and therefore affect operations at) OR 47 and NW Trellis Way. **Appendix C** contains the full results from the SimTraffic Queuing Report.

TABLE 7

2029 Future No-Build 95th Percentile Queues at Banks Study Area Intersections

ID	Intersection	Approach	Lane Group	Storage (feet)	2029 Queue Length (feet)
1	OR 47 (Main Street) & NW Oak Way	Eastbound	**Left**	**70**	**180**
			Thru	750	300
			Right	**30**	**100**
		Westbound	Left	250	220
			Thru/Right	950	150
		Northbound	**Left**	**95**	**100**
			Thru	950	470
			Right	**70**	**120**
		Southbound	**Left**	**125**	**330**
			Thru	**530**	**540**
			Right	**25**	**70**
2	OR 47 (Main Street) & OR 6 Interchange Ramp (south of OR 6)	Westbound	Left/Right	750	140
		Northbound	Thru	-	10
			Right	70	40
		Southbound	Left	115	100
			Thru	-	-
3	OR 47 (Main Street) & NW Trellis Way	Westbound	Left/Right	-	250
		Northbound	Thru/Right	-	70
		Southbound	Left	125	60
			Thru	-	540
4	OR 47 (Main Street) & NW Banks Road	Eastbound	Left/Thru/Right	-	320
		Westbound	**Left/Thru/Right**	**200**	**>200**
		Northbound	Left/Thru	-	100
		Southbound	Left/Thru/Right	-	90
5	NW Banks Road & NW Aerts Road	Eastbound	Left/Thru/Right	-	650
		Westbound	Left/Thru/Right	-	200
		Northbound	Left/Thru/Right	-	110
		Southbound	Left/Thru/Right	Driveway	50
6	OR 6 & NW Aerts Road	Eastbound	Left/Thru/Right	-	520
		Westbound	Left/Thru/Right	-	390
		Northbound	Left/Thru/Right	-	700
		Southbound	**Left/Thru**	**-**	**> 1000**
			Right	**50**	**60**
7	NW Banks Road & Sellers Road	Eastbound	Left/Thru	200	120
		Westbound	**Thru/Right**	**-**	**> 1000**
		Southbound	Left//Right	-	420

Notes:

95th Percentile queues calculated using an average of five, one hour SimTraffic runs

Queue lengths not reported for free-flowing and uncontrolled movements

Queue lengths rounded up to the nearest ten feet

Numbers in black highlight indicate a vehicle queue length that exceeds the available storage length

At the intersection of OR 6 and Aerts Road, the southbound stop-controlled movement is expected to have long queues in excess of 1000 feet because vehicles likely cannot find a safe gap in traffic on OR 6. The southbound queue on Aerts Road could back up to within 700 feet of the Banks Road/Aerts Road intersection. The northbound movement would also likely experience long queues, which may result from left turns waiting for available gaps in traffic. These queues would likely have an impact on travel through Banks.

The intersection of OR 47 (Main Street) and NW Banks Road is expected to experience queues in excess of 1000 feet on the westbound approach. This queue would likely back up beyond Sellers Road, and could extend back to within 400 feet of the NW Banks Road and NW Aerts Road intersection. The southbound queue on Sellers Road could also be long because vehicles waiting to turn from Sellers Road would be blocked by westbound backups on NW Banks Road.

Although the entrances to Banks Elementary School and High School are not study intersections, the school district has noted concern over the queuing in present day along Main Street at these entrances. As volumes along Main Street continue to increase, the 2029 queues at the school entrances are assumed to increase as well. This issue will be noted during the process of alternatives analysis.

Needs and Constraints

Based on the examination of existing and future transportation conditions, the following needs have been identified:

- Realignment of Wilkesboro Road. This is an anticipated need based on buildout of the proposed UGB expansion area south of OR 6. The added vehicles that will accompany growth into the expanded UGB area south of OR 6 would create unsafe conditions at the existing Wilkesboro Road/OR 47 intersection, due to the close proximity of this intersection to the OR 6 ramp terminal. To address this problem, Wilkesboro Road will need to be realigned southward to flow into existing Lippert Lane so that Wilkesboro Road intersects with OR 47 further south from the OR 6 ramp terminal (see Figure 2).
- Realign Washington Avenue. There is a need to close the eastern end of Washington Avenue and realign it so that it intersects with Aerts Road at a point further north of its current intersecting point. The existing alignment of Washington Avenue would be unsafe and operationally inefficient upon the addition of vehicles that will accompany growth into the expanded UGB area east of the existing city.
- Secondary route from the existing City of Banks to the OR 6 access point at Aerts Road via a crossing of the railroad. This is an anticipated need based on buildout of the proposed UGB expansion area to the east of the railroad. Moreover, the need for a secondary route to access OR 6 at Aerts Road is a need that is supported by the Banks Comprehensive Plan Transportation Element (1988 Update; pp. 73-74) and the Banks Transportation Network Plan (1999), which provides a discussion regarding the need for providing secondary route to access OR 6 from the existing city (pp 38-43). A secondary route to the Aerts Road access point at OR 6, which would entail a railroad overcrossing at the south end of Arbor Village (connecting to Rose Avenue/Washington Street on the east side of the track) is an approval criterion for

the development for the undeveloped land at the south end of Arbor Village. By virtue of the Banks City Council, in 2008, requiring a covenant (stipulating the installation of a railroad crossing at the previously described location) on the deed to the aforementioned property, the Council reiterated the need for the City to have such a secondary route to access OR 6 at Aerts Road.

- Increased monitoring of safety conditions at the OR 6/Aerts Road intersection (and potential installation of safety measures), as warranted by future conditions (as the UGB expansion area on the east side of railroad is developed). This intersection has no current status as a location with documented safety issues and there are no existing geometric deficiencies or sight-distance issues. However, in addition to the previously noted fatality at this intersection, north-south users of Aerts Road have repeatedly reported unsafe conditions when trying to cross over OR 6 on Aerts Road or make left turns from southbound Aerts Road to eastbound OR 6. This perceived lack of safety is the result of motorists on Aerts Road trying to find "gaps" in OR 6 traffic, where cars are moving at a high rate of speed (posted speed on OR 6 at this location is 55 miles per hour). The perceived lack of safety at this intersection could worsen operations at the intersection, which is already forecasted to have poor operational conditions in the 2029 No Build model (see Tables 6 and 7 of this memorandum). Moreover, the perceived lack of safety could significantly inhibit circulation in the future – the added vehicles that will accompany growth into the expanded UGB area east of the existing city could avoid utilizing this intersection in a manner that would be efficient for the Banks area transportation system as a whole, opting instead for the access point to OR 6 at OR 47 (Main Street), thereby causing potential congestion issues at that location.
- Sight-distance improvements on Banks Road at the existing intersection with Aerts Road and the future intersection with a new circulator road into the expanded UGB area on the east side of the railroad. Banks Road contains several steep vertical grades – these conditions create sight distance problems for drivers at the intersection of Aerts Road (which sits at the top of a steep grade) and would create problems at a new intersection along Banks Road west of Aerts Road (where a new circulator road would connect with Banks Road – see Figure 2); this latter "new" intersection would sit near the bottom of a vertical grade.
- Pedestrian and bicycle linkages both north-south within the existing Banks UGB (on the east side of Main Street) and connections from the UGB to other parts of the city, particularly to the downtown commercial area, the schools complex, and Sunset Park.
- Solutions to congestion issues at OR 47 (Main Street) at NW Banks Road and OR 6 at NW Aerts Road.
    - Solutions to queuing issues at OR 47 (Main Street) at NW Oak Way.
    - Enhanced local connections to reduce the Banks residents' use of the state highway system for local trips.

The following constraints will guide the types of solutions that will address the needs identified:

- Railroad lines. The stop-controlled intersections of NW Banks Road & NW Aerts Road, OR 47 & NW Banks Road and OR 6 & NW Aerts Road would need to support increased traffic under the no-build scenario. Any examination of alleviating that load through an east-west connection(s) would need to cross two sets of railroad tracks (Port of Tillamook Bay and P&W). ODOT Rail Division discourages at-grade crossings and grade-separated crossings generally cost between $20-30 million.
- Main Street and adjacent land uses. Many residences and commercial buildings in Banks are located close to the street; also, Main Street functions as the heart of the city. Expansion of Main Street would be constrained, as public right-of-way is not available. Expansion of Main Street may also not be desired by the community due to safety concerns in relation to pedestrians, school children, etc.
- Schools and parks along Main Street. The location of schools and parks along Main Street require special attention, particularly relating to safety concerns for children.
- Flooding on NW Cedar Canyon Road. Several community members have discussed how NW Cedar Canyon Road has flooded in past years west of the OR 47 and NW Banks Road intersection.
- Neighborhood streets. Many residents have expressed concerns about increased traffic along local streets. Some connectivity options would likely increase traffic along roadways that have historically been neighborhood streets in character.
- Access management. ODOT has access control along OR 6 in the study area. No new accesses are allowed on OR 6. ODOT also has access spacing standards along OR 47. Because of this, Banks will need to efficiently utilize the two existing access points to OR 6 (at OR 47 and Aerts Road) in conjunction with local transportation system improvements.
- Signal warrants. Any new signal would need to meet ODOT signal warrants.
- Cost. In general, many of the transportation connections or upgrades required to accommodate population and employment associated with the UGB expansion will be expensive. Railroad crossings (grade-separated crossings can exceed $20 million), upgrades of rural county roadways (e.g. Banks Road, Aerts Road), realignment of roadways (e.g. a potential realignment of Wilkesboro to the south), widening to add turn lanes, and any upgrades to Main Street would be expensive and potentially cost prohibitive. Traffic signal installation is also expensive (approximately $250,000 per signal).

Further analysis of solutions will also take into account the decision criteria included in Appendix D.

Potential Opportunities and Range of Solutions

The following opportunities for transportation system improvement will be further discussed during the alternatives analysis portion of the transportation analysis.

Opportunities to Reduce Congestion and Queuing Issues

- The intersection of OR 47 (Main Street) and NW Banks Road actually operates as three separate intersections, and exhibits a v/c ratio over ODOT's mobility standards for the westbound movement in the future condition. Complicating the three separate intersections is the railroad crossing at NW Banks Road. The project that will alter NW Sellers Road (so that it intersects NW Banks Road further to the east), will provide more storage space westbound , but does not help vehicles on the eastbound and northbound stop-controlled approaches that will experience long delays while waiting to find gaps in order to perform their maneuver. As the intersection is currently stop-controlled, installing a traffic signal may better control traffic to help reduce the delay and queues on the NW Banks Road approaches, but would impact the performance of the OR 47 (Main Street) approaches. Prior to signal installation, the location would need to be evaluated to determine if the intersection meets ODOT signal warrants and spacing guidelines.
- Widening and modernizing the approximately 1.70-mile extent of Banks Road between the intersection with OR 47 (Main Street) and the intersection with OR 26. This would entail bringing the road up to current design standards by providing shoulders on Banks Road and performing sight distance improvements at intersections with Banks Road (as warranted by future conditions – described earlier in this memorandum) and adding intermittent or continuous left-turn lanes (as warranted by future conditions). These improvements would make Banks Road a more feasible option for those wishing to travel to, and from, US 26; this could subsequently relieve future congestion issues at the existing access points to OR 6 within Banks, and along OR 6 itself, as drivers would have a suitable east-west alternative to and from US 26.
- Widening Wilkesboro Road to ensure adequate design standard lane width for trucks and other large vehicles in this area that is slated for industrial uses in the 20-year planning horizon.
- The signalized intersection of OR 47 (Main Street) and NW Oak Way will likely have vehicle queues that exceed available storage in the future conditions. The northbound, southbound, and eastbound legs of the intersection have queues that extend past the existing turn pockets, and in some cases extend into the next intersection. Below are potential suggestions to reduce congestion on each approach:
    - Most southbound and northbound movements have queues exceeding the available storage. A low-cost, short-term, and easily implementable improvement to reduce vehicle queuing for the southbound left movement is to extend the southbound left turn pocket from 125 feet to 350 feet. The area is already paved; it would simply require restriping and would not require any right of way acquisition. This additional storage is expected to accommodate future queues in 2029 with the proposed UGB expansion.

- For the eastbound left movement, a similar turn pocket extension could accommodate the queuing. Currently the left turn pocket is 70 ft. Extending the turn pocket to at least 200 feet would provide turning vehicles with a refuge, removing them from the traffic stream of vehicles continuing through the intersection. This improvement would require additional pavement and widening of the OR 6 westbound exit-ramp.
- The westbound left queue is nearing capacity and could exceed the available storage. Many of the vehicles are heading eastbound onto OR 6 towards Hillsboro and Portland. Increasing the turn pocket would be difficult as the road is constrained on either side by development, and there is little available right of way to expand the width of the road.

All of these potential solutions would be based on future analyses warranting their funding and construction. These potential solutions will be evaluated during alternatives analysis.

Opportunities to Improve Safety

Currently OR 6 is designated as a safety corridor by ODOT. There are no identified safety issues from the crash data, and crash rates are below the state average. However, the Banks City Council identified one area of concern, OR 6 near NW Aerts Road. One fatality was reported in this area. Effective safety improvements that could be utilized include increased lighting, a roadside inventory to identify fixed objects in the clear zone, and increased enforcement of speed limits and safe driving in the vicinity. These will be examined during the alternatives analysis.

As shown on Figure 2, it is recommended that the easternmost segment of Washington Avenue be closed to vehicular traffic. Washington Avenue currently intersects with Aerts Road immediately north of the OR 6/Aerts Road intersection. Currently, Washington Avenue only services a few single-family homes and therefore receives very little traffic volume; however, assuming a buildout of the east side of Banks per the proposed UGB expansion strategy, the amount of volume would significantly increase, and would pose a significant safety hazard to the intersection of OR 6/Aerts Road.

Opportunities for Enhanced Local Circulation

Individual developments in the UGB expansion land should be required to provide internal circulation for vehicles, pedestrians and bicyclists, which should be codified per City of Banks Development Code. Local circulation options should consider the feasibility of new or enhanced east-west connections (e.g. upgrades to Wilkesboro Road, Banks Road, or potential rail crossings) as well as north-south connections (e.g. upgrade of NW Aerts Road, connections between areas of UGB expansion). As new development is planned, the City must ensure that these developments provide suitable external connections to the greater Banks area.

Construct a vehicular overcrossing of the railroad to connect the existing city to the UGB expansion area to the east of the railroad. Location options for such an overcrossing include the south end of the Arbor Village neighborhood (connecting to Washington Street on the east side of the railroad) or at Sunset Avenue (which would connect to a new circulator road on the east side of the tracks – see Figure 2 for general location concept of the circulator road). Although a railroad overcrossing is likely infeasible in the short-term, the City should

plan for the long-term construction of such a crossing when it is warranted based future growth.

Opportunities for Bicycle and Pedestrian Connections

Currently bicycle lanes and pedestrian sidewalks are not connected well within the city. Improvements should focus on connecting the existing system of bike lanes and sidewalks to improve non-motorized mobility. A north-south bike route should be established in the existing city in the area east of Main Street, with direct connections to the schools complex.

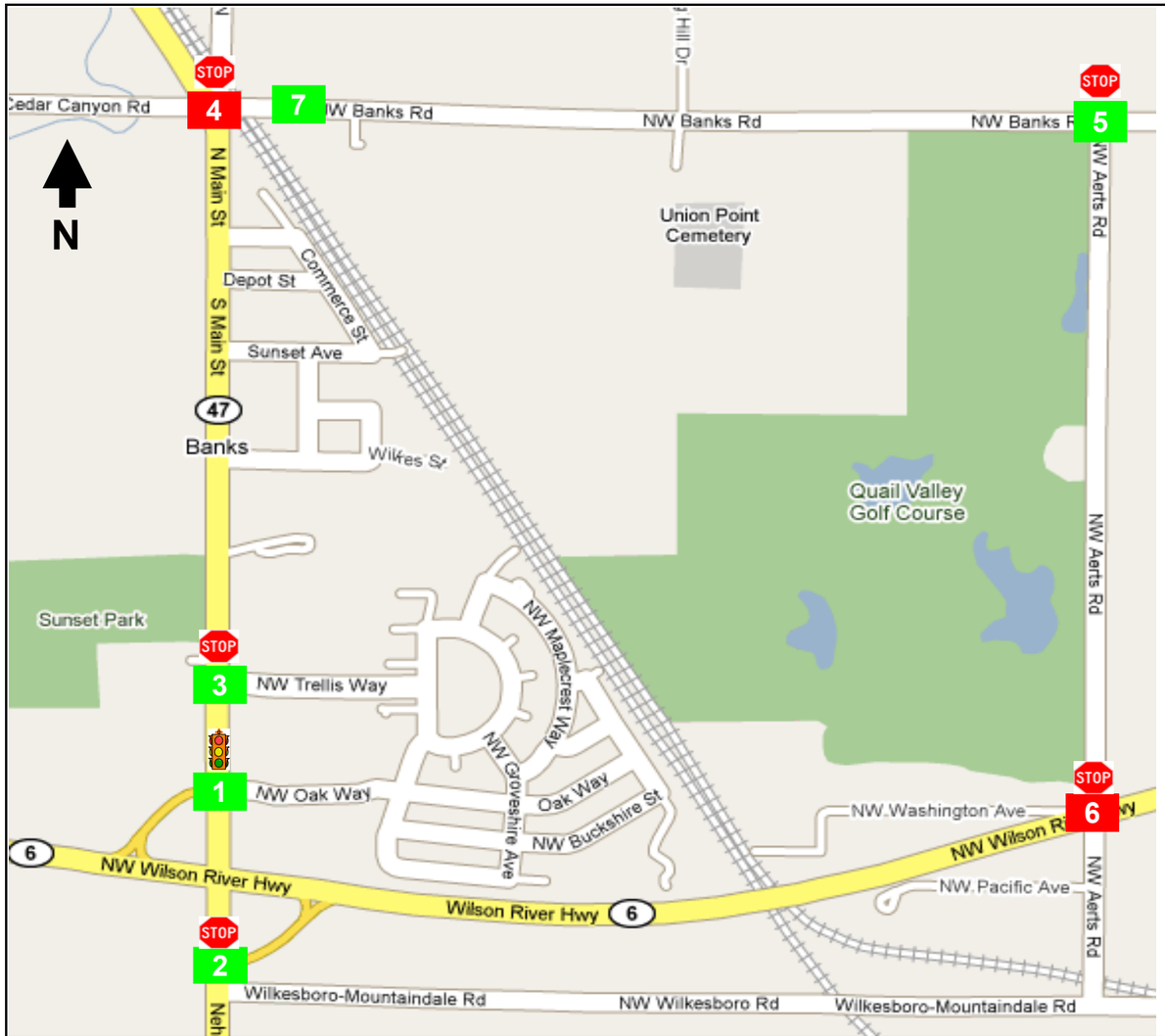
All new and modernized roadways should include bicycle and pedestrian accommodations.

Construct one or more pedestrian/bicycle overcrossings of the railroad to ensure east-west pedestrian/bicycle connectivity from the UGB expansion area east of the railroad to center city destinations, including the residential areas to schools, the library, and town hall.

Consider Future Transit Connections

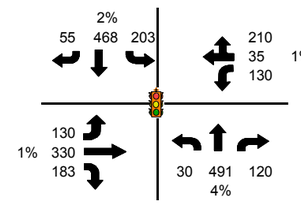
The recently added TCTD bus service in Banks should be monitored regularly to identify the need for further future transit capacity improvements, such as potentially increasing the number of pick-up/drop-off times at the stop the Sunset Avenue/Banks Road intersection or adding another stop location in the City of Banks.

Appendix A: Future No-Build Traffic Operations



1 OR 47 & NW Oak Way

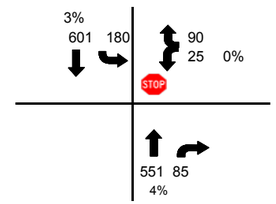
V/C Ratio Std: 0.75 OR 47 30th HV Factor: 1.16
V/C Ratio: 0.63 Oak Way 30th HV Factor: 1.16
OR 6 30th HV Factor: 1.62



Count Date: January 6, 2009
Peak Hour: 4:30-5:30 PM

2 OR 47 & OR 47 Exit

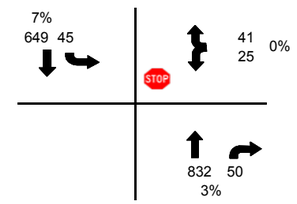
V/C Ratio Std: 0.75 OR 47 30th HV Factor: 1.16
V/C Ratio: 0.48 OR 6 30th HV Factor: 1.62



Count Date: January 6, 2009
Peak Hour: 4:30-5:30 PM

3 OR 47 & NW Trellis Way

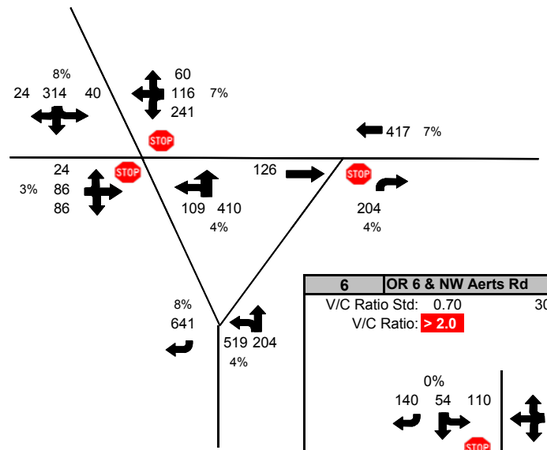
V/C Ratio Std: 0.85 30th HV Factor: 1.21
V/C Ratio: 0.51



Count Date: December 4, 2008
Peak Hour: 4:30-5:30 PM

4 OR 47 & NW Banks Rd

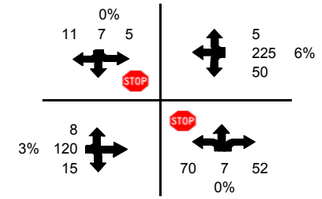
V/C Ratio Std: 0.90 30th HV Factor: 1.21
V/C Ratio: > 2.0



Count Date: December 4, 2008
Peak Hour: 4:30-5:30 PM

5 NW Banks Rd & NW Aerts Rd

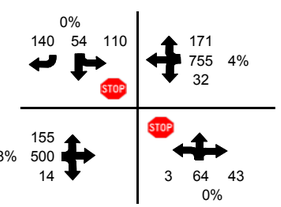
V/C Ratio Std: 0.90 30th HV Factor: 1.21
V/C Ratio: 0.29



Count Date: December 4, 2008
Peak Hour: 4:30-5:30 PM

6 OR 6 & NW Aerts Rd

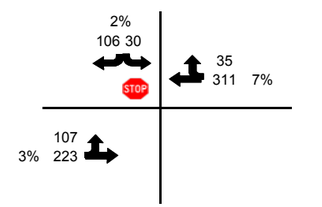
V/C Ratio Std: 0.70 30th HV Factor: 1.21
V/C Ratio: > 2.0



Count Date: December 4, 2008
Peak Hour: 4:30-5:30 PM

7 NW Banks Road & Sellers Road

V/C Ratio Std: 0.90 30th HV Factor: 1.21
V/C Ratio: 0.27



Count Date: December 4, 2008
Peak Hour: 4:30-5:30 PM

CH2MHILL

FIGURE A.1 Tillamook: Banks UGB/TSP Update

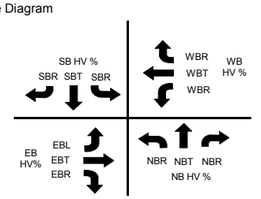
2029 Future No-Build: Volumes, Channelization, & V/C Ratios

Notes:

1. "V/C Ratio Std" corresponds to the intersection's mobility standard
2. Mobility Standards are based on Oregon Highway Plan
3. A green box on the map represents an acceptable measured mobility
4. A red box on the map represents a failing measured mobility
5. The reported Peak Hour Factor (PHF) is for the overall intersection
6. Truck Percentages calculated from raw counts
7. All 30th Highest Hour volumes were seasonally adjusted
8. Intersection map source: Google Earth Maps

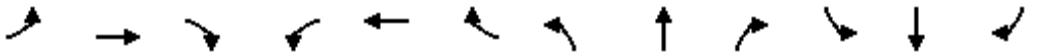
Legend:

Volume Diagram



555 Turning Movement Volume
HV% Percent Heavy Vehicles
Channelization
Stop Controlled Intersection
Signalized Intersection

Appendix B: HCM Synchro Reports



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	130	330	183	130	35	210	30	491	120	203	468	55
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Width	12	12	12	10	10	12	13	16	16	14	14	14
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.87		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1646	1733	1473	1536	1410		1652	1907	1621	1739	1830	1556
Flt Permitted	0.52	1.00	1.00	0.40	1.00		0.39	1.00	1.00	0.37	1.00	1.00
Satd. Flow (perm)	905	1733	1473	639	1410		676	1907	1621	675	1830	1556
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	140	355	197	140	38	226	32	517	126	214	493	58
RTOR Reduction (vph)	0	0	71	0	153	0	0	0	44	0	0	11
Lane Group Flow (vph)	140	355	126	140	111	0	32	517	82	214	493	47
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	4%	4%	4%	2%	2%	2%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2		2	6		6
Actuated Green, G (s)	16.9	16.9	16.9	16.9	16.9		26.5	26.5	26.5	26.5	26.5	26.5
Effective Green, g (s)	16.9	16.9	16.9	16.9	16.9		27.5	27.5	27.5	27.5	27.5	27.5
Actuated g/C Ratio	0.32	0.32	0.32	0.32	0.32		0.52	0.52	0.52	0.52	0.52	0.52
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	2.3	2.3	2.3	2.3	2.3		4.8	4.8	4.8	5.0	5.0	5.0
Lane Grp Cap (vph)	292	559	475	206	455		355	1001	851	354	960	817
v/s Ratio Prot		0.20			0.08			0.27			0.27	
v/s Ratio Perm	0.15		0.09	c0.22			0.05		0.05	c0.32		0.03
v/c Ratio	0.48	0.64	0.26	0.68	0.24		0.09	0.52	0.10	0.60	0.51	0.06
Uniform Delay, d1	14.2	15.1	13.1	15.4	13.1		6.2	8.1	6.2	8.7	8.1	6.1
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	1.9	0.2	7.4	0.2		0.2	0.8	0.1	4.3	0.9	0.1
Delay (s)	14.9	17.1	13.3	22.8	13.2		6.4	9.0	6.3	12.9	9.0	6.2
Level of Service	B	B	B	C	B		A	A	A	B	A	A
Approach Delay (s)		15.6			16.5			8.3			9.9	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	12.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	52.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	80.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	25	90	551	85	180	601
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.91	0.91	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	27	99	580	89	189	633
Pedestrians			1			
Lane Width (ft)			15.0			
Walking Speed (ft/s)			4.0			
Percent Blockage			0			
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						1028
pX, platoon unblocked						
vC, conflicting volume	1593	580			580	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1593	580			580	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	71	81			81	
cM capacity (veh/h)	96	518			989	

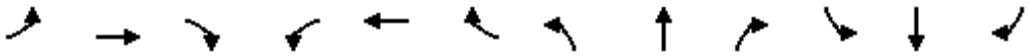
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	126	580	89	189	633
Volume Left	27	0	0	189	0
Volume Right	99	0	89	0	0
cSH	265	1700	1700	989	1700
Volume to Capacity	0.48	0.34	0.05	0.19	0.37
Queue Length 95th (ft)	60	0	0	18	0
Control Delay (s)	30.3	0.0	0.0	9.5	0.0
Lane LOS	D			A	
Approach Delay (s)	30.3	0.0		2.2	
Approach LOS	D				

Intersection Summary			
Average Delay	3.5		
Intersection Capacity Utilization	59.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	25	41	832	50	45	649
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.91	0.91	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	27	45	876	53	47	683
Pedestrians	7		7			7
Lane Width (ft)	15.0		12.0			13.0
Walking Speed (ft/s)	4.0		4.0			4.0
Percent Blockage	1		1			1
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			588			
pX, platoon unblocked	0.83	0.83			0.83	
vC, conflicting volume	1694	916			935	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1734	796			819	
tC, single (s)	6.4	6.2			4.2	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.3	
p0 queue free %	63	86			93	
cM capacity (veh/h)	74	319			649	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	73	928	47	683
Volume Left	27	0	47	0
Volume Right	45	53	0	0
cSH	142	1700	649	1700
Volume to Capacity	0.51	0.55	0.07	0.40
Queue Length 95th (ft)	61	0	6	0
Control Delay (s)	54.5	0.0	11.0	0.0
Lane LOS	F		B	
Approach Delay (s)	54.5	0.0	0.7	
Approach LOS	F			

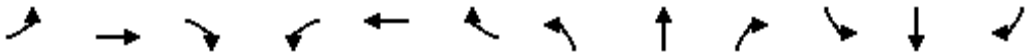
Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	64.0%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	24	86	86	241	116	60	109	410	0	40	314	24
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	26	93	93	262	126	65	115	432	0	42	331	25
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1217	1088	343	1229	1101	432	356			432		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1217	1088	343	1229	1101	432	356			432		
tC, single (s)	7.1	6.5	6.2	7.2	6.6	6.3	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.1	3.4	2.2			2.3		
p0 queue free %	53	50	87	0	30	89	90			96		
cM capacity (veh/h)	56	187	697	72	180	613	1192			1097		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	213	453	546	398
Volume Left	26	262	115	42
Volume Right	93	65	0	25
cSH	193	102	1192	1097
Volume to Capacity	1.10	4.44	0.10	0.04
Queue Length 95th (ft)	257	Err	8	3
Control Delay (s)	146.2	Err	2.6	1.3
Lane LOS	F	F	A	A
Approach Delay (s)	146.2	Err	2.6	1.3
Approach LOS	F	F		

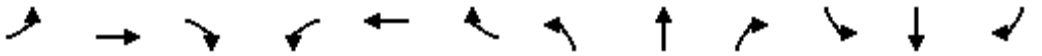
Intersection Summary				
Average Delay	2834.6			
Intersection Capacity Utilization	99.0%	ICU Level of Service	F	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	8	120	15	50	225	5	70	7	52	5	7	11
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	9	141	18	59	265	6	82	8	61	6	8	13
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	271			159			571	557	150	619	563	268
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	271			159			571	557	150	619	563	268
tC, single (s)	4.1			4.2			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			96			80	98	93	98	98	98
cM capacity (veh/h)	1287			1397			405	420	902	357	417	776

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	168	329	152	27
Volume Left	9	59	82	6
Volume Right	18	6	61	13
cSH	1287	1397	522	511
Volume to Capacity	0.01	0.04	0.29	0.05
Queue Length 95th (ft)	1	3	30	4
Control Delay (s)	0.5	1.7	14.7	12.4
Lane LOS	A	A	B	B
Approach Delay (s)	0.5	1.7	14.7	12.4
Approach LOS			B	B

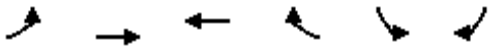
Intersection Summary				
Average Delay	4.7			
Intersection Capacity Utilization	49.2%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	155	500	14	32	755	171	3	64	43	110	54	140
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	163	526	15	34	795	180	3	67	45	116	57	147
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												2
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	975			541			1914	1902	534	1891	1819	885
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	975			541			1914	1902	534	1891	1819	885
tC, single (s)	4.2			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	76			97			0	0	92	0	2	58
cM capacity (veh/h)	684			1018			2	51	550	0	58	347

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	704	1008	116	320
Volume Left	163	34	3	116
Volume Right	15	180	45	147
cSH	684	1018	40	0
Volume to Capacity	0.24	0.03	2.89	879.78
Queue Length 95th (ft)	23	3	321	Err
Control Delay (s)	6.0	0.9	1068.0	Err
Lane LOS	A	A	F	F
Approach Delay (s)	6.0	0.9	1068.0	Err
Approach LOS			F	F

Intersection Summary				
Average Delay	1549.3			
Intersection Capacity Utilization	121.5%	ICU Level of Service	H	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	107	223	311	35	30	106
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	116	242	338	38	33	115
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	376				832	357
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	376				832	357
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	90				89	83
cM capacity (veh/h)	1177				306	687

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	359	376	148
Volume Left	116	0	33
Volume Right	0	38	115
cSH	1177	1700	539
Volume to Capacity	0.10	0.22	0.27
Queue Length 95th (ft)	8	0	28
Control Delay (s)	3.4	0.0	14.2
Lane LOS	A		B
Approach Delay (s)	3.4	0.0	14.2
Approach LOS			B

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	58.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	126	0	0	417	0	204
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.95	0.95
Hourly flow rate (vph)	137	0	0	453	0	215
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			137		590	137
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			137		590	137
tC, single (s)			4.2		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			100		100	76
cM capacity (veh/h)			1417		467	906

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	137	453	215
Volume Left	0	0	0
Volume Right	0	0	215
cSH	1700	1700	906
Volume to Capacity	0.08	0.27	0.24
Queue Length 95th (ft)	0	0	23
Control Delay (s)	0.0	0.0	10.2
Lane LOS			B
Approach Delay (s)	0.0	0.0	10.2
Approach LOS			B

Intersection Summary			
Average Delay		2.7	
Intersection Capacity Utilization		27.6%	ICU Level of Service A
Analysis Period (min)		15	

Appendix C: SimTraffic Queue Report

Intersection: 1: NW Oak Way & OR 47 (Main Street), Interval #1

Movement	EB	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	R	L	TR	L	T	R	L	T	R
Maximum Queue (ft)	219	245	82	194	151	113	480	99	272	477	50
Average Queue (ft)	94	219	67	125	85	37	312	56	231	308	25
95th Queue (ft)	198	291	101	213	158	111	479	114	328	574	59
Link Distance (ft)		224			594		947			527	
Upstream Blk Time (%)	0	14								13	
Queuing Penalty (veh)	0	0								95	
Storage Bay Dist (ft)	70		30	250		95		70	125		25
Storage Blk Time (%)	11	49	14	1		0	34	3	74	35	3
Queuing Penalty (veh)	59	164	70	2		3	53	17	405	95	21

Intersection: 1: NW Oak Way & OR 47 (Main Street), Interval #2

Movement	EB	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	R	L	TR	L	T	R	L	T	R
Maximum Queue (ft)	218	243	80	221	177	140	524	100	274	496	50
Average Queue (ft)	84	182	58	102	72	28	241	54	194	269	33
95th Queue (ft)	170	287	98	210	138	85	448	115	315	528	61
Link Distance (ft)		224			594		947			527	
Upstream Blk Time (%)	0	7								5	
Queuing Penalty (veh)	0	0								33	
Storage Bay Dist (ft)	70		30	250		95		70	125		25
Storage Blk Time (%)	11	46	12	1		0	30	2	50	37	3
Queuing Penalty (veh)	55	142	53	2		2	44	8	258	94	20

Intersection: 1: NW Oak Way & OR 47 (Main Street), All Intervals

Movement	EB	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	R	L	TR	L	T	R	L	T	R
Maximum Queue (ft)	219	245	82	227	177	173	540	100	274	530	50
Average Queue (ft)	86	191	61	108	75	30	258	54	203	279	31
95th Queue (ft)	178	292	99	212	144	92	462	114	321	540	61
Link Distance (ft)		224			594		947			527	
Upstream Blk Time (%)	0	9								7	
Queuing Penalty (veh)	0	0								49	
Storage Bay Dist (ft)	70		30	250		95		70	125		25
Storage Blk Time (%)	11	47	12	1		0	31	2	56	37	3
Queuing Penalty (veh)	56	147	57	2		2	46	10	295	94	20

Intersection: 2: OR 47 Exit & OR 47 (Main Street), Interval #1

Movement	WB	NB	NB	SB
Directions Served	LR	T	R	L
Maximum Queue (ft)	157	14	17	97
Average Queue (ft)	68	2	5	47
95th Queue (ft)	155	15	36	95
Link Distance (ft)	310	386		
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)			70	115
Storage Blk Time (%)			0	1
Queuing Penalty (veh)			0	4

Intersection: 2: OR 47 Exit & OR 47 (Main Street), Interval #2

Movement	WB	NB	NB	SB
Directions Served	LR	T	R	L
Maximum Queue (ft)	152	11	69	116
Average Queue (ft)	57	1	5	52
95th Queue (ft)	125	7	36	93
Link Distance (ft)	310	386		
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)			70	115
Storage Blk Time (%)			0	0
Queuing Penalty (veh)			0	2

Intersection: 2: OR 47 Exit & OR 47 (Main Street), All Intervals

Movement	WB	NB	NB	SB
Directions Served	LR	T	R	L
Maximum Queue (ft)	173	18	86	129
Average Queue (ft)	60	1	5	51
95th Queue (ft)	133	10	36	94
Link Distance (ft)	310	386		
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)			70	115
Storage Blk Time (%)			0	0
Queuing Penalty (veh)			0	2

Intersection: 3: NW Trellis Way & OR 47 (Main Street), Interval #1

Movement	WB	NB	SB	SB
Directions Served	LR	TR	L	T
Maximum Queue (ft)	161	81	59	354
Average Queue (ft)	93	18	27	195
95th Queue (ft)	263	66	63	869
Link Distance (ft)	435	527		3164
Upstream Blk Time (%)	3			
Queuing Penalty (veh)	0			
Storage Bay Dist (ft)			125	
Storage Blk Time (%)				13
Queuing Penalty (veh)				6

Intersection: 3: NW Trellis Way & OR 47 (Main Street), Interval #2

Movement	WB	NB	SB	SB
Directions Served	LR	TR	L	T
Maximum Queue (ft)	178	115	60	486
Average Queue (ft)	76	14	19	73
95th Queue (ft)	242	68	51	373
Link Distance (ft)	435	527		3164
Upstream Blk Time (%)	5			
Queuing Penalty (veh)	0			
Storage Bay Dist (ft)			125	
Storage Blk Time (%)				5
Queuing Penalty (veh)				2

Intersection: 3: NW Trellis Way & OR 47 (Main Street), All Intervals

Movement	WB	NB	SB	SB
Directions Served	LR	TR	L	T
Maximum Queue (ft)	183	125	66	596
Average Queue (ft)	80	15	21	102
95th Queue (ft)	248	68	54	533
Link Distance (ft)	435	527		3164
Upstream Blk Time (%)	5			
Queuing Penalty (veh)	0			
Storage Bay Dist (ft)			125	
Storage Blk Time (%)				7
Queuing Penalty (veh)				3

Intersection: 4: NW Banks Road & OR 47 (Main Street), Interval #1

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LT	LTR
Maximum Queue (ft)	284	112	78	118
Average Queue (ft)	190	91	54	39
95th Queue (ft)	330	116	97	117
Link Distance (ft)	262	27	68	361
Upstream Blk Time (%)	21	97	3	
Queuing Penalty (veh)	0	441	15	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 4: NW Banks Road & OR 47 (Main Street), Interval #2

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LT	LTR
Maximum Queue (ft)	287	130	83	110
Average Queue (ft)	166	93	44	26
95th Queue (ft)	316	119	91	80
Link Distance (ft)	262	27	68	361
Upstream Blk Time (%)	18	97	3	
Queuing Penalty (veh)	0	391	14	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 4: NW Banks Road & OR 47 (Main Street), All Intervals

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LT	LTR
Maximum Queue (ft)	290	135	83	139
Average Queue (ft)	172	93	47	29
95th Queue (ft)	320	119	93	90
Link Distance (ft)	262	27	68	361
Upstream Blk Time (%)	19	97	3	
Queuing Penalty (veh)	0	404	14	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 5: NW Banks Road & NW Aerts Road, Interval #1

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	906	39	74	40
Average Queue (ft)	130	8	46	18
95th Queue (ft)	1366	36	76	49
Link Distance (ft)	4429	460	3905	216
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 5: NW Banks Road & NW Aerts Road, Interval #2

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	40	168	140	49
Average Queue (ft)	2	39	50	17
95th Queue (ft)	16	226	107	48
Link Distance (ft)	4429	460	3905	216
Upstream Blk Time (%)		6		
Queuing Penalty (veh)		0		
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 5: NW Banks Road & NW Aerts Road, All Intervals

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	928	168	145	55
Average Queue (ft)	33	31	49	17
95th Queue (ft)	647	197	101	48
Link Distance (ft)	4429	460	3905	216
Upstream Blk Time (%)		4		
Queuing Penalty (veh)		0		
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 6: OR 6 & Aerts Road, Interval #1

Movement	EB	WB	NB	SB	SB
Directions Served	LTR	LTR	LTR	LT	R
Maximum Queue (ft)	417	321	600	2224	30
Average Queue (ft)	375	99	525	1853	6
95th Queue (ft)	481	312	746	2424	41
Link Distance (ft)	363	497	586	3905	
Upstream Blk Time (%)	49	1	64		
Queuing Penalty (veh)	0	0	0		
Storage Bay Dist (ft)					50
Storage Blk Time (%)				100	1
Queuing Penalty (veh)				147	2

Intersection: 6: OR 6 & Aerts Road, Interval #2

Movement	EB	WB	NB	SB	SB
Directions Served	LTR	LTR	LTR	LT	R
Maximum Queue (ft)	428	509	605	3182	75
Average Queue (ft)	345	129	590	2762	13
95th Queue (ft)	521	411	608	3393	60
Link Distance (ft)	363	497	586	3905	
Upstream Blk Time (%)	39	1	100		
Queuing Penalty (veh)	0	0	0		
Storage Bay Dist (ft)					50
Storage Blk Time (%)				100	1
Queuing Penalty (veh)				138	2

Intersection: 6: OR 6 & Aerts Road, All Intervals

Movement	EB	WB	NB	SB	SB
Directions Served	LTR	LTR	LTR	LT	R
Maximum Queue (ft)	428	509	605	3182	75
Average Queue (ft)	352	121	574	2542	11
95th Queue (ft)	516	389	693	3432	56
Link Distance (ft)	363	497	586	3905	
Upstream Blk Time (%)	42	1	91		
Queuing Penalty (veh)	0	0	0		
Storage Bay Dist (ft)					50
Storage Blk Time (%)				100	1
Queuing Penalty (veh)				140	2

Intersection: 7: NW Banks Road & Sellers Road, Interval #1

Movement	EB	WB	SB
Directions Served	LT	TR	LR
Maximum Queue (ft)	81	1852	334
Average Queue (ft)	34	1139	305
95th Queue (ft)	114	1906	433
Link Distance (ft)	154	4429	333
Upstream Blk Time (%)	1		76
Queuing Penalty (veh)	5		0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 7: NW Banks Road & Sellers Road, Interval #2

Movement	EB	WB	SB
Directions Served	LT	TR	LR
Maximum Queue (ft)	153	3985	375
Average Queue (ft)	32	3153	342
95th Queue (ft)	114	4298	399
Link Distance (ft)	154	4429	333
Upstream Blk Time (%)	1	7	94
Queuing Penalty (veh)	5	21	0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 7: NW Banks Road & Sellers Road, All Intervals

Movement	EB	WB	SB
Directions Served	LT	TR	LR
Maximum Queue (ft)	160	3985	378
Average Queue (ft)	33	2667	333
95th Queue (ft)	114	4444	418
Link Distance (ft)	154	4429	333
Upstream Blk Time (%)	1	6	89
Queuing Penalty (veh)	5	16	0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 41: NW Banks Road & Hwy 47, Interval #1

Movement	EB	WB	NB
Directions Served	T	T	R
Maximum Queue (ft)	14	193	78
Average Queue (ft)	3	173	58
95th Queue (ft)	17	209	80
Link Distance (ft)	27	154	63
Upstream Blk Time (%)	1	76	3
Queuing Penalty (veh)	2	343	6
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 41: NW Banks Road & Hwy 47, Interval #2

Movement	EB	WB	NB
Directions Served	T	T	R
Maximum Queue (ft)	29	234	82
Average Queue (ft)	1	176	58
95th Queue (ft)	13	214	80
Link Distance (ft)	27	154	63
Upstream Blk Time (%)	0	70	4
Queuing Penalty (veh)	1	283	7
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 41: NW Banks Road & Hwy 47, All Intervals

Movement	EB	WB	NB
Directions Served	T	T	R
Maximum Queue (ft)	30	237	82
Average Queue (ft)	2	175	58
95th Queue (ft)	14	213	80
Link Distance (ft)	27	154	63
Upstream Blk Time (%)	1	71	3
Queuing Penalty (veh)	1	298	7
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 42: Hwy 47 & , Interval #1

Movement	NB
Directions Served	LT
Maximum Queue (ft)	202
Average Queue (ft)	79
95th Queue (ft)	203
Link Distance (ft)	3164
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 42: Hwy 47 & , Interval #2

Movement	NB	SE
Directions Served	LT	R
Maximum Queue (ft)	284	14
Average Queue (ft)	73	1
95th Queue (ft)	204	11
Link Distance (ft)	3164	68
Upstream Blk Time (%)		0
Queuing Penalty (veh)		0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 42: Hwy 47 & , All Intervals

Movement	NB	SE
Directions Served	LT	R
Maximum Queue (ft)	286	14
Average Queue (ft)	75	0
95th Queue (ft)	204	10
Link Distance (ft)	3164	68
Upstream Blk Time (%)		0
Queuing Penalty (veh)		0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty, Interval #1: 1955
Network wide Queuing Penalty, Interval #2: 1577
Network wide Queuing Penalty, All Intervals: 1672

Appendix D: Decision Criteria

The following criteria could be used to evaluate potential transportation alternatives and select recommended transportation solutions for the TSP. The proposed evaluation criteria include:

- **Traffic Operations.** *Does the alternative mitigate existing and anticipated (2029) traffic congestion?* This criterion measures the extent to which alternatives alleviate existing and anticipated future traffic congestion.
- **Safety.** *Does the alternative mitigate existing or anticipated safety issues?* This criterion measures the extent to which alternatives ensure safety for all users (drivers, transit, pedestrians, and bicyclists).
- **Mobility.** *Does the alternative enhance mobility for all users?* This criterion measures the extent to which alternatives enhance mobility for transportation users (freight, nonmotorized, transit, transportation disadvantaged, etc.).
- **Land Use.** *Does the alternative minimize land use impacts? Is the alternative consistent with state and local land use planning goals?* This criterion measures the extent to which alternatives minimize property impacts and impacts on existing residential and business access. This criterion relates to economic development because it also evaluates the extent to which alternatives impact future business development through property takes. It also relates to consistency with local, regional and statewide land use plans.
- **Environmental & Social Impacts.** *Does the alternative minimize environmental and social impacts, including impacts on existing and future development and low-income/minority populations?* Most alternatives will have some built and natural environmental impacts. This criterion measures the extent to which alternatives minimize impacts on the social and environmental considerations for the interchange management area. This criterion includes environmental justice considerations.
- **Support for Implementation.** *Can the alternative be supported by both the state and local community?* This criterion measures the extent to which alternatives can be agreed upon that meet the needs and interests of stakeholders within acceptable timelines.
- **Cost-Effectiveness.** *Is the scale of the alternative consistent with the benefits it provides? Is it a practical, affordable solution?* All alternatives will have costs associated with development and implementation. This criterion evaluates how effective the alternative is at relieving congestion compared to the cost.