Future Conditions and Needs: City of Vernonia Transportation System Plan Update

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This memorandum builds upon existing conditions discussed in Project Memorandum #2: Existing Conditions and Needs. This memorandum describes the likely future 2031 land use needs and baseline transportation conditions within the Project Study Area given expected population growth, economic opportunities, typical development patterns, and existing plans, policies, and development codes.

Future Housing and Employment Needs

Housing Needs

Housing Needs Analysis

Housing needs were forecast to the year 2031 using a City of Vernonia population forecast of 2,711 persons. This forecast was based on 2030 population forecast data available from the report *Population Forecasts for Columbia County Oregon, its Cities and Unincorporated Areas* completed by Portland State University's Population Research Center, and adopted by the City in 2009. According to this report, Vernonia is projected to grow at a rate of 0.8% from 2010 to 2020. Population growth is expected to slow to 0.4% from 2020-2030. The average annual growth rate of 0.4% was applied to extend the 2030 population forecast to 2031.

TABLE 1
City of Vernonia Population Forecasts

	2010	2020	2030	2031
Population	2,405	2,605	2,700	2,711
Average Annual Growth Rate (AAGR)		0.8%	0.4%	0.4%

Source: PSU Population Research Center

Between 2009 and 2031 Vernonia is expected to see an increase in population of 400 persons. Additionally, according to the draft City of Vernonia Buildable Lands Inventory the average person per dwelling unit (APPDU) is expected to decline to 2.62 persons by 2030 due to the effects of an aging population. Assuming the APPDU remains the same in 2031, the City of Vernonia is projected to need 153 new dwelling units by 2031.

Forecast 2031 Land Need for Housing

Residential (R) and General Residential (GR) zoned land has a minimum lot size of 5,000 square feet, which equates to a maximum density of 8.7 dwelling units per acre. Low Density Residential (LDR) zoned land has a minimum lot size of 10,000 square feet, which equates to a maximum density of 4.4 dwelling units per acre. To project Vernonia's residential land needs, the following equation was used:

> (Net population increase/Average persons per dwelling unit) ÷ Dwelling units per acre by zone = Number of new acres needed by zone

Table 2 shows the resulting residential land needs under low, medium, and high density growth scenarios. The low density scenario assumes all available LDR land is consumed and the remaining demand is split evenly between R and GR Zones. The medium density scenario assumes residential land demand is distributed evenly between the three residential zones. The high density scenario assumes all residential land demand is supplied by the R and GR zones, and no LDR land is consumed.

TABLE 2
City of Vernonia 2031 Residential Land Needs

Zone	Density (du per acre)	Net Buildable acres[1]	Maximum # of units available	Low Density Scenario (net acres consumed)	Medium Density Scenario (net acres consumed)	High Density Scenario (net acres consumed)
R	8.7	130.5	1,137	4.2	5.8	8.8
GR	8.7	11.4	99	4.2	5.8	8.8
LDR	4.4	18.3	80	18.3	11.7	0
Total		**160.3**	**1,317**	**26.7**	**23.4**	**17.5**

[1] Source: Draft City of Vernonia Buildable Lands Inventory (2009)

Vernonia will require 17.5 – 26.7 net acres of buildable residential land to meet projected housing needs in 2031. Currently, Vernonia has a sufficient amount of buildable residential land to meet housing needs under any of these projected growth scenarios. For the remainder of this analysis, it is assumed that Vernonia will need 23.4 net acres of buildable residential land to meet housing demands in 2031 (the medium density growth scenario).

Type and Level of Employment Growth

Employment Needs Analysis

Employment needs were forecast to the year 2031 using employment information from the draft City of Vernonia Economic Opportunity Analysis (2009). According to this

report, commercial jobs are projected to grow at an average annual rate of 1.09 percent from 2008 to 2030 and industrial jobs are expected to grow at an average annual rate of 0.91 percent. These growth rates were applied respectively to the projected number of commercial and industrial jobs in 2030 to achieve estimates for 2031. As shown in Table 3, Vernonia is expected to add 127 new commercial jobs and 28 new industrial jobs by 2031.

TABLE 3
City of Vernonia Employment Forecast

	2008[1]	2030[1]	Projected 2031	Total New Jobs
Commercial Jobs (AAGR 1.09%)	449	570	576	127
Industrial Jobs (AAGR 0.91%)	123	150	151	28
Total	572	720	727	155

[1] Source: Draft City of Vernonia Economic Opportunity Analysis (2009)

Forecast 2031 Land Need for Job Growth

According to the draft City of Vernonia Economic Opportunity Analysis (2009), Vernonia's current commercial land density is about 33 jobs per acre and the current industrial land density is about 2.9 jobs per acre. At these densities, 3.9 acres of Downtown (DT) and General Commercial (GC) land would be needed to meet commercial land demand in 2031 and 9.8 acres of industrial land would be needed to meet industrial land demand.

TABLE 4
City of Vernonia 2031 Employment Land Needs

Zone	Density (jobs per acre)[1]	Buildable acres[2]	New jobs (2008-2031)	Land needed (acres)
GC & DT	33.0	1.4	127	3.9
LI	2.9	28.2	28	9.8
Total		**160.3**	**155**	**13.7**

[1] Source: Draft City of Vernonia Economic Opportunity Analysis (2009)
[2] Source: Draft City of Vernonia Buildable Lands Inventory (2009)

Future Land Supply

Forecast 2031 Land Supply

Table 5 shows that with no changes to current zoning, the current land supply is more than adequate to meet both residential and industrial land demands through 2031. However, the supply of buildable commercial land is not sufficient to meet the projected commercial land demand.

TABLE 5

2031 Forecast Buildable Lands – Existing Zoning

Zone	Current Buildable Land Supply (acres)[1]	2031 Land Demand (acres)	Unmet Demand (acres)	2031 Remaining Buildable Lands (acres)
R	130.5	5.8	0	124.7
GR	11.4	5.8	0	5.6
LDR	18.3	11.7	0	6.6
LI	28.2	9.8	0	18.4
PR	0	0	0	0
GC & DT	1.4	3.9	-2.5	0
TOTALS	**189.9**	**37.0**	**-2.5**	**155.3**

[1] Source: Draft City of Vernonia Buildable Lands Inventory (2009)

Vernonia has two zones that encourage commercial development: Downtown and General Commercial zones. Expanding available commercial lands would be one way for Vernonia to encourage local economic development and meet future commercial land needs.

Forecast 2031 Land Supply – Alternative Land Use Scenario

The City of Vernonia has developed an alternative land use scenario that reflects the City's desire to gain more commercial land outside the floodplain. To meet the projected employment demands and replace commercially zoned lands located in floodplain areas, the City is proposing to expand the Downtown Commercial Zone to include 6 acres of commercial land on the west side of Rose Avenue and 3 acres of commercial land between Jefferson and Weed Avenue. The 9 acres proposed for re-zoning are currently zoned for General Residential (GR). This means that under the alternative land use scenario, 9 acres of residential GR land would be re-zoned to commercial DT land.

Additionally, with 9 new acres of commercial land, the commercial job density would decrease from 33.0 to 19.4 jobs per acre. This means that the amount of commercial land needed to meet commercial land demand would increase to 6.6 acres under the alternative land use scenario.

Table 6 shows that under the alternative land use scenario, the buildable land supply would be more than adequate to meet residential, commercial, and industrial land demands through 2031. The 3.4 acres of unmet demand for General Residential (GR) land is due to the rezoning of 9 acres of GR land. However, this demand could be more than offset with the abundant supply of buildable Residential (R) land.

TABLE 6

2031 Forecast Buildable Lands – Alternative Land Use Scenario

Zone	Current Buildable Land Supply (acres)[1]	2031 Land Demand (acres)	Unmet Demand (acres)	2031 Remaining Buildable Lands (acres)
R	130.5	5.8	3.4	121.3
GR	2.4	5.8	-3.4	0.0
LDR	18.3	11.7	0.0	6.6
LI	28.2	9.8	0.0	18.4
PR	0.0	0	0.0	0.0
GC & DT	10.4	6.6	0.0	3.8
TOTALS	**189.9**	**39.7**	**0.0**	**150.2**

[1] Source: Draft City of Vernonia Buildable Lands Inventory (2009)

Future Transportation Conditions

Project Study Area

The project study area for the 2031 Future traffic analysis is based on the existing traffic analysis study area outlined in *Technical Memorandum 2: Existing Conditions and Needs, City of Vernonia Transportation System Plan Update (CH2M HILL, 2010).* The study area includes ten existing intersections within the City of Vernonia, eight of which are located along OR 47.

Forecasting Methodology

The year 2031 is the horizon analysis year for the future conditions traffic analysis, providing a 21-year forecast from existing conditions. Existing year (2010) 30th highest hour volumes were grown to reach future year (2031) land use scenario analysis volumes. Future volumes were reached using a Level 1 trending analysis and by adding the traffic generated from planned and programmed land use developments.

Based on ODOT Transportation System Planning Guidelines (2008), a Level 1 Trending Analysis is an appropriate methodology for forecasting future year volumes for areas where there is not enough data available to perform a cumulative (Level 2) analysis. This method typically projects future traffic volumes from historical growth trends of regional traffic volumes. These trends are usually determined from traffic volume data on the nearest state highway, since historical data are readily available. It is used mainly in rural or small urban areas where significant growth is not anticipated.

The existing traffic volumes were counted between April 2008 and March 2010 and were factored up to existing year (2010) traffic volumes. The traffic counts were also seasonally adjusted to the peak month for the study area and then balanced between local intersections. This volume represents the 30th worst hour of the year, and generally provides a target 'design hour' volume for future analysis. A growth rate was then applied to these existing turning movement volumes to develop a baseline 2031 traffic volume forecast.

Four different sources were compared to determine an annual geometric growth rate for the City of Vernonia. Table 7 shows the various data sources, the annual growth rate (geometric) and the growth factor. A brief description of each data source is provided below:

TABLE 7

Vernonia Transportation System Plan –2031 Growth Rate

Growth Rate Source	Annual Growth Rate	Growth Factor (2031/2010)
City of Vernonia – Portland State University Research Center – Medium Growth Forecast	0.58%	1.129
Columbia County – Portland State University Research Center – Medium Growth Forecast	0.92%	1.213
OR 47 Historical Growth 1999 – 2009 (ODOT)[1]	0.61%	1.135
OR 47 Future Volumes Table – 2029 (ODOT)[2]	1.41%	1.341

[1]PSU Population Research Center (2006)
[2] Data provided by Doug Baumgartner, ODOT Traffic, Region 1.
[3]http://www.oregon.gov/ODOT/TD/TPAU/A_Data.shtml

Population forecasts were analyzed for both Columbia County and the City of Vernonia based on research conducted by the Portland State University Population Research Center. The historical and medium growth forecasts are commonly used to forecast population and employment growth within a given community or county. Based on Table 18, the City of Vernonia population is expected to increase from 2,405 in 2010 to 2,700 in 2030, or at a 0.58 percent annual growth rate. Countywide, the annual growth rate is higher at 0.92 percent, corresponding to a population increase of 9,810 persons (58,505 persons in 2030, 48,695 persons in 2010). PSU population forecasts are provided in Appendix A.

Historical traffic volumes along OR 47 were provided from ODOT for the years from 1999 to 2009. Annual ADT traffic counts were collected at six different locations between milepost 61.27 and 62.79 for the 10-year period. Averaging data from all six locations, traffic volumes increased from approximately 5070 vehicles per day in 1999 to 5350 vehicles per day in 2009, representing an annual growth rate of 0.61 percent.

The ODOT Analysis Procedures Manual (APM) recommends using the ODOT Future Transportation Volume Table for developing future year traffic volumes (http://www.oregon.gov/ODOT/TD/TPAU/A_Data.shtml). This table projects average annual daily traffic volumes roughly 20 years in to the future for highways throughout the State of Oregon. Each forecasted volume is given an R-squared value, which measures the degree of correlation between historical traffic volumes and time. Forecasted volumes with an R-squared value greater than 0.75 represents a strong relationship, and can typically be used with a high degree of confidence. The APM also states forecasted volumes with an R-squared greater than 0.50 may be used if more reliable data are unavailable. Within the City of Vernonia Urban Growth Boundary, five locations were identified as having an R-squared greater than 0.50 and only one location, at milepost 61.25, has an R-squared value greater than 0.75. An investigation of these five locations showed on average, traffic volumes would increase from 4,160 ADT in

2009 to 5,500 ADT in 2029, representing an annual growth rate of 1.41 percent. Table 1 shows the growth rate calculation for this method.

TABLE 8
State Highway Annual Growth Rates

Milepost	2009 ADT	2029 ADT	R-squared Value	Overall Factor	1-year growth[1]
OR 47 – Nehalem Highway No. 102					
60.40	2000	2700	0.57	1.35	1.5%
61.25	3200	4400	0.76	1.38	1.6%
61.72	5100	6600	0.64	1.29	1.3%
62.11	6600	8500	0.59	1.29	1.3%
62.79	3900	5300	0.67	1.36	1.5%
Average	4160	5500	-	1.32	1.41%
				OR 47 Annual Rate	1.41%
				OR 47, 22-Year Factor	1.34

[1]Geometric Growth Rate
Source: ODOT 2029 Highway Future Volume Table
http://www.oregon.gov/ODOT/TD/TP/docs/TADR/2029FVT.pdf
ADT – Average Daily Traffic
The available growth rates are only projected to year 2029; this study assumed the traffic would grow at the same rate through year 2031.

Based on the data available and the information provided in Table 8, an annual growth rate of 0.61 percent was chosen as the most appropriate growth rate. This value was applied to existing year traffic volumes to obtain 2031 volumes. The 0.61 percent growth rate was selected because it is representative of both the historical growth observed along OR 47 between 1999 and 2009 and is approximately the same forecasted population growth rate for the City of Vernonia. It appears to represent both the local growth expected in the city and account for regional, through trip growth along OR 47. The countywide growth rate was not selected since it provides more of a regional growth forecast. The growth rate calculated using the Future Transportation Volume Table was dismissed due to the number of low R-squared values found in the data.

Trips generated by three planned development projects (pipeline projects) were also added to the forecasted 2031 traffic volumes. These three projects include:

- Nehalem View Subdivision
- Vernonia Schools Relocation Project
- West Oregon Electric Cooperative HQ and City development

Each of these transportation impact studies (TIS) provides a forecasted trip generation, trip distribution, and assignment for each development. The PM peak hour traffic volume assignment for each study was added to the Vernonia transportation network background volumes for the Year 2031. Although all pipeline projects are located within the city, trips from these studies had different distribution patterns and affected different study intersections. At study intersections where turning volumes were not provided by the previous studies, site specific traffic was distributed to the local

roadway network based on existing travel patterns. The Year 2031 Baseline forecasts the project trip assignment for the three pipeline projects and the final rounded and balanced Year 2031 PM peak hour forecasts are provided in Appendix B.

Future Planned Infrastructure Projects

The traffic analysis assumes that only one planned and programmed project will occur within the study area. As part of the Vernonia Schools Relocation Project, a 100-foot eastbound left-turn pocket is assumed to be constructed at the intersection of Bridge Street and Missouri Avenue. No additional transportation improvements within the study area have committed funding sources. A review of the ODOT Draft 2010-2013 Statewide Transportation Improvement Program indicates that no state projects are anticipated along OR 47 within the study area.

Future Year Traffic Analysis

Performance and Mobility Standards

For the 2031 future conditions, the mobility standards for intersections within ODOT's jurisdiction vary based on roadway classification. These standards vary based on facility type, if the facility is located inside an urban growth boundary, or if a specific highway has been designated as a special transportation area (STA). Within the City of Vernonia study area, mobility standards (maximum volume to capacity ratios) along the state highway vary between 0.80 and 0.95. For the intersections under the City of Vernonia jurisdiction, a LOS D standard was used. Table 9 shows the mobility standards for the intersection operational analysis.

Traffic Analysis Software Tools

A Synchro 7 computer traffic operations model was constructed for the 2031 Future analysis. The future year assumes existing lane geometry (since no future programmed improvements are planned) with 2031 forecasted turning movement volumes. The model assumes existing truck percentages, as that is the most accurate available data. Peak hour factors were updated per guidance from TPAU's Analysis Procedures Manual (APM) Section 5.3.3. Future year peak hour factors should be 0.95 for major arterials, 0.90 for minor arterials, and 0.85 for minor streets. Since OR 47 is classified as a Urban Collector/District Highway, and all other study facilities are either a Rural Major Collector or Local Roads, all intersection approaches were assumed to have a 0.85 peak hour factor, or operate with their existing peak hour factor if greater than 0.85.

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.

Operational Analysis Results

This section updates the Future Transportation Demand section of the 1999 TSP. The volume to capacity ratios and 95th percentile queue lengths were collected from the future Synchro and SimTraffic simulation models for the ten study area intersections.

These results indicate that the future traffic growth assumed will not lead to significant operational problems within Vernonia.

Table 9 also provides a summary of the Year 2031 LOS conditions for the ten study intersections during the PM peak hour. In the existing conditions analysis, all of the intersections meet mobility standards. Even with the growth of traffic in the city, all intersections are expected to operate at an acceptable mobility standard in the Year 2031. Detailed Synchro mobility reports are also reported in Appendix C.

TABLE 9

Vernonia Transportation System Plan – Intersection Operational Results

ID	Intersection	Control Type	Mobility Standard[2]		Year 2031 Operations	
			Uncontrolled Approach	Controlled Approach	Uncontrolled Approach	Controlled Approach
1	State Avenue/Stoney Point Road	TWSC	LOS D		LOS A (9.8 sec/veh) Worst Movement= EBL/T/R	
2	Rose Avenue/Bridge Street[1]	AWSC	0.95		0.38	
3	Bridge Street/Weed Avenue	TWSC	0.95	0.95	0.04	0.31
4	Bridge Street/State Avenue	TWSC	0.80	0.80	0.22	0.20
5	Bridge Street/Texas Avenue	TWSC	0.80	0.80	0.03	0.06
6	Bridge Street/Missouri Avenue	TWSC	0.80	0.80	0.17	0.18
7	Bridge Street/Riverside Drive	TWSC	0.80	0.80	0.03	0.06
8	Rose Avenue/Maple Street	TWSC	0.80	0.80	0.00	0.12
9	Maple Street/Weed Avenue	AWSC	LOS D		LOS A (7.5 sec/veh)	
10	Rose Avenue/Cougar Street	TWSC	0.80	0.80	0.02	0.15

[1]The intersection of Bridge Street/Rose Avenue has a free NBR movement. The westbound approach is yield controlled.
[2]Future Mobility Source: ODOT Highway Design Manual (Table 10-1).
AWSC: All-Way Stop Controlled
TWSC: Two-Way Stop Controlled
V/C ratios for All-Way Stop Controlled intersections are for the whole intersection.
Year 2031 Operations as reported from Synchro 7.

The vehicle queuing analysis identifies deficient vehicle storage locations and provides key information as the project advances into the alternative development stage. Table 10 shows the forecasted 2031 PM peak hour 95th percentile vehicle queues lengths at the 10 study intersections. One movement, the northbound right turn at Rose Street/Bridge Street, is expected to have a 95th percentile queue that exceeds existing storage capacity. The current right turn pocket can store approximately three vehicles. With the anticipated growth, the right turn queue is likely to spill back out of the existing right turn pocket. The full SimTraffic queuing results are provided in Appendix C.

TABLE 10
Vernonia TSP – Year 2031 Baseline Conditions 95th Percentile Queues

ID	Intersection	Method	Approach	Lane Group	Existing Storage (feet)	Queue Length (feet)
1	State Avenue/ Stoney Point Road	95% Queue SimTraffic	Eastbound	Left/Thru/Right	-	20[1]
			Westbound	Left/Thru/Right	740	20
2	Rose Avenue/ Bridge Street	95% Queue SimTraffic	Eastbound	Left/Thru/Right	280	50
			Westbound	Left/Thru/Right	260	70
			Northbound	Left/Thru	280	60
				Right	75	80
			Southbound	Left/Thru/Right	300	60
3	Bridge Street/ Weed Avenue	95% Queue SimTraffic	Southbound	Left/Thru/Right	-	80
4	Bridge Street/ State Avenue	95% Queue SimTraffic	Southbound	Left/ Right	240	70
5	Bridge Street/ Texas Avenue	95% Queue SimTraffic	Northbound	Left/Thru/Right	Driveway	n/a
			Southbound	Left/Thru/Right	150	40
6	Bridge Street/ Missouri Avenue	95% Queue SimTraffic	Northbound	Left/Thru/Right	850	20
			Southbound	Left/Thru/Right	120	90
7	Bridge Street/ Riverside Drive	95% Queue SimTraffic	Northbound	Left/Thru/Right	170	n/a
			Southbound	Left/Thru/Right	170	40
8	Rose Avenue/ Maple Street	95% Queue SimTraffic	Eastbound	Left/Thru/Right	260	20
			Westbound	Left/Thru/Right	290	70
9	Maple Street/ Weed Avenue	95% Queue SimTraffic	Eastbound	Thru/Right	290	60
			Westbound	Left/Thru	290	50
			Northbound	Left/ Right	270	60
			Southbound	Left/Thru/Right	280	60
10	Rose Avenue/ Cougar Street	95% Queue SimTraffic	Eastbound	Left/Thru/Right	270	50
			Westbound	Left/Thru/Right	driveway	60

Notes:
[1]Queue lengths less than 20 feet are rounded up to the 20 feet to represent a standard vehicle length.
95th Percentile queues calculated using an average of five, one hour SimTraffic runs.
Queues lengths not reported for free-flowing and uncontrolled movements.
Queue lengths rounded to the nearest 10 feet
Numbers in black highlight indicate a vehicle queues length that exceeds the available storage length.

Turn-Lane Warrants

A turn lane warrant analysis was completed to check if turn lanes meet the installation criteria outlines in the Highway Design Manual. Turns lanes improve safety and the capacity of the roadway by reducing the speed differential between through and turning vehicles. Meeting a turn lane criteria does not necessarily require installation. The APM outlines three criteria if a turn lane should be installed including:

- Traffic volumes
- Crash experience
- Special cases

Turn-lane warrants were completed at all study intersection based on the 2031 PM peak hour traffic volumes. The other two criteria were not analyzed. Tables 11 and 12 have been prepared showing the threshold volumes for meeting turning left and right turn-lane warrants, respectively. This analysis was performed in accordance with Chapter 7 of the APM, utilizing Exhibit 7-1 for identifying left turn-lane warrants and Exhibit 7-2 for right turn-lane warrants.

TABLE 11
Vernonia TSP – Year 2031 Left Turn Lane Warrants

Intersection	Movement	Estimated 2031 PM Peak Hour Volume	Opposing/Advancing Volumes[1]	Turn Lane Warrant Threshold	Is Warrant Met?
Rose Avenue/ Bridge Street	WBL	195	320	50	Yes
	NBL	25	355	44	No
	SBL	45	355	44	Yes
Bridge Street/ Weed Avenue	WBL	50	680	17	Yes
	EBL	30	660	17	Yes
Bridge Street/ State Avenue	EBL	85	755	17	Yes
Bridge Street/ Texas Avenue	EBL	35	625	20	Yes
Bridge Street/ Riverside Drive	EBL	35	475	31	Yes
Rose Avenue/ Maple Street	NBL	3	568	22	No
	SBL	5	570	22	No
Rose Avenue/ Cougar Street	NBL	4	534	25	No
	SBL	25	555	22	Yes

[1]Only movements having opposing/advancing volumes greater than 200 vehicles per hour were analyzed.
Numbers in black highlight indicates a warrant is met for a left-turn pocket.
Left turn lane warrants based on Exhibit 7-1 from the *ODOT Analysis Procedure Manual (APM).*

As shown in Table 11, several eastbound and westbound left lanes along Bridge Street are warranted. Eastbound left turn lanes are warranted along all study intersections along Bridge Street and westbound left turn lanes are warranted at the intersections of Bridge Street/Rose Avenue and Bridge Street/Weed Avenue. Furthermore, left turn lanes are warranted along Rose Avenue at a few study intersections.

Table 12 shows that no study intersections will warrant a right-turn lane based on 2031 PM peak hour traffic volumes.

TABLE 12

Vernonia TSP – Year 2031 Right Turn-Lane Warrants

Intersection	Movement	Estimated 2031 PM Peak Hour Volume	Approaching Volume	Turn Lane Warrant Threshold	Is Warrant Met?
Rose Avenue/ Bridge Street	SBR	0	65	105	no
	EBR	10	42	115	no
	WBR	35	280	80	no
Bridge Street/ Weed Avenue	SBR	10	73	105	no
	EBR	5	340	75	no
	WBR	50	370	65	no
Bridge Street/ State Avenue	SBR	70	85	105	no
	WBR	30	315	75	no
Bridge Street/ Texas Avenue	SBR	30	33	115	no
	WBR	5	270	80	no
Bridge Street/ Missouri Avenue	SBR	55	80	105	no
	EBR	15	320	75	no
	WBR	25	235	85	no
Bridge Street/ Riverside Drive	SBR	20	30	115	no
	WBR	15	210	85	no
Rose Avenue/ Maple Street	NBR	45	348	75	no
	SBR	15	225	85	no
	EBR	2	7	115	no
	WBR	35	73	105	no
Maple Street/ Weed Avenue	NBR	10	13	115	no
	SBR	15	55	105	no
	EBR	2	52	105	no
Rose Avenue/ Cougar Street	NBR	20	319	75	no
	SBR	20	240	85	no
	EBR	3	23	115	no
	WBR	30	60	105	no

Numbers in black highlight indicates a warrant is met for a right-turn pocket.
Right turn-lane warrants based on Exhibit 7-2 from the *ODOT Analysis Procedure Manual (APM).*

Future System Deficiencies

Based on the analysis of existing and future transportation conditions, and recommendations from traffic impact analyses, the following needs have been identified for the future.

Missing Links

This section updates the Connectivity section of the 1999 TSP. OR 47 will carry much of the east-west traffic through the city by the year 2031 due to the lack of east-west connectivity through the city. Improving the connectivity and completing parts of the grid network around downtown Vernonia will provide some relief along OR 47. However, topographical constraints through the city provide a challenge. A few missing links are identified below that could improve east-west connectivity through the city:

- A two-way connection between Rose Avenue and Weed Avenue along Cougar Street.
- 1st Avenue between Bridge and Cougar Streets
- Columbia Street between 3rd Avenue and Weed Avenue
- Nehalem Street connection to Weed Avenue
- Cougar Street between Jefferson Avenue and Adams Avenue
- North-south road parallel to OR 47 on east side where OR 47 is Mist Drive
- Bridges (as called out in the 1999 TSP)

Geometric Deficiencies

- The intersection of Rose Avenue and Bridge Street will likely have northbound right turn queue that exceeds available storage in the future conditions.
- The flashing beacon at Rose Avenue/Bridge Street is confusing for visitors.
- There is a potential safety conflict at the offset intersection of Weed Avenue and Bridge Street.

Safety Issues

No safety needs were identified.

Summary of Future Conditions and Needs

Land Use

- With current zoning, the City of Vernonia's buildable land supply will be more than adequate to meet both residential and industrial land needs through 2031. However, the supply of buildable commercial land is not sufficient to meet the projected commercial land demand.
- The alternative land use scenario would add 9 acres of commercial land to the Downtown (DT) commercial district. Under this scenario, the buildable land supply

within Vernonia would be more than adequate to meet residential, commercial, and industrial land needs through 2031.

Traffic and Transportation

- All study intersections are anticipated to operate at an acceptable mobility standard in the Year 2031 PM peak hour.
- One study area intersection, Bridge Street/Rose Avenue, will experience vehicle queuing on the northbound right turn.
- Several left turn lane warrants were met for eastbound and westbound left turn movements along Bridge Street. No right turn lane warrants were met at any study intersections for the PM peak hour.
- There is little east-west connectively through the city
- The intersection of Rose Avenue/Bridge Street can be confusing for visitors.

Next Steps

The existing conditions and deficiencies will be reviewed by the Project Advisory Committee (PAC) and the Project Management Team (PMT) and relevant information will be added. These future conditions and deficiencies will help inform recommended suggested transportation improvements.

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The contents of this document do not necessarily reflect views or policies of the State of Oregon.

Appendix A

Censuses and more recent population estimates and housing data, and where available, detailed information about historic and planned future residential development. Forecasts were not constrained by either current city boundaries or residential building capacities. Adjustments to 1990 and 2000 census counts for Clatskanie and 2000 census counts for Vernonia were based on surveys and censuses conducted by the PSU Population Research Center in 1991 and 2006. The housing unit model was not used to forecast the population of the City of Prescott; its population remains at its 2008 level throughout the forecast period.

TABLE 18:

Historical & Medium Growth Forecast: Total Population
Columbia County Cities & Unincorporated Area

	Clatskanie	Columbia City	Prescott	Rainier	St. Helens	Scappoose	Vernonia	Unincorp.	County-wide
1990: Total Population	1,708	1,003	63	1,674	7,535	3,529	1,808	20,237	37,557
2000:									
Total Population	1,675	1,571	72	1,687	10,019	4,976	2,292	21,268	43,560
Numeric change	*-33*	*568*	*9*	*13*	*2,484*	*1,447*	*484*	*1,031*	*6,003*
Average Annual Growth Rate	*-0.2%*	*4.6%*	*1.3%*	*0.1%*	*2.9%*	*3.5%*	*2.4%*	*0.5%*	*1.5%*
2010:									
Total Population	1,795	1,979	75	1,844	12,847	6,601	2,405	21,149	48,695
Numeric change	*120*	*408*	*3*	*157*	*2,828*	*1,625*	*113*	*-119*	*5,135*
Average Annual Growth Rate	*0.7%*	*2.3%*	*0.4%*	*0.9%*	*2.5%*	*2.8%*	*0.5%*	*-0.1%*	*1.1%*
2020:									
Total Population	1,948	2,292	75	2,060	15,591	8,234	2,605	21,220	54,025
Numeric change	*153*	*313*	*0*	*216*	*2,744*	*1,633*	*200*	*71*	*5,330*
Average Annual Growth Rate	*0.8%*	*1.4%*	*0.0%*	*1.1%*	*1.9%*	*2.2%*	*0.8%*	*0.0%*	*1.0%*
2030:									
Total Population	2,058	2,532	75	2,210	17,842	10,022	2,700	21,066	58,505
Numeric change	*110*	*240*	*0*	*150*	*2,251*	*1,788*	*95*	*-154*	*4,480*
Average Annual Growth Rate	*0.5%*	*1.0%*	*0.0%*	*0.7%*	*1.3%*	*1.9%*	*0.4%*	*-0.1%*	*0.8%*

Medium Growth Forecast adopted by Adj + County 9/09

City of Vernonia TSP Update

Population 2340
ADT 4000
2-lane District Highway
Weekday Rural Populated
ATR Range 3600 4400
Highway 102 MP 62.5

NO ONSITE OR NEARBY ATR!

Note: Table was modifed to include 2009 Seasonal Trends for ATR Station 03-013 and seasonal adjustment interpolation calculations.
-JDJ

1. Similar ATR Method

			Trend	Area	Facility		Classifica	ADT	Designation		Population			
BEST METHOD	-2.50%	**ATR 03-013**	*Aggricultural*	*Rural*	2 lane	Weekday	District Hi	3900	OR 213 Cascade					
Marquam			31	28	31	30	31	30	31	31	30	31	30	31
03-013	Peak Month	Peak%	January	February	March	April	May	June	July	August	September	October	November	December
2009	August	109	93	94	96	102	105	105	106	109	108	103	98	91
2008	July	114	91	100	102	104	110	109	114	106	103	100	105	84
2007	June	112	84	96	101	103	107	109	110	112	109	102	100	89
2006	August	113	89	92	94	103	105	109	111	113	111	106	98	92
2005	August	111	92	95	97	101	105	109	110	111	107	103	102	94
	Average	112	91	95	98	103	106	109	110	111	108	103	100	91
	Factor		**1.2353**	**1.1789**	**1.1429**	**1.0909**	**1.0599**	**1.0275**	**1.0151**	**1.0120**	**1.0370**	**1.0909**	**1.1200**	**1.2353**

Seasonal Adjustment Interpolation

Month	Date	Days Ahead	Days Back	Month Ahead	Month Back	Seasonal Adj Factor
December	2	13	17	1.2353	1.1200	1.185
March	10	5	23	1.1429	1.1789	1.149
April	24	21	9	1.0599	1.0909	1.082

2. Seasonal Trend Table

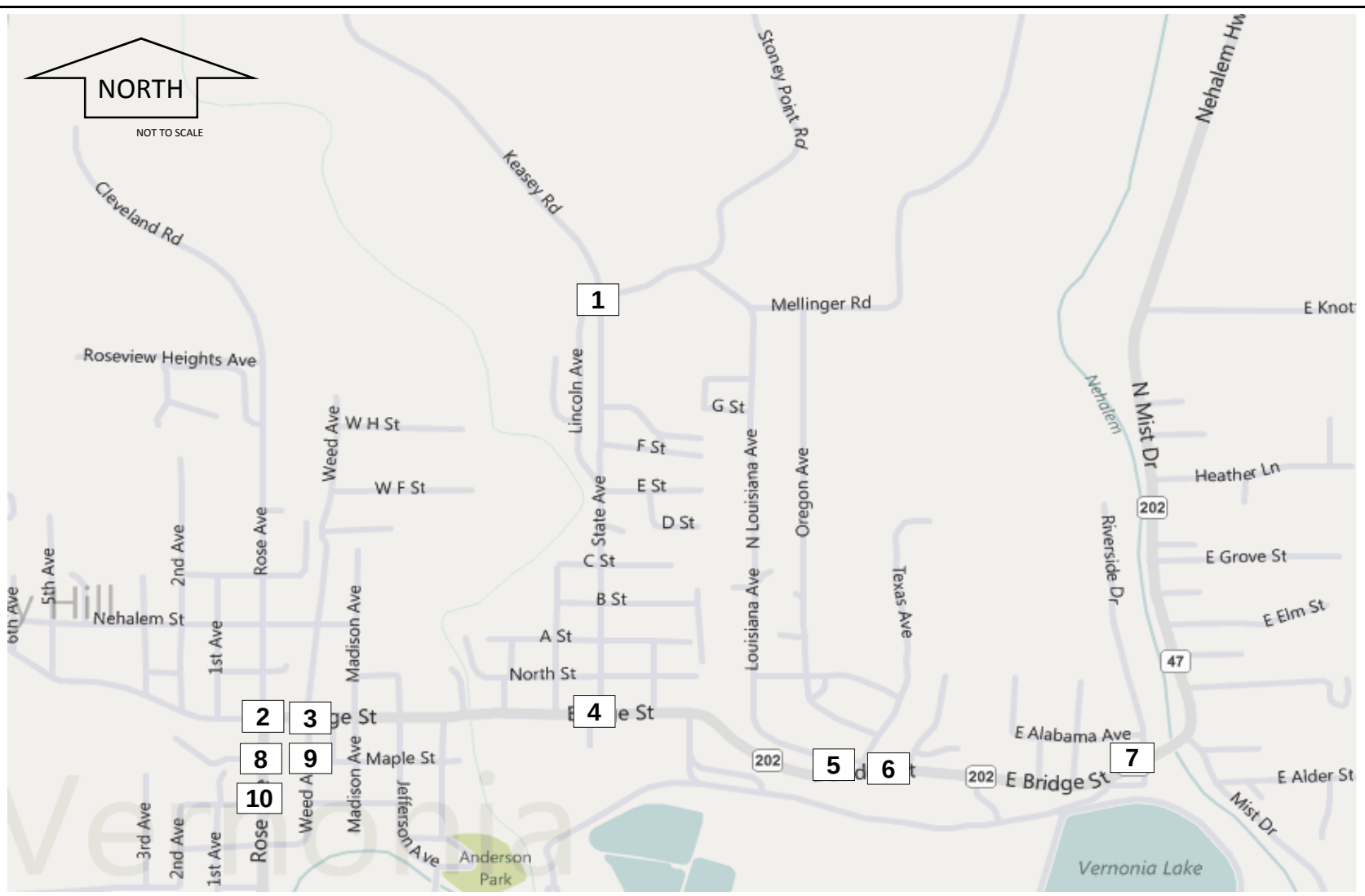
			January	February	March	April	May	June	July	August	September	October	November	December	Peak
AGRICULTURE			**1.1881**	**1.0732**	**1.0221**	**0.9854**	**0.9446**	**0.9240**	**0.8917**	**0.8940**	**0.9054**	**0.9336**	**0.9865**	**1.1632**	**0.8821**
Factor			**1.3469**	**1.2166**	**1.1587**	**1.1171**	**1.0709**	**1.0475**	**1.0109**	**1.0134**	**1.0264**	**1.0583**	**1.1184**	**1.3186**	

Yearly Growth Adjustment Factor

													Growth										
MP	**Location**	**2009 ADT**	**2008 ADT**	**2007 ADT**	**2006 AD**	**2005 ADT**	**2004 ADT**	**2003 ADT**	**2002 ADT**	**2001 ADT**	**2000 ADT**	**1999 ADT**		**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Avg**
61.72	0.01 mile wes	5100	4000	4200	4200	3900	4000	4000	5300	5100	4900	4600		1.0652	1.0408	0.9623	0.7547	1.0000	0.9750	1.0769	1.0000	0.9524	1.2750	1.0102
62.11	0.02 mile wes	6600	4800	5100	5000	4900	5000	5000	6500	6400	6300	5900		1.0678	1.0159	0.9846	0.7692	1.0000	0.9800	1.0204	1.0200	0.9412	1.3750	1.0174
62.27	Rock Creek E	7200	5200	5400	5400	5300	5400	5400	6900	6800	6700	6700		1.0000	1.0149	0.9855	0.7826	1.0000	0.9815	1.0189	1.0000	0.9630	1.3846	1.0131
62.52	0.02 mile eas	5200	3600	3800	3700	4200	4300	4300	5500	5400	5300	5200		1.0192	1.0189	0.9818	0.7818	1.0000	0.9767	0.8810	1.0270	0.9474	1.4444	1.0078
62.56	0.02 mile sou	4100	3200	3400	3300	3600	3700	3700	4600	4500	4400	4200		1.0476	1.0227	0.9783	0.8043	1.0000	0.9730	0.9167	1.0303	0.9412	1.2813	0.9995
62.79	0.02 mile sou	3900	3100	3300	3300	3300	3400	3400	4100	4000	3900	3800		1.0263	1.0256	0.9756	0.8293	1.0000	0.9706	1.0000	1.0000	0.9394	1.2581	1.0025
	AVG	5350	3983	4200	4150	4200	4300	4300	5483	5367	5250	5067												1.008 Average

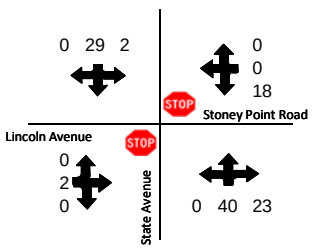
ANNUAL GROWTH

Appendix B



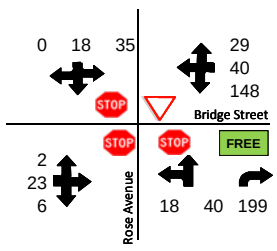
1	Stoney Point Road/State Avenue

Growth Rate: 0.61%
Growth Factor: 1.135



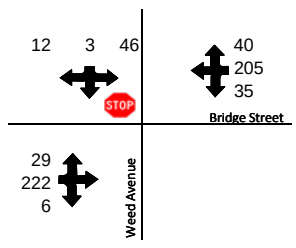
2	Bridge Street/Rose Avenue

Growth Rate: 0.61%
Growth Factor: 1.135



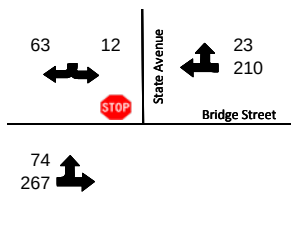
3	Bridge Street/Weed Avenue

Growth Rate: 0.61%
Growth Factor: 1.135



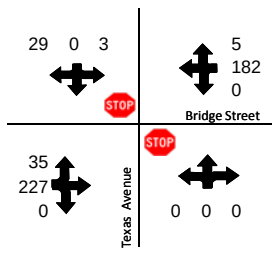
4	Bridge Street/State Avenue

Growth Rate: 0.61%
Growth Factor: 1.135



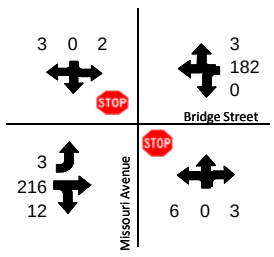
5	Bridge Street/Texas Avenue

Growth Rate: 0.61%
Growth Factor: 1.135



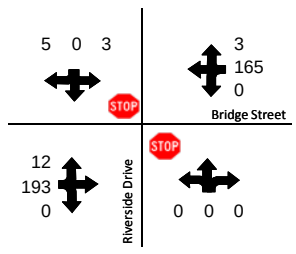
6	Bridge Street/Missouri Avenue

Growth Rate: 0.61%
Growth Factor: 1.135



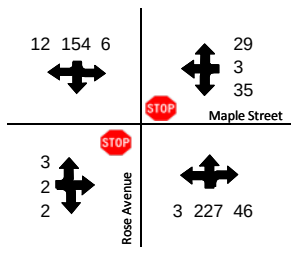
7	Bridge Street/Riverside Drive

Growth Rate: 0.61%
Growth Factor: 1.135



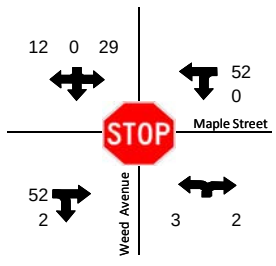
8	Maple Street/Rose Avenue

Growth Rate: 0.61%
Growth Factor: 1.135



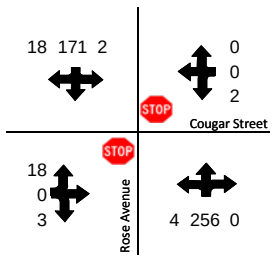
9	Maple Street/Weed Avenue

Growth Rate: 0.61%
Growth Factor: 1.135



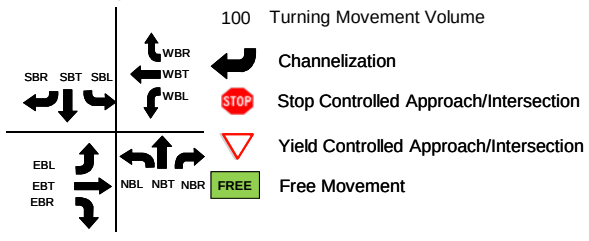
10	Cougar Street/Rose Street

Growth Rate: 0.61%
Growth Factor: 1.135



Legend:

Volume Diagram



100 Turning Movement Volume

Channelization

Stop Controlled Approach/Intersection

Yield Controlled Approach/Intersection

Free Movement

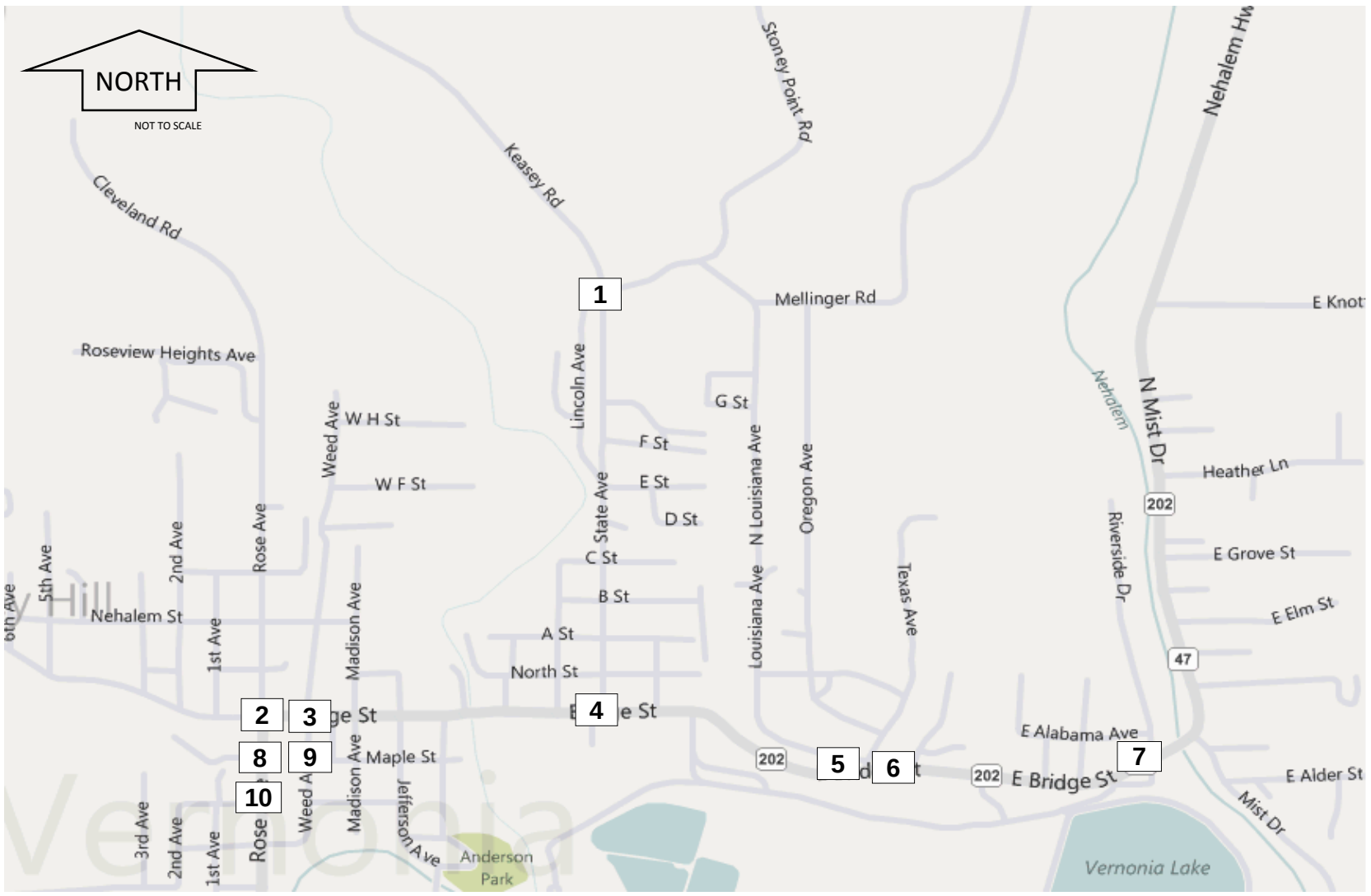
Notes:

1. Map Source: www.bing.com/maps
2. System peak hour occurred between 4:00 PM to 5:00 PM.
3. Mobility Standards are based on the Oregon Highway Plan or City of Vernonia LOS Standards.
4. Synchro software version 7 used for analysis.
5. VC = Volume to Capacity Ratio
6. V/C Ratio Std = Intersection Mobility Standard (per ODOT)

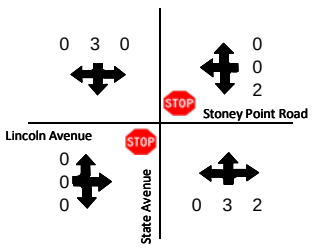
*** City of Vernonia has a LOS D mobility standard. LOS (avg delay/veh) is reported for the worst operating movement (for TWSC) and total intersection (for AWSC).

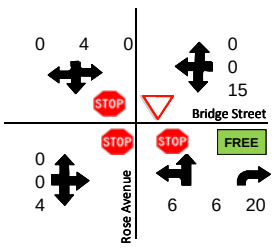
2031 Baseline PM Peak Hour Future Conditions: Unbalanced and Unrounded Traffic Volumes

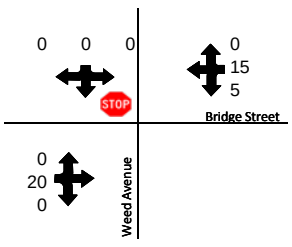
Vernonia Transportation System Plan

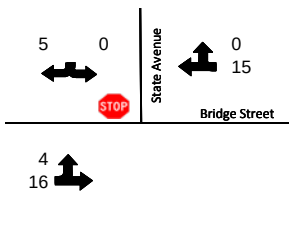


1	Stoney Point Road/State Avenue	2	Bridge Street/Rose Avenue	3	Bridge Street/Weed Avenue	4	Bridge Street/State Avenue

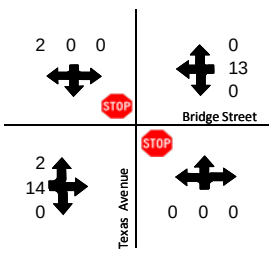


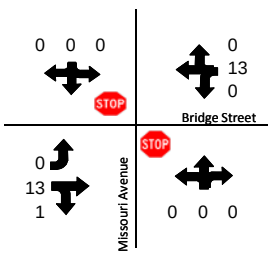


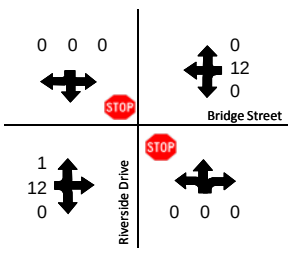


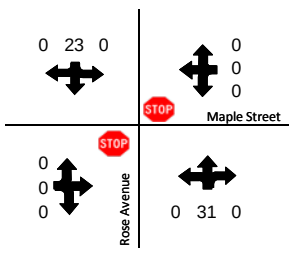


5	Bridge Street/Texas Avenue	6	Bridge Street/Missouri Avenue	7	Bridge Street/Riverside Drive	8	Maple Street/Rose Avenue

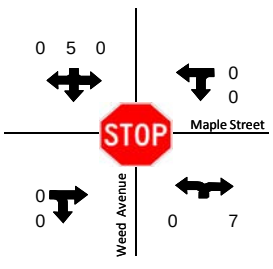


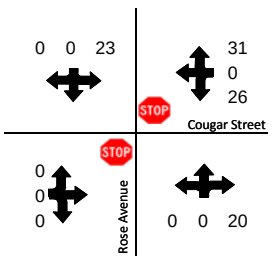


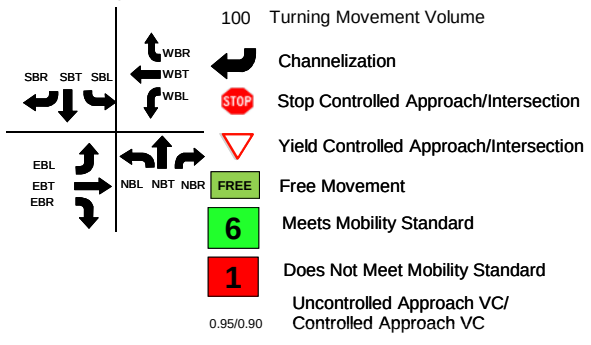




9	Maple Street/Weed Avenue	10	Cougar Street/Rose Street	Legend:



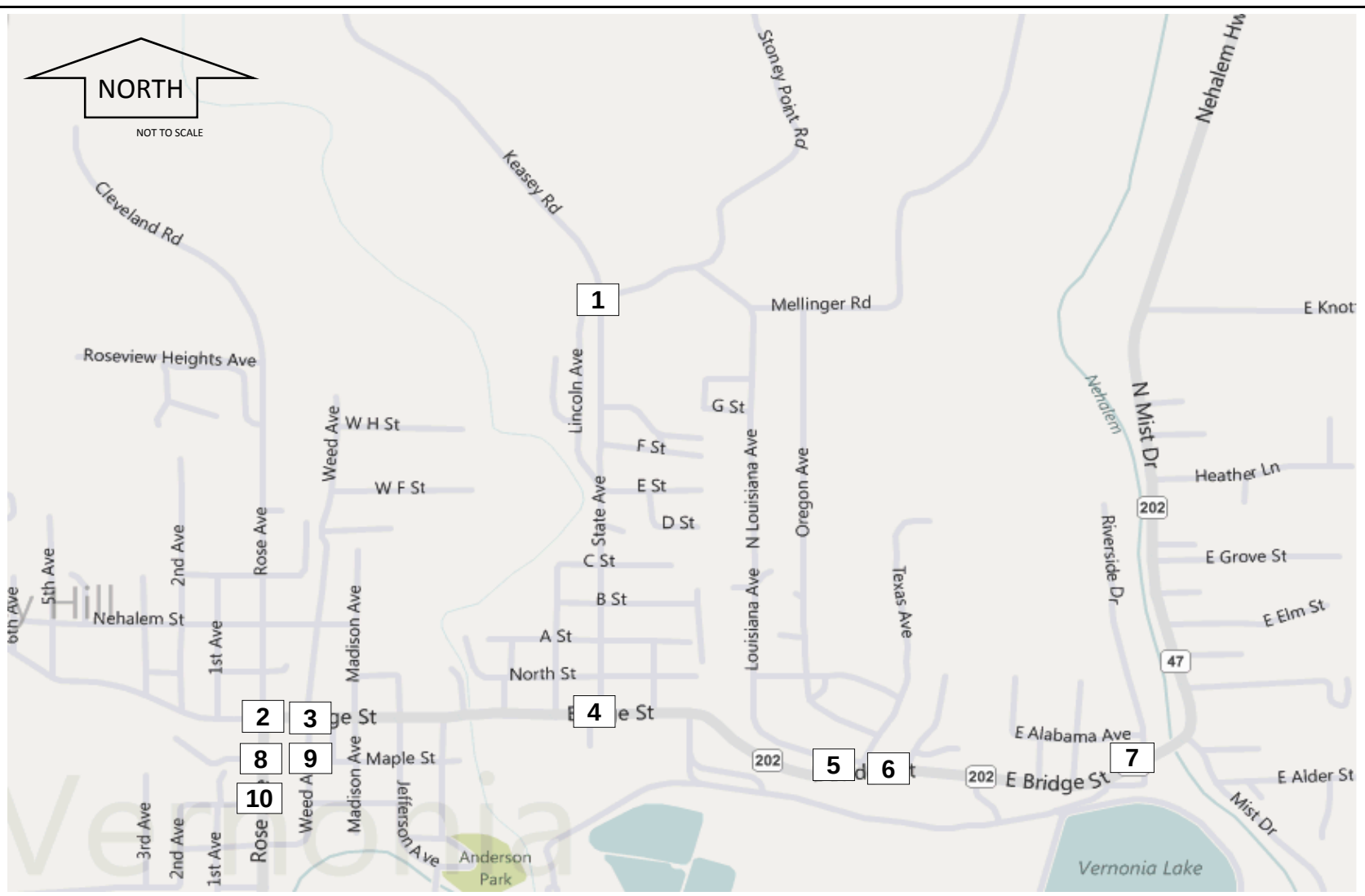




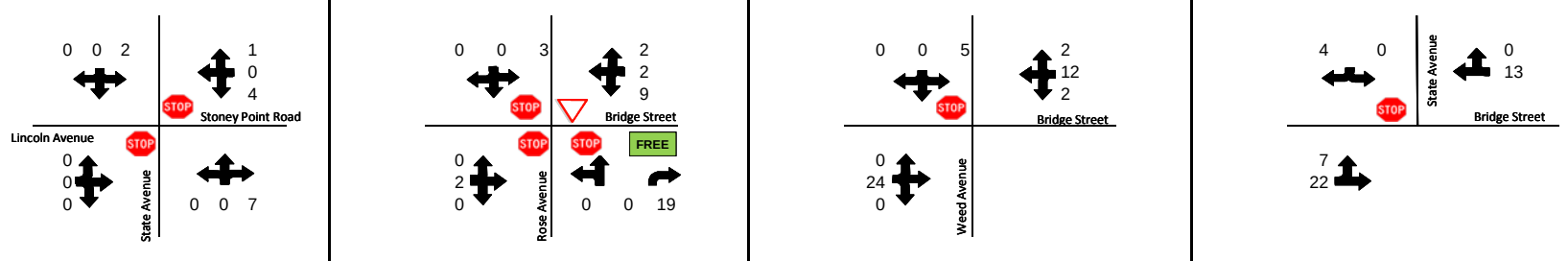
Notes:

1. Map Source: www.bing.com/maps
2. System peak hour occurred between 4:00 PM to 5:00 PM.
3. Source: West Oregon Electric Cooperative, Inc. HQ Facility TIA (DEA May 2010)

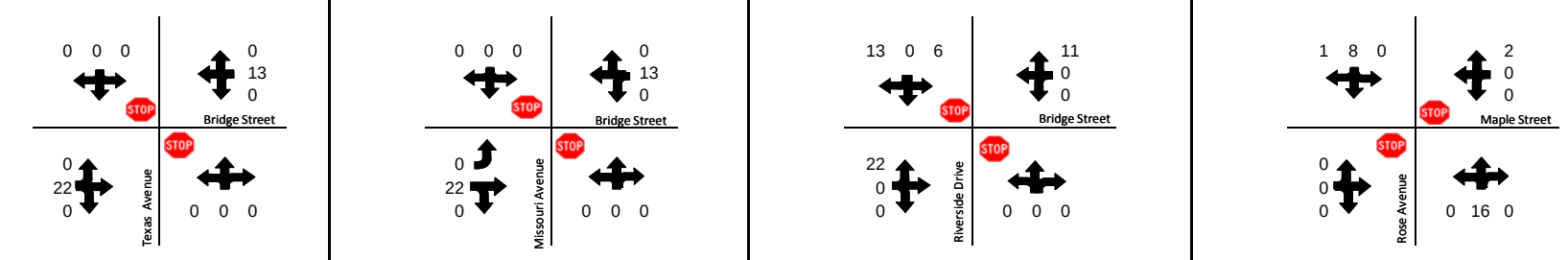
2031 PM Peak Hour WOEC Site Traffic Volume Distribution and Assignment
Vernonia Transportation System Plan



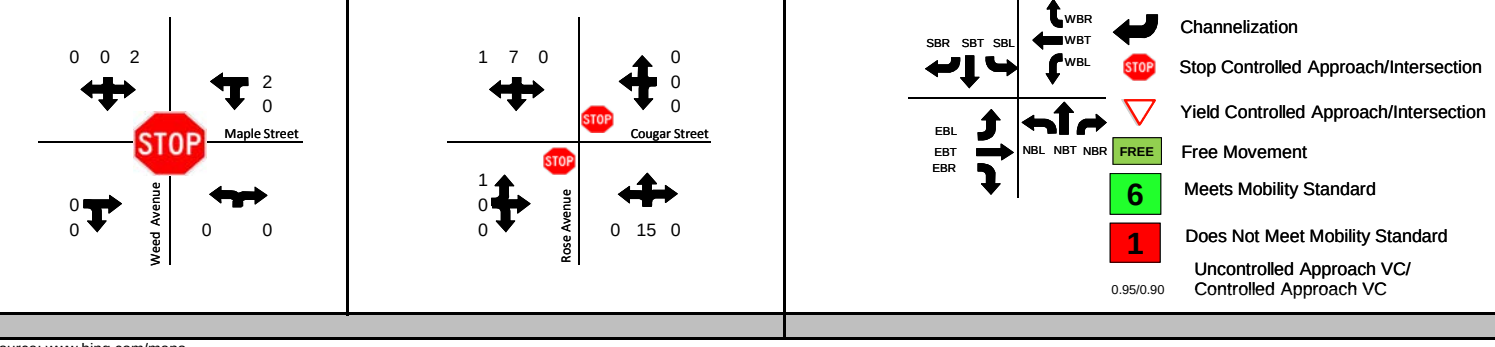
1	Stoney Point Road/State Avenue	2	Bridge Street/Rose Avenue	3	Bridge Street/Weed Avenue	4	Bridge Street/State Avenue



5	Bridge Street/Texas Avenue	6	Bridge Street/Missouri Avenue	7	Bridge Street/Riverside Drive	8	Maple Street/Rose Avenue



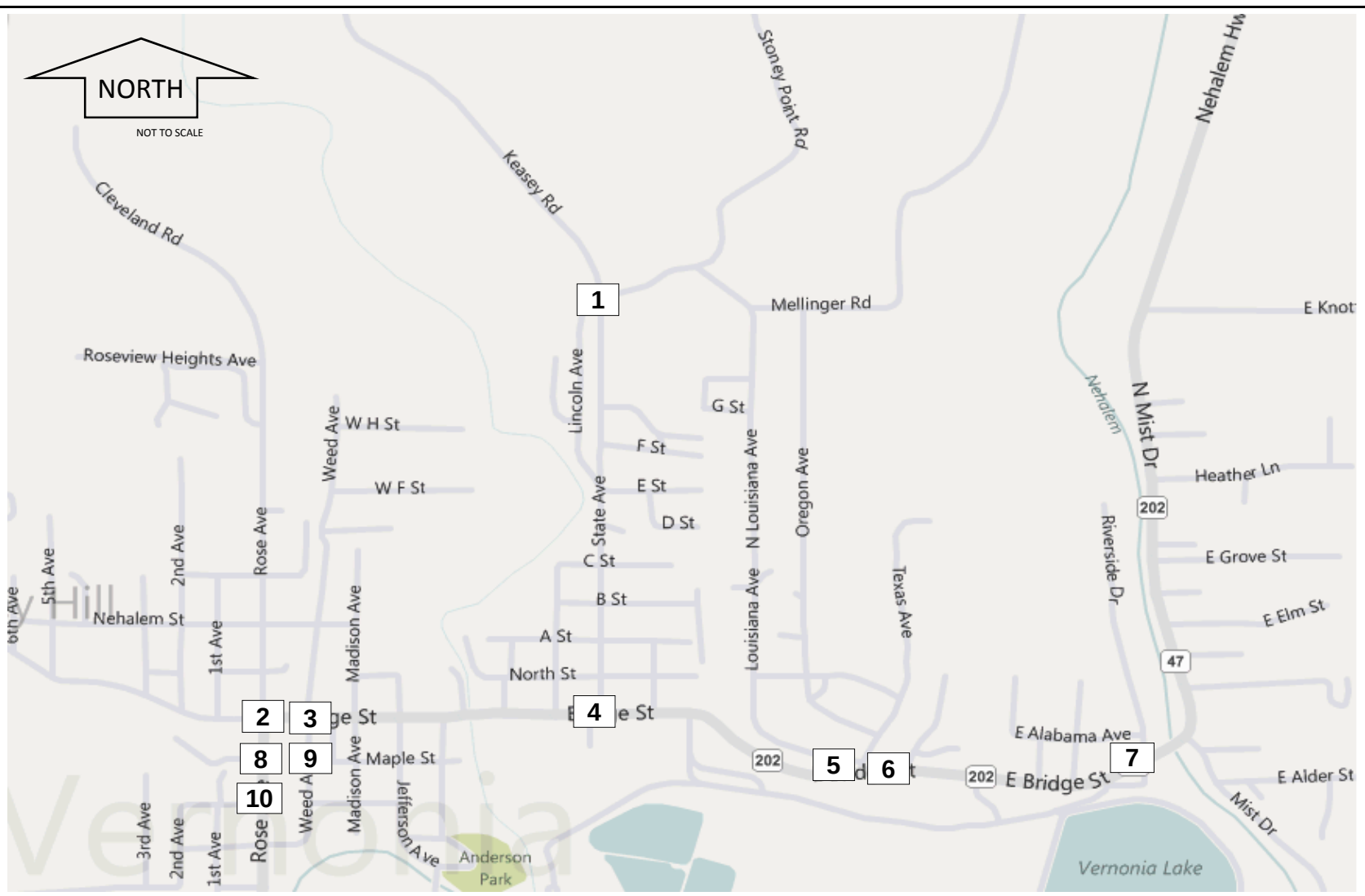
9	Maple Street/Weed Avenue	10	Cougar Street/Rose Street	Legend:



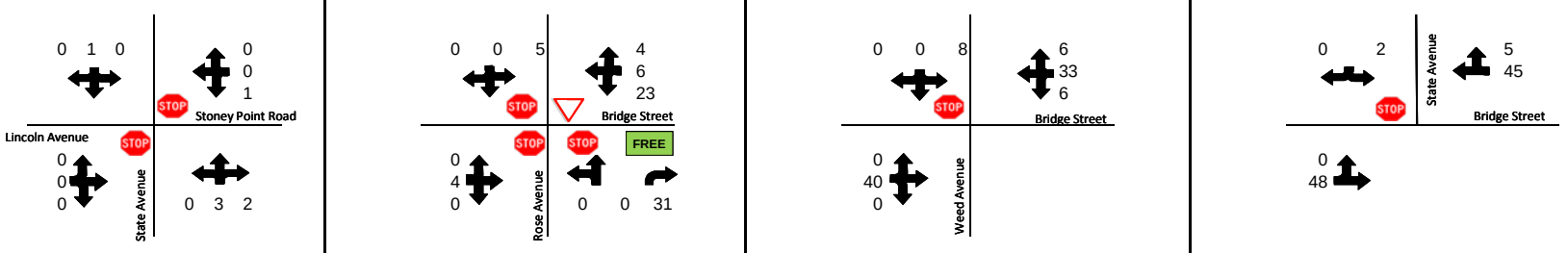
Notes:

1. Map Source: www.bing.com/maps
2. System peak hour occurred between 4:00 PM to 5:00 PM.
3. Source: Nehalem View Subdivision Traffic Impact Study (Lancaster Engineering, May 2008)

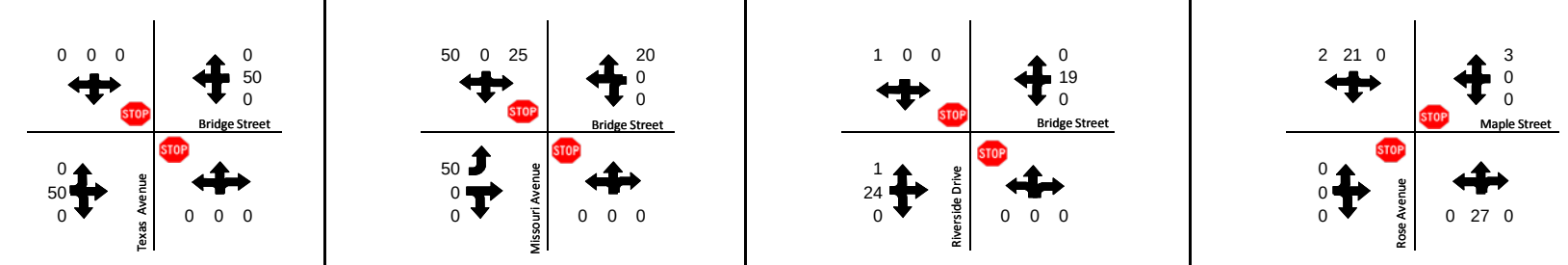
2031 PM Peak Hour Nehalem View Site Traffic Volume Distribution and Assignment
Vernonia Transportation System Plan



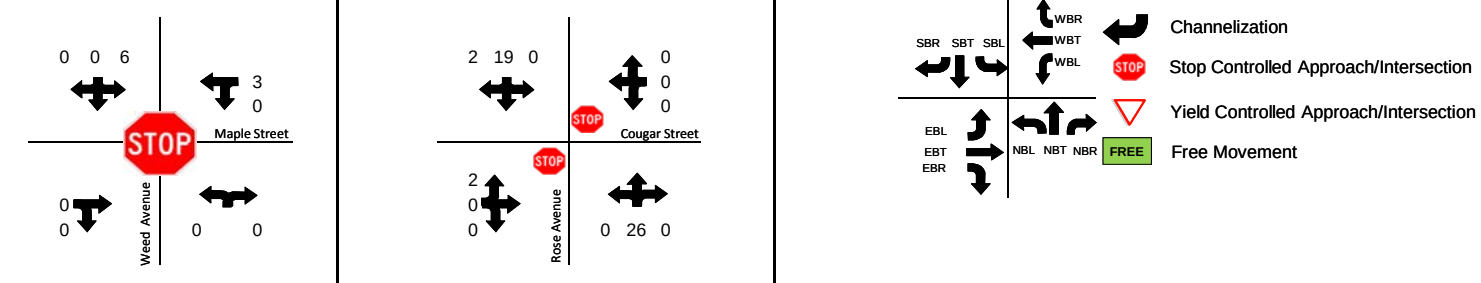
1	Stoney Point Road/State Avenue	2	Bridge Street/Rose Avenue	3	Bridge Street/Weed Avenue	4	Bridge Street/State Avenue



5	Bridge Street/Texas Avenue	6	Bridge Street/Missouri Avenue	7	Bridge Street/Riverside Drive	8	Maple Street/Rose Avenue



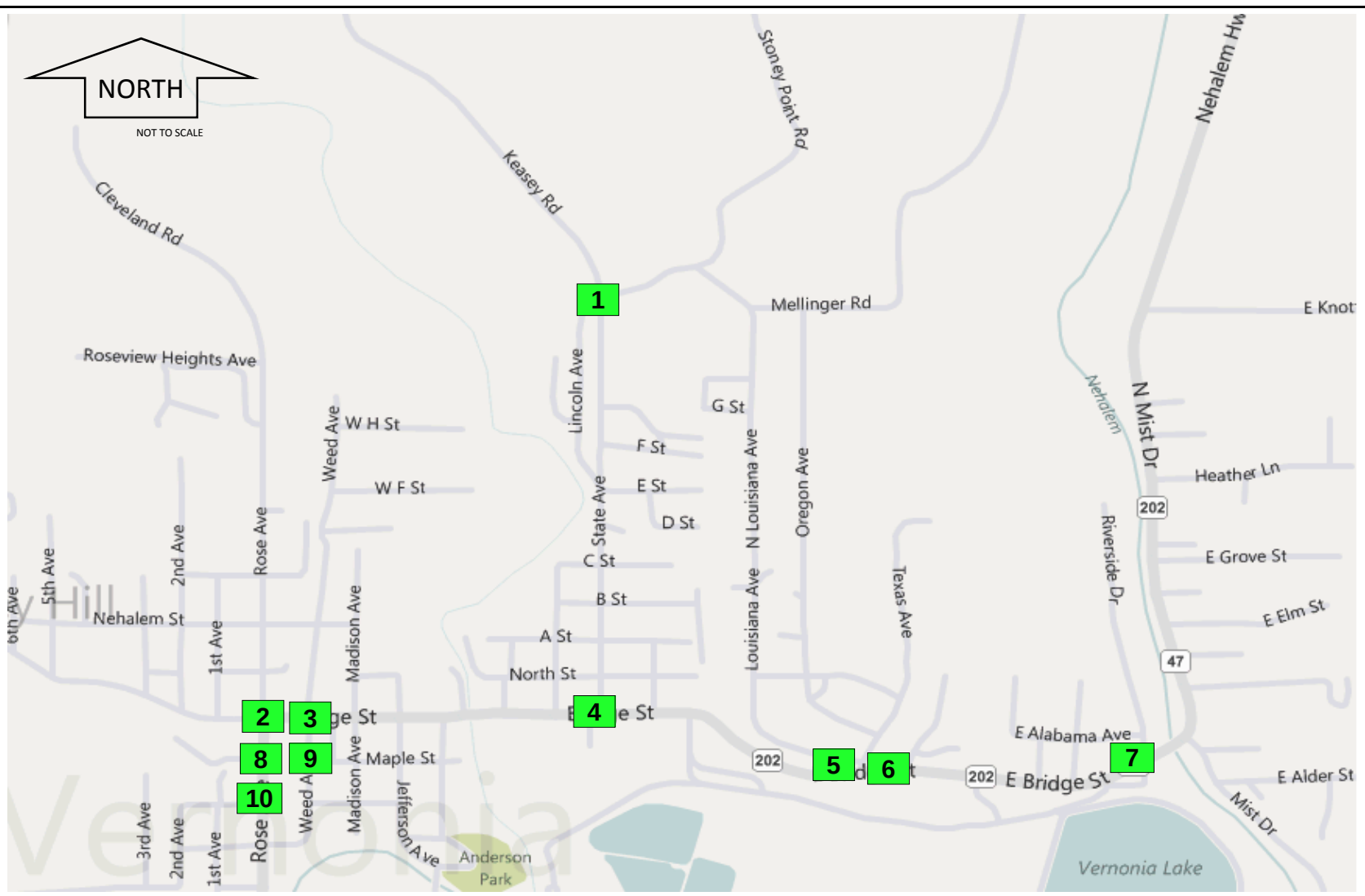
9	Maple Street/Weed Avenue	10	Cougar Street/Rose Street	Legend:

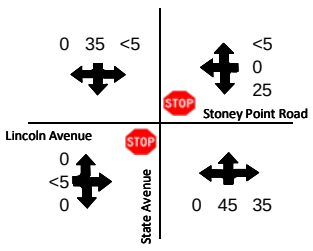
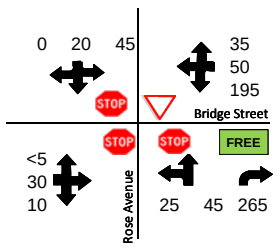
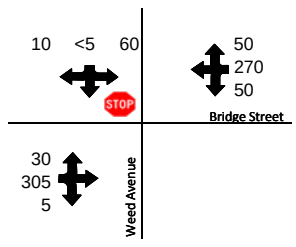
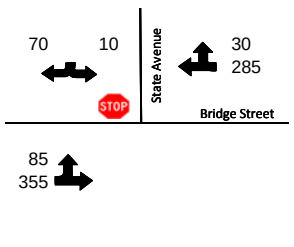


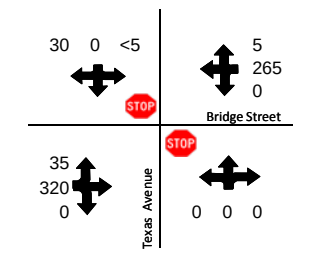
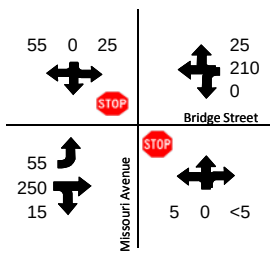
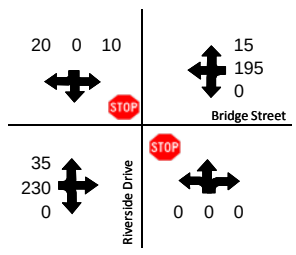
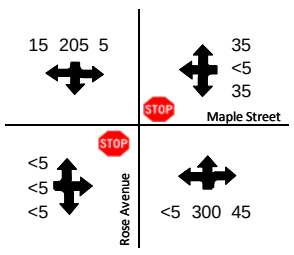
Notes:

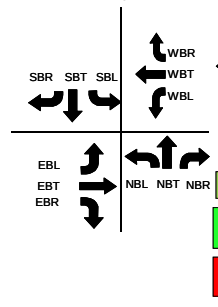
1. Map Source: www.bing.com/maps
2. System peak hour occurred between 4:00 PM to 5:00 PM.
3. Source: Vernonia School Relocation Project Transportation Impact Analysis (KAI, March 2010)

2031 PM Peak Hour Vernonia School Relocation Site Traffic Volume Distribution and Assignment
Vernonia Transportation System Plan



1	Stoney Point Road/State Avenue	2	Bridge Street/Rose Avenue	3	Bridge Street/Weed Avenue	4	Bridge Street/State Avenue
V/C Ratio Std:	LOS D	V/C Ratio Std:	0.95/0.95	V/C Ratio Std:	0.95/0.95	V/C Ratio Std:	0.80/0.80
V/C Ratio***:	LOS A (9.8 sec/veh)	V/C Ratio:	0.38	V/C Ratio:	0.04/0.31	V/C Ratio:	0.22/0.20
							

5	Bridge Street/Texas Avenue	6	Bridge Street/Missouri Avenue	7	Bridge Street/Riverside Drive	8	Maple Street/Rose Avenue
V/C Ratio Std:	0.80/0.80	V/C Ratio Std:	0.80/0.80	V/C Ratio Std:	0.80/0.80	V/C Ratio Std:	0.80/0.80
V/C Ratio:	0.03/0.06	V/C Ratio:	0.17/0.18	V/C Ratio:	0.03/0.06	V/C Ratio:	0.00/0.12
							

9	Maple Street/Weed Avenue	10	Cougar Street/Rose Street	Legend:	
V/C Ratio Std:	LOS D	V/C Ratio Std:	0.80/0.80	Volume Diagram	
V/C Ratio***:	LOS A (7.5 sec/veh)	V/C Ratio:	0.02/0.15		

100 Turning Movement Volume

Channelization

Stop Controlled Approach/Intersection

Yield Controlled Approach/Intersection

FREE Free Movement

6 Meets Mobility Standard

1 Does Not Meet Mobility Standard

0.95/0.90 Uncontrolled Approach VC/ Controlled Approach VC

Notes:

1. Map Source: www.bing.com/maps
2. System peak hour occurred between 4:00 PM to 5:00 PM.
3. Mobility Standards are based on the Oregon Highway Plan or City of Vernonia LOS Standards.
4. Synchro software version 7 used for analysis.
5. VC = Volume to Capacity Ratio
6. V/C Ratio Std = Intersection Mobility Standard (per ODOT)

*** City of Vernonia has a LOS D mobility standard. LOS (avg delay/veh) is reported for the worst operating movement (for TWSC) and total intersection (for AWSC).

Year 2031 PM Peak Hour Future Conditions: Rounded and Balanced Volumes, Channelization, and Operations

Vernonia Transportation System Plan

Appendix C

Intersection: 1: Stoney Point Rd & State St

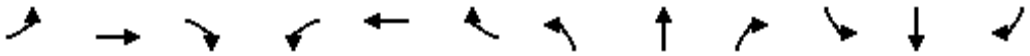
Movement	EB	WB	SB
Directions Served	LTR	LR	LTR
Maximum Queue (ft)	25	53	10
Average Queue (ft)	2	19	0
95th Queue (ft)	15	47	6
Link Distance (ft)	524	999	1041
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Bridge St & Rose Ave

Movement	EB	WB	NB	NB	SB
Directions Served	LTR	LTR	LT	R	LTR
Maximum Queue (ft)	50	100	79	97	65
Average Queue (ft)	25	26	33	25	33
95th Queue (ft)	51	69	58	82	56
Link Distance (ft)	1293	224	265		448
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)				75	
Storage Blk Time (%)			0	0	
Queuing Penalty (veh)			0	0	

Intersection: 3: Bridge St & Weed Ave

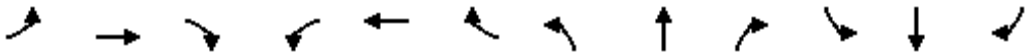
Movement	EB	WB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	33	141	96
Average Queue (ft)	3	26	41
95th Queue (ft)	16	88	75
Link Distance (ft)	224	2044	618
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	2	0	25	0	1	0	45	35	4	35	0
Sign Control		Stop			Stop			Free			Free	
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)	0	2	0	29	0	1	0	53	41	5	41	0
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	125	145	41	125	124	74	41			94		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	125	145	41	125	124	74	41			94		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.3		
p0 queue free %	100	100	100	97	100	100	100			100		
cM capacity (veh/h)	850	748	1036	849	768	994	1568			1457		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	2	31	94	46
Volume Left	0	29	0	5
Volume Right	0	1	41	0
cSH	748	854	1568	1457
Volume to Capacity	0.00	0.04	0.00	0.00
Queue Length 95th (ft)	0	3	0	0
Control Delay (s)	9.8	9.4	0.0	0.8
Lane LOS	A	A		A
Approach Delay (s)	9.8	9.4	0.0	0.8
Approach LOS	A	A		

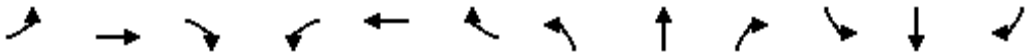
Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	20.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Yield			Stop			Stop	
Volume (vph)	2	30	10	195	50	35	25	45	265	45	20	0
Peak Hour Factor	0.85	0.85	0.85	0.91	0.91	0.91	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	2	35	12	214	55	38	29	53	312	53	24	0

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	49	308	82	312	76
Volume Left (vph)	2	214	29	0	53
Volume Right (vph)	12	38	0	312	0
Hadj (s)	-0.13	0.10	0.14	-0.53	0.14
Departure Headway (s)	4.5	4.5	5.0	3.2	5.0
Degree Utilization, x	0.06	0.38	0.11	0.28	0.11
Capacity (veh/h)	748	774	668	1112	667
Control Delay (s)	7.8	10.2	8.6	7.4	8.6
Approach Delay (s)	7.8	10.2	7.7		8.6
Approach LOS	A	B	A		A

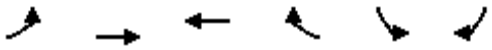
Intersection Summary				
Delay	8.7			
HCM Level of Service	A			
Intersection Capacity Utilization	41.3%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	30	305	5	50	270	50	0	0	0	60	3	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.96	0.96	0.96	0.92	0.92	0.92	0.85	0.85	0.85
Hourly flow rate (vph)	35	359	6	52	281	52	0	0	0	71	4	12
Pedestrians					3			4			12	
Lane Width (ft)					12.0			0.0			12.0	
Walking Speed (ft/s)					4.0			4.0			4.0	
Percent Blockage					0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	345			369			861	886	369	859	863	319
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	345			369			861	886	369	859	863	319
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			96			100	100	100	72	99	98
cM capacity (veh/h)	1196			1195			252	261	675	256	269	714

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	400	385	86
Volume Left	35	52	71
Volume Right	6	52	12
cSH	1196	1195	282
Volume to Capacity	0.03	0.04	0.31
Queue Length 95th (ft)	2	3	31
Control Delay (s)	1.0	1.5	23.3
Lane LOS	A	A	C
Approach Delay (s)	1.0	1.5	23.3
Approach LOS			C

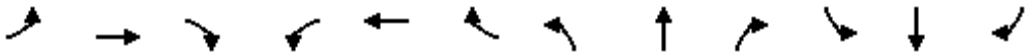
Intersection Summary				
Average Delay	3.4			
Intersection Capacity Utilization	44.1%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	85	355	285	30	15	70
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	100	418	335	35	18	82
Pedestrians		1	7		6	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		0	1		1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	377				984	360
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	377				984	360
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	91				93	88
cM capacity (veh/h)	1171				244	669

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	518	371	100
Volume Left	100	0	18
Volume Right	0	35	82
cSH	1171	1700	512
Volume to Capacity	0.09	0.22	0.20
Queue Length 95th (ft)	7	0	18
Control Delay (s)	2.4	0.0	13.7
Lane LOS	A		B
Approach Delay (s)	2.4	0.0	13.7
Approach LOS			B

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	59.6%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	35	320	0	0	265	5	0	0	0	3	0	30
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.85	0.85	0.85	0.92	0.92	0.92	0.85	0.85	0.85
Hourly flow rate (vph)	38	344	0	0	312	6	0	0	0	4	0	35
Pedestrians		1			2							
Lane Width (ft)		12.0			12.0							
Walking Speed (ft/s)		4.0			4.0							
Percent Blockage		0			0							
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	318			344			770	737	346	736	734	316
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	318			344			770	737	346	736	734	316
tC, single (s)	4.2			4.2			7.1	6.5	6.2	7.2	6.6	6.3
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.5	4.0	3.3	3.6	4.1	3.4
p0 queue free %	97			100			100	100	100	99	100	95
cM capacity (veh/h)	1220			1177			294	335	696	314	325	701

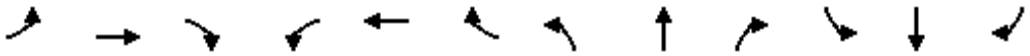
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	382	318	0	39
Volume Left	38	0	0	4
Volume Right	0	6	0	35
cSH	1220	1177	1700	631
Volume to Capacity	0.03	0.00	0.00	0.06
Queue Length 95th (ft)	2	0	0	5
Control Delay (s)	1.1	0.0	0.0	11.1
Lane LOS	A		A	B
Approach Delay (s)	1.1	0.0	0.0	11.1
Approach LOS			A	B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	49.8%	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)	55	250	15	0	210	25	5	0	3	25	0	55
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	61	278	17	0	247	29	6	0	4	29	0	65
Pedestrians		1						3				
Lane Width (ft)		12.0						12.0				
Walking Speed (ft/s)		4.0						4.0				
Percent Blockage		0						0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	276			297			739	688	289	665	681	263
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	276			297			739	688	289	665	681	263
tC, single (s)	4.1			4.2			7.1	6.5	6.2	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.5	4.0	3.3	3.8	4.3	3.6
p0 queue free %	95			100			98	100	100	91	100	91
cM capacity (veh/h)	1275			1233			292	353	753	320	319	706

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	61	294	276	9	94
Volume Left	61	0	0	6	29
Volume Right	0	17	29	4	65
cSH	1275	1700	1233	379	513
Volume to Capacity	0.05	0.17	0.00	0.02	0.18
Queue Length 95th (ft)	4	0	0	2	17
Control Delay (s)	8.0	0.0	0.0	14.7	13.6
Lane LOS	A			B	B
Approach Delay (s)	1.4		0.0	14.7	13.6
Approach LOS				B	B

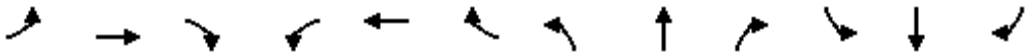
Intersection Summary				
Average Delay	2.6			
Intersection Capacity Utilization	44.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	35	230	0	0	195	15	0	0	0	10	0	20
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	0.92	0.92	0.92	0.85	0.85	0.85
Hourly flow rate (vph)	41	271	0	0	229	18	0	0	0	12	0	24
Pedestrians								2				
Lane Width (ft)								12.0				
Walking Speed (ft/s)								4.0				
Percent Blockage								0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	247			273			617	602	273	591	593	238
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	247			273			617	602	273	591	593	238
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 %	97			100			100	100	100	97	100	97
cM capacity (veh/h)	1301			1260			383	402	770	411	407	806

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	312	247	0	35
Volume Left	41	0	0	12
Volume Right	0	18	0	24
cSH	1301	1260	1700	610
Volume to Capacity	0.03	0.00	0.00	0.06
Queue Length 95th (ft)	2	0	0	5
Control Delay (s)	1.3	0.0	0.0	11.3
Lane LOS	A		A	B
Approach Delay (s)	1.3	0.0	0.0	11.3
Approach LOS			A	B

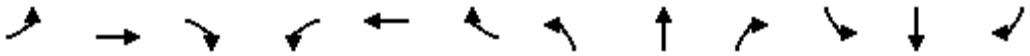
Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	40.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	2	2	35	3	35	3	300	45	5	205	15
Sign Control		Stop			Stop			Free			Free	
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	0.89	0.89	0.89
Hourly flow rate (vph)	4	2	2	41	4	41	4	353	53	6	230	17
Pedestrians		4			1			4				
Lane Width (ft)		12.0			12.0			12.0				
Walking Speed (ft/s)		4.0			4.0			4.0				
Percent Blockage		0			0			0				
Right turn flare (veh)						1						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	663	668	247	645	650	380	251			407		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	663	668	247	645	650	380	251			407		
tC, single (s)	7.1	6.5	6.2	7.2	6.6	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.1	3.4	2.2			2.2		
p0 queue free %	99	99	100	89	99	94	100			100		
cM capacity (veh/h)	347	377	792	369	376	653	1298			1151		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	8	86	409	253
Volume Left	4	41	4	6
Volume Right	2	41	53	17
cSH	425	710	1298	1151
Volume to Capacity	0.02	0.12	0.00	0.00
Queue Length 95th (ft)	1	10	0	0
Control Delay (s)	13.6	13.6	0.1	0.2
Lane LOS	B	B	A	A
Approach Delay (s)	13.6	13.6	0.1	0.2
Approach LOS	B	B		

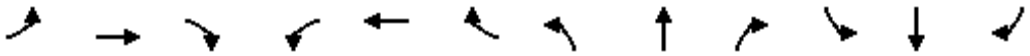
Intersection Summary				
Average Delay	1.8			
Intersection Capacity Utilization	38.2%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	0	50	2	0	55	0	3	0	10	35	5	15
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)	0	59	2	0	65	0	4	0	12	41	6	18

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	61	65	15	65
Volume Left (vph)	0	0	4	41
Volume Right (vph)	2	0	12	18
Hadj (s)	0.06	0.05	0.15	0.01
Departure Headway (s)	4.2	4.2	4.4	4.2
Degree Utilization, x	0.07	0.08	0.02	0.08
Capacity (veh/h)	833	837	785	828
Control Delay (s)	7.5	7.5	7.5	7.6
Approach Delay (s)	7.5	7.5	7.5	7.6
Approach LOS	A	A	A	A

Intersection Summary				
Delay	7.5			
HCM Level of Service	A			
Intersection Capacity Utilization	22.7%	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)	20	0	3	30	0	30	4	295	20	25	195	20
Sign Control		Stop			Stop			Free			Free	
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	0.87	0.87	0.87
Hourly flow rate (vph)	24	0	4	35	0	35	5	347	24	29	224	23
Pedestrians		8										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		4.0										
Percent Blockage		1										
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	705	681	244	665	681	359	255			371		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	705	681	244	665	681	359	255			371		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	93	100	100	90	100	95	100			98		
cM capacity (veh/h)	325	362	795	365	362	690	1295			1188		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	27	71	375	276
Volume Left	24	35	5	29
Volume Right	4	35	24	23
cSH	352	477	1295	1188
Volume to Capacity	0.08	0.15	0.00	0.02
Queue Length 95th (ft)	6	13	0	2
Control Delay (s)	16.1	13.8	0.1	1.0
Lane LOS	C	B	A	A
Approach Delay (s)	16.1	13.8	0.1	1.0
Approach LOS	C	B		

Intersection Summary				
Average Delay	2.3			
Intersection Capacity Utilization	39.9%	ICU Level of Service	A	
Analysis Period (min)	15			

Intersection: 4: Bridge St & State St

Movement	EB	WB	SB
Directions Served	LT	TR	LR
Maximum Queue (ft)	162	22	92
Average Queue (ft)	43	1	43
95th Queue (ft)	114	12	73
Link Distance (ft)	2044	1937	3068
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 5: Bridge St & Texas Ave

Movement	EB	SB
Directions Served	LTR	LR
Maximum Queue (ft)	99	62
Average Queue (ft)	16	17
95th Queue (ft)	59	43
Link Distance (ft)	1937	1754
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 6: Bridge St & Missouri Ave

Movement	EB	NB	SB
Directions Served	L	LR	LR
Maximum Queue (ft)	47	28	126
Average Queue (ft)	8	6	49
95th Queue (ft)	31	22	94
Link Distance (ft)		287	314
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	100		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 7: Bridge St & Riverside Dr

Movement	EB	SB
Directions Served	LTR	LR
Maximum Queue (ft)	66	46
Average Queue (ft)	10	17
95th Queue (ft)	40	41
Link Distance (ft)	1613	674
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 8: Maple St & Rose Ave

Movement	EB	WB	WB	NB	SB
Directions Served	LTR	LT	R	LTR	LTR
Maximum Queue (ft)	32	84	68	42	43
Average Queue (ft)	5	28	33	3	1
95th Queue (ft)	24	65	66	22	23
Link Distance (ft)	488	298		252	265
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)			25		
Storage Blk Time (%)		5	4		
Queuing Penalty (veh)		2	2		

Intersection: 9: Maple St & Weed Ave

Movement	EB	WB	NB	SB
Directions Served	TR	LT	LR	LTR
Maximum Queue (ft)	71	63	73	63
Average Queue (ft)	29	26	17	29
95th Queue (ft)	57	49	56	55
Link Distance (ft)	298	630	226	264
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 10: Cougar St & Rose Ave

Movement	EB	WB	NB	SB
Directions Served	LR	LR	LTR	LTR
Maximum Queue (ft)	49	73	19	57
Average Queue (ft)	19	34	1	9
95th Queue (ft)	49	61	8	40
Link Distance (ft)	548	236	1717	252
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 4