



MEMORANDUM

TO: Jon Holan, Community Development Director
City of Forest Grove

FROM: Anne Sylvester, PTE

DATE: September 4, 2015

PROJECT #: 0742.01 Forest Grove Westside Planning Project

SUBJECT: 2035 PM Peak Hour Traffic Operations Analysis of "Worst Case" Land Use Alternative

Introduction and Background

The memorandum presents the results of traffic operations analysis for the "Worst Case" land use alternative developed by the City of Forest Grove for the Westside Planning Project. Included in this memo is a discussion of:

- Key elements in the land use alternative
- The methodology used to develop and analyze long-range traffic forecasts at key intersections impacted by Westside growth
- Review of the traffic forecasts and operating analysis results including a comparison with the adopted 2014 Transportation System Plan
- Identification of impacts associated with Westside development and potential roadway improvement needs

As illustrated in Figure 1, two areas within the City of Forest Grove are included in the Westside Planning Project:

- David Hill planning area
- Purdin Road planning area

David Hill - The David Hill planning area is located in the northwestern portion of the City of Forest Grove and has been included in the Urban Growth Boundary (UGB) for several years. David Hill is one of the city's prime growth areas and over 90 percent of this area is projected to develop by 2025. While urban land use designations currently exist, the need for street and infrastructure planning is urgent. However, due to the extent of unknown factors affecting the development of a transportation system for David Hill, the City's recently adopted Transportation System Plan (TSP) did not identify a potential future street system. The TSP called for further refinement planning to address the unique aspects of providing urban services in this topographically challenged area. This refinement planning has been incorporated into the Westside Project along with consideration of connectivity issues for the Gales Creek area located immediately south of David Hill.

Purdin Road - The Purdin Road planning area is located east of David Hill and directly north of the city. It is predominately used for agricultural purposes. This area was added to the UGB through legislative



action in 2014, but there has been no comprehensive planning to guide the designation of urban land uses or infrastructure. The Westside Planning Project is intended to meet these needs.

Figure 1. Westside Planning Project Study Areas



“Worst Case” Land Use Alternative

Figure 2 was developed by City staff to illustrate the component elements of the “Worst Case” Westside Land Use Alternative. Use of the term “worst case” refers to the option that has the highest potential level of trip generation of any land use scenario considered in both planning areas. It is assumed that if a transportation system can be developed that meets the needs of this scenario, than all other possible development options could likely be accommodated. Figure 1 identifies a series of transportation zones by which different land uses are aggregated for analysis purposes. See Table 1 for more detailed information concerning the specific land use types and quantities included in each zone. Figure 1 also shows existing riparian areas which must be avoided as the area is developed, along with the 440-foot contour interval on the west side of the David Hill area. This elevation represents the limit of existing city water service.

As indicated in Table 1, a net total of just over 376 acres have been identified for development as part of the Westside Planning Project. This excludes areas designated as vegetated corridors under Clean Water Services standards. Under the existing Comprehensive Plan (adopted in 2014) the two planning areas are entirely zoned for residential development yielding a total of 693 single family dwelling units. Under the “Worst Case” land use scenario, mixed use development is proposed consisting of single and multi-



Figure 2. "Worst Case" Land Use Alternative



Table 1. Comparison of Existing Comprehensive Plan and “Worst Case” Alternative

Zone	Area	“Worst Case” Land Use Alternative					2014 Comprehensive Plan					
		Density (units/ac)	Net Ac	Slope Deduction	Dwelling Units	KSF	Acres	Density (units/ac)	Net Ac	Slope Deduction	Dwelling Units	
1	Purdin (Business Park) ¹		20.02	0%		218.0		20.02	0%			
2	Purdin (RML)	12.0	9.34	0%	112		1/20 ac	9.34	0%			
3	Purdin (Retail Commercial) ²		15.88	0%		172.9		15.88	0%			
4	Purdin (Park)		10.98	0%				10.98	0%			
5	Purdin (Elementary School) ³		11.96	0%		65.0		11.96	0%			
6	Purdin (R5)	8.71	56.82	0%	494		1/20 ac	56.82	0%		2	
7	Purdin (R7)	6.22	50.49	0%	314		1/20 ac	50.49	0%		3	
<i>Sub-Total Purdin</i>			<i>175.49</i>		<i>920</i>			<i>175.49</i>			<i>5</i>	
8	Watercrest (R7) ⁴	6.22	56.50	10%	316		4.35	56.50	10%		220	
9	South of David Hill Rd (R10) ⁵	4.35	10.39	20%	36		4.35	10.39	20%		36	
10	North of David Hill Rd (R10)	4.35	14.18	15%	52		4.35	14.18	15%		52	
11	David Hill Village (RML)	12.0	12.05	15%	122		4.35	12.05	15%		44	
12	David Hill Village (Comm)		2.90	0%		15.0		2.90	0%			
12	David Hill Village (Res) ⁶	12.0	--	0%	4		4.35	--	0%		12	
13	Thatcher (R10)	4.35	76.65	10%	300		4.35	76.65	10%		300	
14	David Hill (R10)	4.35	28.50	15%	105		1.0	28.50	15%		24	
<i>Sub-Total David Hill/Gales Creek</i>			<i>201.17</i>		<i>935</i>	<i>15.0</i>					<i>688</i>	
Totals			376.66		1.855	470.95	10.98				376.66	693

¹ Assumes an FAR of 0.25 for employment uses. Approximately 20.02 net acres will allow for about 218,000 square feet of business park space. Based on 37.9 employees per net acre, the estimated employment is 758.

² Assumes an FAR of 0.25 for commercial uses. Approximately 15.88 net acres will allow for about 172,900 square feet of retail space. Based on 11.0 employees per net acre, the estimated employment is 175.

³ Assumes average school size of 65,000 sq. ft. consistent with newer elementary schools in Forest Grove.

⁴ Land area within Thatcher Park and Thatcher Woods has been deducted from total land area. This deduction is approximately 25.18 acres.

⁵ Area outside of riparian zone and landslide hazard area.

⁶ Assumes limited residential above retail or standalone-plex development



family dwellings, retail, business park and an elementary school. This development would include an estimated 1,855 dwelling units, an increase of 1,162 units over the existing plan with 247 more in the David Hill planning area and 915 more in the Purdin Road planning area. 218,000 square feet of business park is planned (yielding an estimated 758 employees), 172,900 square feet of retail (yielding an estimated 175 employees), a 10.98 acre park and an 65,000 square foot elementary school.

2035 Traffic Projections

To determine traffic impacts associated with the “worst case” land use alternative and to identify any potential roadway improvement needs, the expected traffic volumes associated with this development must be forecast and analyzed. The process used to prepare “worst case” traffic projections is described in the following pages. For consistency with the City’s recently adopted TSP, the 2035 PM peak hour was chosen as the basis for this analysis.

Traffic Forecasting Methodology

The development of 2035 PM peak hour projections for the Westside involved a multi-step process starting with review of the volumes and land development assumptions inherent in the TSP. These volumes were developed using Metro’s regional travel demand model with a modified version of the Gamma population and employment projections that is based on the City’s 2014 Comprehensive Plan. Seven intersections were identified for analysis as these were either critical locations in the Forest Grove transportation system or would likely experience the greatest degree of impact associated with proposed Westside land uses.

The process of moving from TSP forecasts to Westside forecasts based on the “worst case” land use alternative includes the following steps:

1. **Comparison of Land Use Projections** – The household and employment forecasts that are consistent with the 2014 Comprehensive Plan and which undergird the TSP were compared with the estimate dwelling unit and employment forecasts for the Westside “worst case” alternative for TAZ’s 1392, 1393 and 1396 in the modified regional travel demand model.
2. **Calculation of Land Use Growth** – Estimates of new growth in household and employment forecasts (over the forecasts used in the TSP) were determined by location.
3. **Development of Trip Generation Estimates** – Trip end estimates consistent with the TSP were obtained from the regional model for TAZ’s 1392, 1393 and 1396. These estimates were factored up or down by location consistent with the new dwelling unit and/or employment growth in the “worst case” alternative. For the Gales Creek and David Hill areas, total trip ends with the ‘worst case’ alternative are expected to very slightly decrease in comparison with the TSP. This is because, while the number of dwelling units increased with the “worst case” alternative, the regional model originally included trips related to future employment in these areas. As the ‘worst case’ alternative includes only minor growth in employment in TAZ’s 1393 and 1396, the net growth in trip-making in comparison to the TSP would likely decrease. Total trip ends for TAZ 1392 (the Purdin Road planning area) are expected to see a significant increase as this area was not included within the UGB at the time the TSP was developed.
4. **Identification of Trip Distribution Patterns** – Trip distribution assumptions for the net increase in trips with the “worst case” alternative were developed through review of traffic patterns from several different runs of the Metro regional model. The trip distribution analysis also incorporated a variety of roadway network additions that are included in the TSP, and thus in



the regional travel forecasts. There is a strong attractiveness from the Purdin Road planning area to/from the north and east (linking Forest Grove with Hillsboro and Portland).

Approximately 47 percent of net new trips are expected to travel in this direction. However, it is anticipated that the majority of new trips to/from the Purdin planning area would be destined to the west and southwest (approximately 25 percent), south (about 5 percent) and southeast (about 23 percent). Highway 47 is a highly attractive route for these trips, as is David Hill and Thatcher Roads.

5. **Preparation of Trip Assignments** – Net new trips from each Westside analysis zone (see Figure 2 for the location of these zones) were assigned to the street system consistent with the assumed trip distribution pattern.

Roadway Network Assumptions

Traffic forecasts for the “worst case” alternative include the roadway system improvements and extensions in the Westside vicinity that were adopted as part of the City’s TSP. These are described below:

- **David Hill Road** – The extension of David Hill Road is included from its current terminus eastward to intersect at Highway 47. A single lane roundabout was assumed for this intersection based on current project development activities.
- **Vista Drive/Talisman Lane** – The addition of the Vista Drive and Talisman Lane extensions between Gales Creek and Thatcher Roads are included. With these improvements a significant volume of existing and projected future traffic would be diverted away from the intersection of Gales Creek and Thatcher Roads. Without these improvements it will be necessary to signalize or otherwise improve traffic operations at the Gales Creek/Thatcher intersection.
- **Highway 47 at Verboort Road/Purdin Road** – Improvements to the intersection of Highway 47 and Verboort/Purdin Road are included to address existing safety issues and future capacity needs. A single lane roundabout was assumed based on current project development activities. Improvements to this location, increasing densification in the Westside and completion of the David Hill Road extension are all expected to draw traffic away from the Highway 47/Martin Road intersection, helping to address expected future congestion problems at this location.
- **Highway 47 at Martin Road** – As noted above, the addition of new local and arterial street connections in the northwestern portion of the City will help to reduce regional traffic entering the city via Martin Road. As noted in the TSP, the connection of Martin Road across Highway 47 ultimately connecting with 23rd Avenue. This connection is expected to reduce some traffic volumes along Highway 47, but would worsen traffic operations at the intersection with Martin Road, exacerbating the need for intersection improvements that could include signalization.
- **Main Street and B Street Extensions** – The proposed recommended street layout for the Purdin Road area includes connections into developed portions of the city via extensions of Main Street and B Streets. Extensions of these two streets are included in the adopted TSP between Hartford Drive and the David Hill Road extension.

2035 PM Peak Hour Turning Movement Projections

Figure 3 presents the 2035 PM peak hour turning movement projections resulting from the analysis process described above.



Figure 3. 2035 PM Peak Hour Traffic Volumes with Worst Case Land Use Alternative



2035 Projected PM Peak Hour Traffic Operations

Mobility Standards

Level of Service, delay and volume-to-capacity ratios are used as measures of effectiveness for study intersection performance. As part of its adoption of the 2011 TSP, the City endorsed use of a minimum standard Level of Service (LOS) D to determine project improvement needs for streets under its jurisdiction. ODOT and Washington County standards apply to roadways under their jurisdiction. The applicable intersection operational standards for Washington County and ODOT are summarized below.

- ODOT defines a maximum volume-to-capacity ratio for Highway 47 of 0.99¹
- Washington County defines acceptable performance in urban areas as volume-to-capacity ratio of 0.99 with LOS E or better².

These two standards apply to the various intersections analyzed for Westside land uses.

2035 PM Peak Hour Operations Analysis Results

To identify the magnitude of traffic impacts associated with the “worst case” alternative, a comparison was made with the 2035 PM peak hour traffic operations as incorporated into the recently adopted TSP. As noted above, traffic analysis in the TSP used future volume forecasts that were consistent with the adopted 2014 Comprehensive Plan. These forecasts also assumed the roadway connections and improvements discussed above. Operations analysis results based on adopted TSP traffic projections are presented in Table 2.

Table 2. 2035 PM Peak Hour Intersection Level of Service with TSP Land Uses and Streets

No.	Intersection	Operational Standard	Level of Service (LOS) ¹	Average Delay* (Seconds) ²	Volume / Capacity (V/C) ²
<i>Unsignalized Intersections</i>					
1	Thatcher Road/Watercrest Road	LOS E/0.99	A/C	17.2	0.09
2	Gales Creek Road/Thatcher Road	LOS E/0.99	A/B	11.6	0.24
3	Highway 47/Verboort & Purdin	V/C=0.99	A/F	>200	>2.00³
5	Highway 47/Martin Road	V/C=0.99	A/F	>200	>2.00
7	Highway 47/David Hill Road	V/C=0.99	A	8.4	0.60 ⁴
<i>Signalized Intersections</i>					
4	Highway 47/Sunset Drive	V/C=0.99	B	16.1	0.50
6	Pacific Avenue/Quince Street	V/C=0.99	D	53.4	0.97

* Minor street average delay reported for unsignalized intersections

1 First value is the free movement, second value is the worst stopped movement.

2 Worst stopped movement.

3 Development of local street connections in Forest Grove may divert added WB traffic to this location requiring improvements. This analysis assumes existing lane configuration and traffic control. Subsequent to TSP preparation, improvement of the intersection as a single lane roundabout was undertaken.

4 Assumes stop control for side street traffic. Subsequent to TSP preparation, improvement of the intersection as a single lane roundabout was undertaken.

¹ Oregon Highway Plan, Policy Element, Table 7, Oregon Department of Transportation, 1999.

² Washington County 2020 Transportation System Plan, Washington County, 2002.



Table 2 includes information for each intersection including the relevant operational standard based on roadway jurisdiction (e.g., ODOT, or Washington County), Level of Service for the through unstopped movement and the worst case stopped movement, average delay for the worst case stopped movement, and volume-to-capacity ratio for the worst case stopped movement.

As indicated in this table, two intersections along Highway 47 are expected to fail by 2035 during the PM peak hour – Highway 47 at Verboort Road/Purdin Road and Highway 27 at Martin Road. The TSP assumes that both of these intersections would retain their existing configurations.

Table 3 presents a summary of intersection operations analysis results for conditions with the “worst case” land use alternative. As indicated in the table, the intersection of Highway 47 with Martin Road would still show significant failure and will need further study to identify an appropriate solution. The intersection of Highway 47 with Verboort/Purdin Road was assumed to be improved to a single lane roundabout which provides substantially more capacity than the existing stop-controlled single lane configuration. However, by 2035 with the addition of Purdin Road planning area traffic, this location could begin to see significant delays with a volume/capacity ratio exceed the adopted mobility standard. The new intersection of Highway 47 with David Hill Road is currently being developed as a single lane roundabout, but this location is also expected to see failure by 2035 with the addition of Purdin Road traffic.

All other intersections within the study area are expected to operate within their adopted mobility standards during the 2035 PM peak hour.

Table 3. 2035 PM Peak Hour Intersection Level of Service with Westside “Worst Case” Land Use Scenario

No.	Intersection	Operational Standard	Level of Service (LOS) ¹	Average Delay* (Seconds) ²	Volume / Capacity (V/C) ²
<i>Unsignalized Intersections</i>					
1	Thatcher Road/Watercrest Road	LOS E/0.99	A/C	21.3	0.13
2	Gales Creek Road/Thatcher Road	LOS E/0.99	A/B	10.7	0.20
5	Highway 47/Martin Road	V/C=0.99	B/F	170.5	1.24
<i>Roundabouts</i>					
3	Highway 47/Verboort & Purdin	V/C=0.99	E	59.6	1.22 ³
7	Highway 47/David Hill Road	V/C=0.99	E	78.2	1.23 ³
<i>Signalized Intersections</i>					
4	Highway 47/Sunset Drive	V/C=0.99	C	33.2	0.59
6	Pacific Avenue/Quince Street	V/C=0.99	E	64.2	0.98

* Minor street average delay reported for unsignalized intersections

1 First value is the free movement, second value is the worst stopped movement.

2 Worst stopped movement.

3 Pending single lane roundabout intersection improvements are assumed here.



Improvements

In order to address the expected deficiencies the following intersection improvements could be considered.

Highway 47 at Martin Road

This intersection is currently unsignalized with stop-control on Martin Road. It operates within ODOT's mobility targets based on the TSP's existing conditions analysis. As noted in the TSP, as the community grows, this intersection (and the immediately adjacent intersection of 24th Avenue) will become increasingly congested. Both signalization and installation of a roundabout were considered for this location during the TSP planning process (the intersection is expected to meet signal warrants based on the 2035 traffic projections in the TSP). However, no resolution of differences among affected agencies on the appropriate improvement could be achieved. Accordingly, this area is shown in the Roadway Network Plan as a "TPR Refinement Area" for which further study and deliberation needs to be conducted leading to a recommended course of action.

Highway 47 at Verboort Road/Purdin Road

This intersection is currently located outside of the Forest Grove UGB in rural Washington County. Working together, Washington County and ODOT have partnered to develop an improvement concept to address existing safety deficiencies and future congestion needs at this location. Dependent on the final land use plan for the Purdin Road planning area, some improvement to this intersection may be needed by 2035. This improvement could include added channelization at the roundabout.

Highway 24 at David Hill Road

Washington County and ODOT have also partnered to extend David Hill Road from its existing easterly terminus to connect with Highway 47, including development of a single lane roundabout at the new intersection. As with the Verboort Road/Purdin Road intersection and dependent on the final land use plan for the Purdin Road planning area, some improvement to this intersection may be needed by 2035. This improvement could include added channelization at the roundabout.