

Appendix B – Transportation

DKS Associates July 2008 Update – Power Point Presentation
DKS Transportation Analysis dated April 22, 2008





Brookman Addition Update

July, 2008

Revised Concept Plan

- Transportation Review
 - Roadway system
 - Trip generation
 - Local street impacts
 - Off-site impacts



**Brookman Addition
Concept Plan**

DKS Associates
Traffic • Transportation • Engineering • Planning • GIS

GREENWORKS

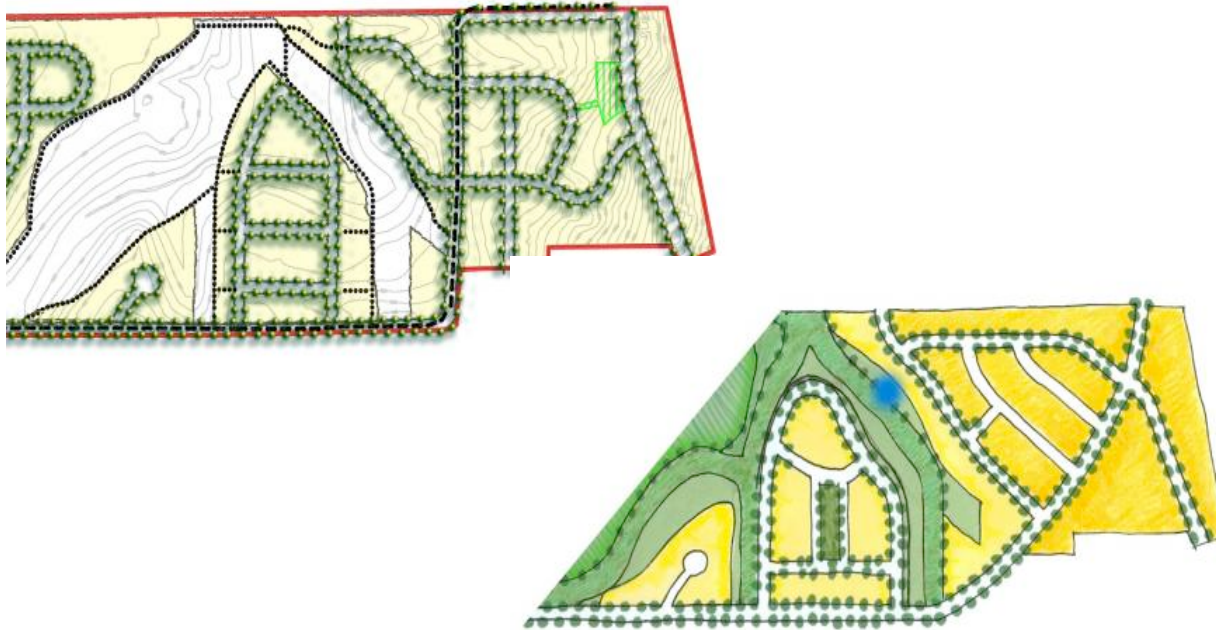


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Roadway System

- Brookman Road Alignment:
 - Widening and potential ROW acquisition
 - Impacts on water & septic systems



Brookman Addition Concept Plan

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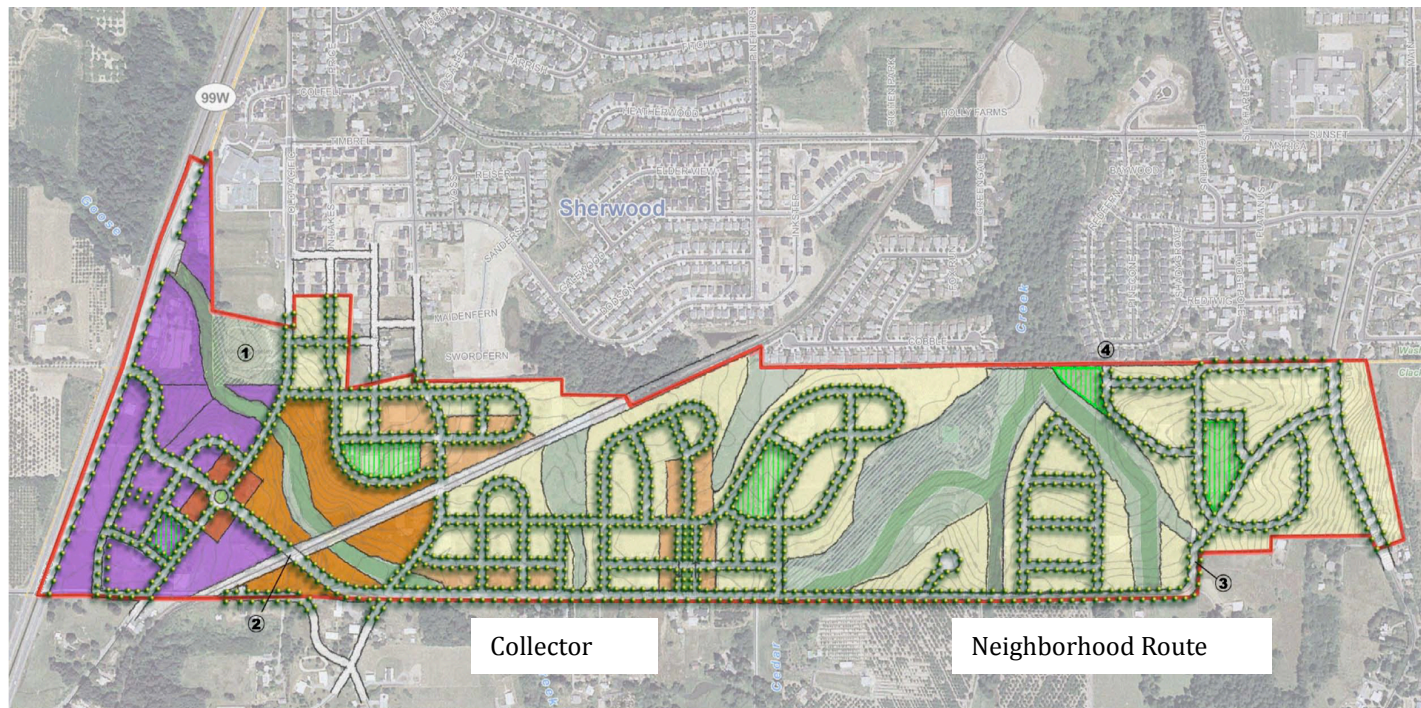
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Roadway System

- Revised Layout/Functional Class



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Trip Generation

Table 1: Motor Vehicle Trip Generation – Committee Recommended Plan

Land Use	ITE Code	Size	PM Peak Hour Trips		
			In	Out	Total
Commercial - Retail	814	29 employees	33	42	75
Employment – Office	710	349 employees	27	134	161
Employment – Industrial	110	102 employees	9	34	43
Medium Density Residential	210	943 households	600	353	953
High Density Residential	220	296 households	119	65	184
TOTAL	-	-	788	628	1,416

Table 2: Motor Vehicle Trip Generation – July 2008 Update

Land Use	ITE Code	Size	PM Peak Hour Trips		
			In	Out	Total
Commercial - Retail	814	29 employees	33	42	75
Employment – Office	710	774 employees	61	295	356
Employment – Industrial	110	226 employees	20	75	95
Medium Density Residential	210	798 households	509	298	807
High Density Residential	220	290 households	117	63	180
TOTAL	-	-	740	773	1,513



Brookman Addition Concept Plan



Local Street Impacts

Table 3 – Residential Street Weekday Two-Way Volumes

	<i>Facility Threshold</i>	<i>2007</i>	<i>2030</i>		
		<i>Existing</i>	<i>No-Build</i>	<i>Concept Plan (April 2008)</i>	<i>Concept Plan Update (July 2008)</i>
SW Woodhaven Dr. south of Sunset Blvd	3,000	1,200	1,200	1,900	1,700
SW Timbrel Ln. south of Sunset Blvd	*	2,300	2,400	6,600	6,400
SW Pinehurst Dr. south of Sunset Blvd.	3,000	1,500	1,700	2,100	1,800
SW Middleton Road south of Inkster Dr.	3,000	300	400	500	500

* SW Timbrel lane is designated as a collector roadway in the City of Sherwood TSP. Therefore, residential street thresholds were not applied



**Brookman Addition
Concept Plan**



Local Street Impacts

- Redfern Connection
 - No significant change in findings
 - 1,200 vehicles per day (vpd) with full connection
 - Serving traffic into Brookman Addition, not cut-through between Ladd Hill and Sunset
 - Sample Roadways with approx. 1,000 vpd:
 - Woodhaven south of Sunset (1,200 vpd)
 - Brookman east of Hwy 99W (1,100 vpd)
 - Lincoln north of Willamette (1,000 vpd)
 - Pine north of Sunset (1,100)
 - Willamette southwest of Pine (800 vpd)



Off-Site Impacts

- Hwy 99W/Sunset/Elwert
 - Prior mitigations (turn lanes) no longer needed to meet rezone TPR requirements
- No Other Significant Changes



**Brookman Addition
Concept Plan**





Memorandum

DATE: April 22, 2008
TO: Joe Dills, Otak
FROM: Chris Maciejewski, PE; Garth Appanaitis
SUBJECT: **Brookman Addition Concept Plan: Committee Recommended Plan – Transportation Analysis**

P07124-000-000

The purpose of this memorandum is to review the transportation performance and other key characteristics of the project committee recommended Sherwood Brookman Road Concept Plan. The first two sections of this memorandum discuss compliance of the proposed Concept Plan with City functional classification and access spacing standards. The final five sections discuss the traffic impacts of the Concept Plan, including trip generation, study area operations analysis, neighborhood street impacts, recommended mitigation measures, and transportation cost estimates. The traffic impact analysis for the potential land use addresses long term issues utilizing a forecast year of 2030.

Functional Classification

Highway 99W is classified as a statewide highway in the Oregon Highway Plan¹. The City's Transportation System Plan (TSP)² identifies Brookman Road and Old Pacific Highway as collector roadways, Middleton Road as a neighborhood route, and Highway 99W as an arterial. Brookman Road is also identified as a collector in the Washington County TSP. The Brookman Road Concept Plan includes a roadway network that is significantly different than the existing system, and was reviewed to determine which streets should be classified as collectors or neighborhood routes. Brookman Road and Old Highway 99W were maintained as collector designations and Middleton Road was maintained a neighborhood route. The additional proposed roadways would be local streets. Figures 1 shows the recommended functional classifications.

¹ 1999 Oregon Highway Plan, Oregon Department of Transportation, January 2006.

² City of Sherwood Transportation System Plan, Prepared by DKS Associates, March 2005.

Figure 1: Brookman Concept Plan Functional Classification



Access Spacing Review

The proposed functional classification designations indicated in Figure 1 establishes the access spacing standards for the roadway network. Along the collector roadways, access spacing should be a minimum between off-sets of 100 feet and a maximum of 400 feet to meet City of Sherwood and Washington County standards. In general, the Concept Plan achieves these standards, with several minor exceptions. Access spacing standards in excess of 400 feet occur along green-spaces where motor vehicle access will not be provided, as well as at the grade-separated rail crossing on Brookman Road.

In addition to meeting City of Sherwood access spacing standards within the study area street network, access spacing along Highway 99W was reviewed. The Oregon Highway Plan access spacing standard for Highway 99W in Sherwood with a posted speed of 45 miles per hour (mph) is 990 feet. However, the Brookman Road Concept Plan is working in coordination with the I-5 to 99W Connector Study, which is in the process of analyzing six possible alternatives, one of which has identified a potential interchange location near the existing intersection of Highway 99W/Brookman Road. To work around the potential interchange location, the Concept Plan has closed the existing Brookman Road access to Highway 99W and proposes a new connection as far to the north as possible given the topographic features of the area (between 1,000 feet and 1,300 feet may be possible). Therefore, the Concept Plan is as consistent as feasible with the state access spacing standards while maintaining one connection to Highway 99W.

Trip Generation

To determine the impact of rezoning the study area, the amount of motor vehicle traffic generated development of the Concept Plan was determined. Trip generation was estimated based on rates provided by the Institute of Transportation Engineers³ (ITE) for similar land use types. Table 1 lists the estimated PM peak hour trips for each proposed land use of the Concept

³ *Trip Generation Manual, 7th Edition*, Institute of Transportation Engineers, 2003.

Plan. Because the existing zoning of the study area is rural residential which allows little growth, the entire amount of trips listed in Table 1 was included in the impact analysis. The total PM peak hour trips generated by the concept plan is approximately 1,400 trips (which is roughly equivalent to build-out of the same number of single family homes – for comparison, there are approximately 850 existing homes in the area bounded by Brookman Road/Sunset Boulevard/Highway 99W/Ladd Hill Road).

Table 1: Motor Vehicle Trip Generation

			PM Peak Hour Trips		
Land Use ⁴	ITE Code	Size	In	Out	Total
Commercial - Retail	814	29 employees	33	42	70
Employment – Office	710	349 employees	27	134	161
Employment – Industrial	110	102 employees	9	34	43
Medium Density Residential	210	943 households	600	353	953
High Density Residential	220	296 households	119	65	184
TOTAL	-	-	788	628	1,416

Operations Analysis

The following sections describe the future forecasting and operations analysis completed for the Brookman Concept Plan. The future conditions evaluation includes future forecasting, identification of study area improvements, and motor vehicle intersection capacity analysis.

Future Forecasting

Future travel demand forecasting for the Brookman Road study area utilized the latest 2030 model developed by Metro, Washington County, and DKS Associates for the I-5 to 99W Connector Study. As part of the model development for the I-5 to 99W Connector Study, the Sherwood TSP travel demand model zone structure and network detail was used as a guideline to refine the regional model. In addition, a detailed focus model was created for the Brookman Road Concept Plan study area, which incorporates the use of *HCM 2000 Methodology* for node delays (instead of the regional model macroscopic delay functions).

Future 2030 PM peak hour volumes at study intersections were developed for the Brookman Concept Plan land uses scenario by adjusting the travel demand model trip tables to reflect the trip rates listed in Table 1. These volumes were then used to analyze and determine future impacts from the proposed Brookman Road area on the planned roadway network. The future 2030 PM peak hour scenarios include:

- 2030 No Build (no development in the Brookman Road area)
- 2030 with Brookman Road Concept Plan

⁴ Park space generates a nominal amount of trips (ITE Code 411 - 1.59 trips/acre/weekday). These neighborhood parks were assumed to be limited to internal use and were not included in the external trip generation for the plan.

Planned Study Area Roadway Improvements

The City of Sherwood TSP provides specific information regarding future transportation projects that were identified to meet needs created by future growth within the study area without growth along Brookman Road. For the study area intersections, the only capacity improvement project identified with committed funding is the City's capacity enhancements at the intersection of Sunset Boulevard/Sherwood Boulevard (signal or roundabout). The remaining projects in the study area that may provide additional capacity (e.g. the I-5 to 99W Connector) were not included in any of the future analysis scenarios in order to meet OAR 660-012-060 requirements.

Concept Plan Assumed Projects

Several transportation improvements (in addition to the construction of the general roadway facilities shown in Figure 1) were assumed to be constructed in order to improve traffic operations in the study area and limit the impact to neighborhood streets with the proposed Concept Plan. Analysis conducted for the preliminary Concept Plan alternatives determined that the following projects would be needed with development of the concept plan:

- Traffic signal control at Hwy 99W/Brookman Road
- All-way stop control (or a roundabout) at Brookman Road/Ladd Hill Road
- Traffic calming measures on Pinehurst Drive and Inkster Drive
- Southbound right turn lane at Brookman Drive/Ladd Hill Road (not needed if roundabout)

These projects are associated with development of the Concept Plan and were not assumed in the 2030 No Build analysis. Costs estimates for these projects (and other Concept Plan transportation improvements) are included in Table 6.

Redfern Drive has been identified as an area of special concern, and an extension into the concept plan area may be considered if motor vehicle volumes do not exceed 1,000 vehicles per day. For the purposes of this analysis, no motor vehicle connection was assumed since prior analysis⁵ indicated volume thresholds would be exceeded. However, the potential for pedestrian, bicycle, emergency vehicle or a full motor vehicle connection remains, pending refined future development layout of the site if the connection does not exceed 1,000 motor vehicles per day.

Capacity Analysis

In order to provide a baseline comparison to the future Brookman Road Concept Plan, the 2030 No Build scenario evaluates future traffic volumes assuming the planned roadway geometry and no development of the Brookman Road project area beyond what currently exists today. The Concept Plan was evaluated to determine the impacts to the study area. Intersections that do not meet performance standards under the Concept Plan must be mitigated to the level of performance that would occur without development of the area per Oregon's Transportation Planning Rule (TPR).

The performance standard for intersections controlled by City of Sherwood is Level of Service (LOS) D. For intersections along Highway 99W, performance standards are based on the

⁵ *Brookman Addition Concept Plan – Transportation Analysis*, prepared by DKS Associates, March 19, 2008.

volume-to-capacity (v/c) ratio of the intersection. The v/c standard for Highway 99W/Brookman Road and Highway 99W/Sunset Boulevard is 0.99. As listed in Table 2, the intersections of Hwy 99W/Sunset Boulevard, Highway 99W/Brookman Road, and Sunset Boulevard/Woodhaven fail to meet ODOT/City standards in the No-Build scenario. Under the Brookman Road Concept Plan development (and construction of assumed projects) the intersection of Highway 99W/Brookman Road would meet performance standards as a signalized intersection. However, the intersections of Highway 99W/Sunset Boulevard and Sunset Boulevard/Woodhaven Drive would continue to not meet performance standards. In addition, Sunset Boulevard/Timbrel Lane would not meet performance standards. While the intersection of Sunset Boulevard/Woodhaven Drive would not meet performance standards, the performance would improve due to traffic shifts associated with the adjacent improvements at Sunset Blvd/Timbrel Ln. Therefore, mitigation would not be required at this location. Two intersections have impacts that will require mitigation (indicated in bold type).

Table 2: 2030 PM Peak Hour Intersection Performance

		Intersection Performance (Delay LOS V/C)	
Intersection	Agency	No Build	Concept Plan
Signalized Intersections			
Hwy 99W / Sunset Blvd	ODOT	94.3 F 1.24	111.0 F 1.28
Sunset Blvd / Sherwood Blvd	City	15.5 B 0.46	22.6 C 0.62
All-Way Stop Intersections			
Brookman Rd / Old Hwy 99 ⁶	City	7.0 A 0.43	0.4 A 0.20
Sunset Blvd / Pinehurst Dr	City	23.0 C 0.81	28.0 D 0.87
Unsignalized Intersections			
Hwy 99W / Brookman Rd ⁷	ODOT	1126 A/F 3.20	29.7 C 0.93
Sunset Blvd / Woodhaven Dr	City	86.2 A/F 0.91	88.9 A/F 0.89
Sunset Blvd / Timbrel Ln	City	24.3 A/C 0.34	134.4 B/F 1.02
Sunset Blvd / Redfern Dr	City	26.2 A/D 0.14	32.1 A/D 0.17
Brookman Rd / Ladd Hill Rd ⁸	County	16.3 A/C 0.35	13.7 B 0.68
Brookman Rd / Middleton Rd ⁹	County	10.8 A/B 0.23	9.2 A 0.33

2-Way Stop Intersection LOS:

A/A = Major Street turn LOS/ Minor Street turn LOS

All-Way Stop/Signalized Intersection LOS:

LOS = Level of Service

Delay = Average delay per vehicle (seconds)

V/C = Volume to Capacity Ratio

⁶ Analyzed as single-lane roundabout for Concept Plan

⁷ Analyzed as signalized intersection for Concept Plan. ODOT's desired signal spacing standard is one half mile, MUTCD signal warrants must be met based on ODOT methodology and OAR 734-020-460 (1) A traffic signal shall not be installed unless one or more of the warrants identified in the MUTCD are met or will be met consistent with the requirements of OAR734-020-0490. The satisfaction of a warrant or warrants, however, is not in itself justification for a traffic signal. Installation of a signal must be approved by the State Traffic Engineer.

⁸ Analyzed as all-way-stop control for Concept Plan

⁹ Analyzed as all-way stop control for Concept Plan

Mitigation Measures

To offset the negative impacts of the Brookman Road area development on the surrounding transportation system, mitigation measures are required. In addition, more extensive mitigation measures would be needed to bring each study intersection into conformance with ODOT/City operational standards. Table 3 lists a series of mitigation measures (including those previously assumed to be constructed with development) that would be required for the Concept Plan.

Table 3: Intersection Mitigations

Location	Project	Scenario	
		No Build	Concept Plan
Hwy 99W/Sunset Blvd	Add eastbound right turn overlap		X
	Add westbound right turn lane		X
	Add westbound right turn overlap		X
	Hwy 99W 7-lane section	+	+
Hwy 99W/Brookman Rd	Add a traffic signal*	+	X
Sunset Blvd/Woodhaven Drive	Prohibit left turns; or Construct a roundabout	+	+
Sunset Blvd/Timbrell Ln	Construct a roundabout		X
Brookman Rd/Ladd Hill Rd	All-way stop control ^{10*}		X
	Add a southbound right turn lane*		X
	-or- Construct a roundabout		X

X – Required to meet OAR 660-012-060 Transportation Planning Rule (TPR) requirements for rezone approval

+ - Needed to meet State/City operations standards

* - Project was assumed in Capacity Plan analysis

Based on the mitigation measures listed for in Table 3 for TPR compliance (projects indicated with an “X”), operations analysis was performed for the Concept Plan. The results are listed in Table 4. As listed, each intersection would be mitigated to either meet operations standards, or to a level not worse than 2030 No-Build conditions. Two locations (Hwy 99W/Sunset Boulevard and Sunset Boulevard/Woodhaven Drive) would not meet performance standards for either the No Build or Concept Plan scenarios. Improvements are triggered due to background traffic and these locations would not require additional mitigation to that identified in Table 3 to meet TPR requirements for this plan. These system capacity deficiencies will need to be addressed by City of Sherwood, Washington County or ODOT for meeting long-term needs.

¹⁰ Assumed improvement for capacity analysis.

Table 4: 2030 PM Peak Hour Intersection Performance – Mitigated for TPR Compliance

		Intersection Performance (Delay LOS V/C)	
Intersection	Agency	No Build	Concept Plan
Signalized Intersections			
Hwy 99W / Sunset Blvd	ODOT	92.7 F 1.23	66.5 E 1.14
Sunset Blvd / Sherwood Blvd	City	15.5 B 0.46	22.5 C 0.63
Hwy 99W / Brookman Rd ¹¹	ODOT	1126 A/F 3.20	30.3 C 0.93
All-Way Stop Intersections			
Sunset Blvd / Pinehurst Dr	City	23.0 C 0.81	30.9 D 0.91
Brookman Rd / Ladd Hill Rd ¹²	County	16.3 A/C 0.35	13.2 B 0.66
Brookman Rd / Middleton Rd ¹³	County	10.8 A/B 0.23	9.0 A 0.31
Roundabout Intersections			
Brookman Rd / Old Hwy 99 ¹⁴	City	7.0 A 0.43	0.5 A 0.21
Sunset Blvd / Timbrel Ln ¹⁵	City	24.3 A/C 0.34	3.6 A 0.49
Unsignalized Intersections			
Sunset Blvd / Redfern Dr	City	26.2 A/D 0.14	33.2 A/D 0.19
Sunset Blvd / Woodhaven Dr	City	86.2 A/F 0.91	68.7 A/F 0.79

2-Way Stop Intersection LOS:

A/A = Major Street turn LOS/ Minor Street turn LOS

All-Way Stop/Signalized Intersection LOS:

LOS = Level of Service

Delay = Average delay per vehicle (seconds)

V/C = Volume to Capacity Ratio

Residential Street Impacts

A significant challenge to development of the Brookman Road area is providing connections to the surrounding street network without degrading livability on residential streets. North of the site, there are several local or neighborhood route street connections that will be provided, which will increase traffic volumes on those roadways. To monitor the impacts of the Concept Plan, a screenline analysis was conducted to determine traffic volumes at key points on the system.

Table 5 lists the existing, future no-build, and Concept Plan weekday traffic volumes at four locations north of the site. Generally, daily traffic volumes below 2,000 to 3,000 vehicles are considered livable for residential streets. However, narrow residential streets (28 feet wide) have

¹¹ Intersection is unsignalized in No Build scenario

¹² Intersection is unsignalized in No Build scenario

¹³ Intersection is unsignalized in No Build scenario

¹⁴ Intersection is all-way stop controlled in No Build scenario

¹⁵ Intersection is unsignalized in No Build scenario

a lower traffic volume threshold of 1,000 vehicles per day, as adopted in the City of Sherwood TSP. Locations with traffic volumes exceeding these levels should be considered for a traffic management program (which could include the installation of traffic calming devices to manage vehicle speeds).

Volumes listed in Table 5 for the Concept Plan assume that traffic calming projects and other network mitigation would be implemented as previously stated with development of the Concept Plan. With the inclusion of traffic calming measures, traffic volumes will be within facility standards for most neighborhood streets.

Table 5 – Residential Street Weekday Two-Way Volumes

	<i>Facility Threshold</i>	<i>2007 Existing</i>	<i>2030</i>	
			<i>No-Build</i>	<i>Concept Plan</i>
SW Woodhaven Dr. south of Sunset Blvd	3,000	1,200	1,200	1,900
SW Timbrel Ln. south of Sunset Blvd	*	2,300	2,400	6,600
SW Pinehurst Dr. south of Sunset Blvd.	3,000	1,500	1,700	2,100
SW Middleton Road south of Inkster Dr.	3,000	300	400	500

* SW Timbrel lane is designated as a collector roadway in the City of Sherwood TSP. Therefore, residential street thresholds were not applied

Cost Estimates

Planning level cost estimates for transportation facility construction, traffic calming measures, and intersection improvements that were developed for the Concept Plan are listed in Table 6. The total cost of the transportation network in the Concept Plan area is approximately \$105 million.

Table 6: Transportation Planning Cost Estimates

Location	Project	Planning Cost (\$1,000s)
<i>Concept Plan Infrastructure Projects</i>		
Concept Area	Construct new 2-lane local roadways	\$80,400
Old Highway 99	Upgrade to collector standards	\$1,235
Brookman Road east of Middleton Road	Urbanize and rebuild existing roadway	\$10,855
Brookman Road west of Middleton Road	Construct new collector with grade-separated rail crossing	\$6,770
Brookman Road/Old Hwy 99	Construct a roundabout	\$800
<i>Traffic Calming / Neighborhood Cut-through Reduction Projects</i>		
Redfern Drive/Pinehurst Drive/Inkster Drive	Install speed cushions	\$50
<i>Intersection Mitigation Projects*</i>		
Hwy 99W/Sunset Blvd	Add eastbound right turn overlap phase	\$10
	Add westbound right turn lane	\$250
	Add westbound right turn overlap phase	\$10
Hwy 99W/Brookman Rd	Add a traffic signal	\$250
Sunset Blvd/Timbrell Ln	Construct a roundabout	\$800
Brookman Rd/Ladd Hill Rd	All-way stop control	\$10
	Add a southbound right turn lane	\$250
	-or- Construct a roundabout	\$800
<i>Concept Plan Infrastructure Projects Subtotal</i>		\$100,060
<i>Traffic-Calming Subtotal</i>		\$50
<i>Intersection Mitigation Subtotal</i>		\$1,580-\$2,120
<i>TRANSPORTATION TOTAL</i>		\$101,690-\$102,230

* – Required to meet OAR 660-012-060 Transportation Planning Rule (TPR) requirements for rezone approval