

Appendix L:

Transportation Analysis Components

- T-1 Level of Service (LOS) Definitions
- T-2 Queue Observations and Calibration
- T-3 King County Link Capacity
- T-4 Pedestrian Facilities
(Roadway Shoulder Inventory)
- T-5 Sight Distance Memo &
Roadway Profiles
- T-6 School Bus Stop Locations
- T-7 Visum Outputs
- T-8 LOS Summary Table
- T-9 WSDOT Left-Turn Lane Chart

Signalized intersection level of service (LOS) is defined in terms of the average total vehicle delay of all movements through an intersection. Vehicle delay is a method of quantifying several intangible factors, including driver discomfort, frustration, and lost travel time. Specifically, LOS criteria are stated in terms of average delay per vehicle during a specified time period (for example, the PM peak hour). Vehicle delay is a complex measure based on many variables, including signal phasing (i.e., progression of movements through the intersection), signal cycle length, and traffic volumes with respect to intersection capacity. Table 1 shows LOS criteria for signalized intersections, as described in the *Highway Capacity Manual* (Transportation Research Board, Special Report 209, 2000).

Table 1. Level of Service Criteria for Signalized Intersections

Level of Service	Control Delay Per Vehicle (Seconds)	General Description (Signalized Intersections)
A	≤10	Free Flow
B	>10 - 20	Stable Flow (slight delays)
C	>20 - 35	Stable flow (acceptable delays)
D	>35 - 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>55 - 80	Unstable flow (intolerable delay)
F	>80	Forced flow (jammed)

Unsignalized intersection LOS criteria can be further reduced into two intersection types: all-way stop-controlled and two-way stop-controlled. All-way, stop-controlled intersection LOS is expressed in terms of the average vehicle delay of all of the movements, much like that of a signalized intersection. Two-way, stop-controlled intersection LOS is defined in terms of the average vehicle delay of an individual movement(s). This is because the performance of a two-way, stop-controlled intersection is more closely reflected in terms of its individual movements, rather than its performance overall. For this reason, LOS for a two-way, stop-controlled intersection is defined in terms of its individual movements. With this in mind, total average vehicle delay (i.e., average delay of all movements) for a two-way, stop-controlled intersection should be viewed with discretion. Table 2 shows LOS criteria for unsignalized intersections (both all-way and two-way, stop-controlled).

Table 2. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Total Delay (sec/veh)
A	0 - 10
B	>10 - 15
C	>15 - 25
D	>25 - 35
E	>35 - 50
F	>50

Appendix T-2a

Queue Observations and Calibration

WOODINVILLE, WASHINGTON
156TH AVE NE
WOODINVILLE-DUVALL RD

TPG04335M
SB QUEUE OBSERVATIONS

TIME	SB RIGHT TURN	SB LEFT TURN
7:00:05	6	2
7:01:58	9	1
7:03:44	5	3
7:05:33	3	5
7:07:25	11	2
7:09:13	6	4
7:11:00	5	0
7:12:55	6	2
7:14:40	7	2
7:16:35	10	4
7:18:25	4	2
7:20:20	3	4
7:22:05	5	3
7:23:55	0	4
7:25:45	6	1
7:27:30	2	3
7:29:23	1	5
7:31:11	4	5
7:33:03	2	6
7:34:54	5	7
7:36:44	4	4
7:38:36	0	2
7:40:22	7	7
7:42:15	4	7
7:44:03	4	3
7:45:54	3	5
7:47:44	3	6
7:49:34	1	7
7:51:24	4	2
7:53:12	0	3
7:55:00	0	2
7:56:55	0	4
7:58:55	0	1
8:00:35	6	1
8:02:22	2	5
8:04:13	1	3
8:06:04	1	4
8:07:53	5	2
8:09:44	3	3
8:11:34	3	5
8:13:25	5	2
8:15:15	2	2
8:17:05	0	2
8:18:55	1	7
8:20:45	0	6
8:22:35	3	3
8:24:23	2	3
8:26:13	9	5
8:28:05	1	5
8:29:55	4	0
8:31:45	8	1
8:33:35	5	2
8:35:23	5	6
8:37:14	2	3
8:39:03	4	4
8:40:55	2	1
8:42:44	2	2
8:44:33	4	1
8:46:23	1	7
8:48:13	8	3
8:50:04	5	2
8:51:55	2	2
8:53:45	5	1
8:55:33	2	5
8:57:23	1	4
8:59:13	2	0
95th% Queue	8.75	7

Appendix T-2b

Queue Observations and Calibration

	EXISTING			NO ACTION		PROPOSED ACTION		R-1 ZONING ALT.		ATTACHED HOUSING ALT.	
	Existing AM Peak Synchro 95th% (feet)	Existing AM Peak 95th % Observed (vehicles)	Existing AM Peak 95th % Observed (feet) ¹	Calibration Factor	Calibrated Existing 95th% Queue (feet)	Synchro 95th% Queue	Calibrated 95th% Queue (feet)	Synchro 95th% Queue (feet)	Calibrated 95th% Queue (feet)	Synchro 95th% Queue (feet)	Calibrated 95th% Queue (feet)
SB Left	101	8.75	175	1.73	175	118	204	108	187	115	199
SB Right	138	7	140	1.01	140	163	185	147	149	160	162

¹ - Based on on 20 foot average vehicle length/spacing (per field observations)

KING COUNTY RECOMMENDED LINK TYPE CAPACITY VALUES

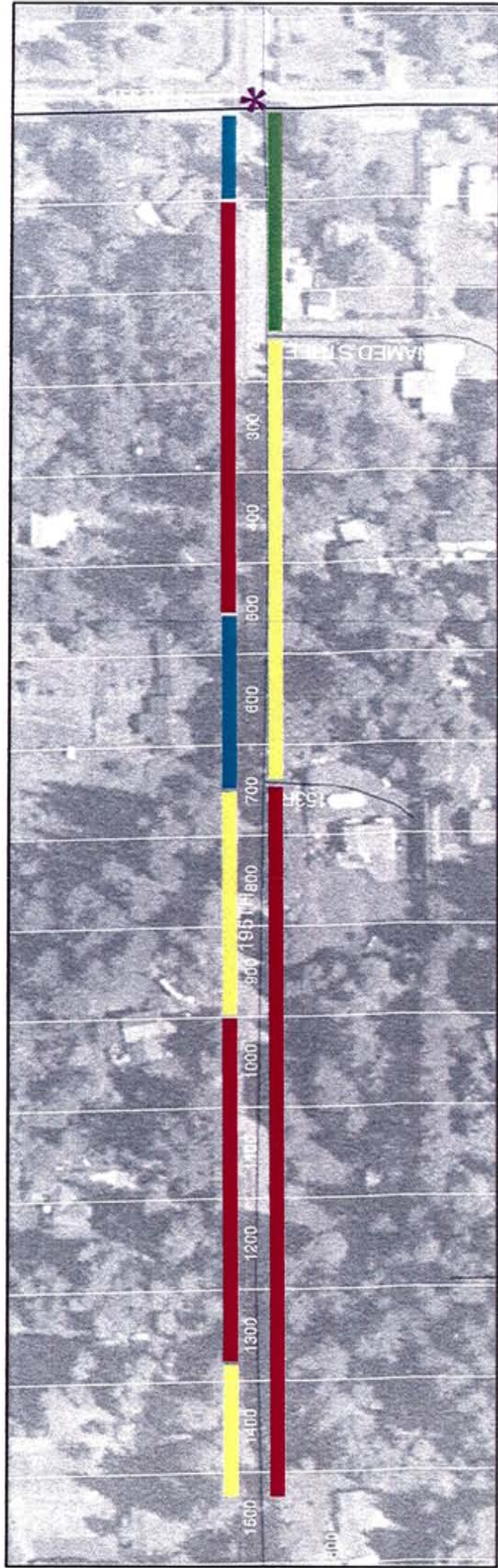
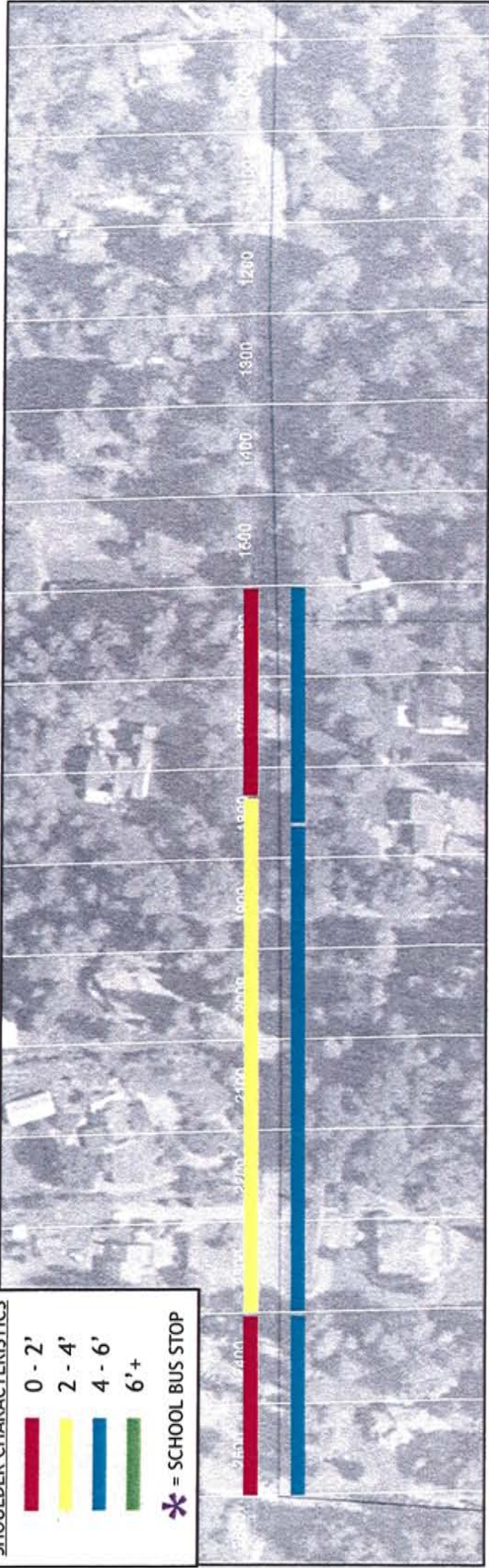
T Y P E	Number of Lanes	Area	Pavement Type	Width of Traffic Lane	Intersection Control	Other Information	ADT Capacity		Peak Cap. One Direc.
							Two Direc.	One Direc.	
1	Centroid connector						100,000	50,000	5,000
	Arterials								
2	Two Lane	Rural	Oil mat Paved	Less than 20'	Stop sign	Minimal shoulders	7,400	3,700	740
3	Two Lane	Rural or Urban	Paved	18'-20'	Stop sign	Minimal shoulders	9,520	4,760	740
4	Two Lane	Rural or Urban	Paved	20'-22'	Any type	Long Dist. Btw Cont. Intersec.	19,000	9,500	1,240
5	Two Lane	Urban	Paved	22'-24'	Stop Sign	Adequate Shoulders	11,620	5,810	760
6	Two Lane	Urban	Paved	22'-24'	Traffic Signal	Adequate Shoulders	13,200	6,600	760
7	Two Lane	Urban	Paved	22'-24'	Any Type	Long Dist. Btw Cont. Intersec.	21,120	10,560	1,320
8	Two Lane/ turn channel	Urban	Paved	32'-36' at intersection	Traffic Signal	Channel at Intersection	16,900	8,450	1,030
9	Three Lane	Urban	Paved	32'-40'	Traffic Signal	Two Way Turn Lane	19,220	9,610	1,030
10	Four Lane	Urban	Paved	40'-44'	Traffic Signal		25,380	12,690	1,930
11	Four Lane	Urban	Paved	40'-48'	Any Type	Long Dist. Btw Cont. Intersec.	38,000	19,000	2,600
12	Four Lane/ turn channel	Urban	Paved	56'-60' at intersection	Traffic Signal		30,560	15,280	2,160
13	Five Lane Section	Urban	Paved	56'-60'	Traffic Signal		34,240	17,120	2,160
14	Six Lane	Urban	Paved	60'-72'	Traffic Signal		35,880	17,940	2,850
15	Six Lane/turn chan.	Urban	Paved	78'-84'	Traffic Signal		40,100	20,050	3,060
16	Four Lane/turn chan. Transit/carpool	Urban	Paved	60'-72'	Traffic Signal		31,280	15,640	2,450
	Freeways								
17	Two Lane controlled access	Urban	Paved	24'	Interchange		27,500	13,750	1,925
18	Four Lane frwy	Urban	Paved	48'	Interchange	Full access control	72,600	36,300	3,960
19	Six Lane frwy	Urban	Paved	72'	Interchange	Full access control	103,500	51,750	6,210
20	Eight Lane frwy	Urban	Paved	96'	Interchange	Full access control	138,000	69,000	8,280
21	Four Lane frwy/ w/Transit/carpool	Urban	Paved	60' include. shoulder	Interchange	Full access control	74,940	37,470	5,460
22	Six Lane frwy w/ Transit/carpool	Urban	Paved	88' include shoulder	Interchange	Full access control	105,040	52,520	7,710
	External Links								
23	Four-Six Lane Arterial	Urban CBD	Paved Paved	88'+	Traffic Signal	20-25 MPH	50,660	25,330	3,800
24	Two Lane Arterial	Rural	Paved		Long Distance		19,000	9,500	1,240
25	Two Lane Arterial	Rural	Paved				9,520	4,760	740
26	Two Lane Arterial	Urban	Paved				13,720	6,860	760
27	Four Lane Arterial	Rural	Paved		Long Distance		38,000	19,000	7,600
28	Four Lane Arterial	Rural	Paved				25,380	12,690	1,930
29	Four Lane Arterial	Urban	Paved				33,720	16,860	2,160
30	Six Lane Arterial	Urban	Paved				42,200	21,100	3,060
31	Eight Lane Arterial	Urban	Paved				50,660	25,330	3,800
	Freeway on/off	Urban	Paved				230,000	115,000	8,280

Source: King County Department of Transportation, Transportation System Planning Section, as reviewed and recommended by the KJS & Associates in 1995.



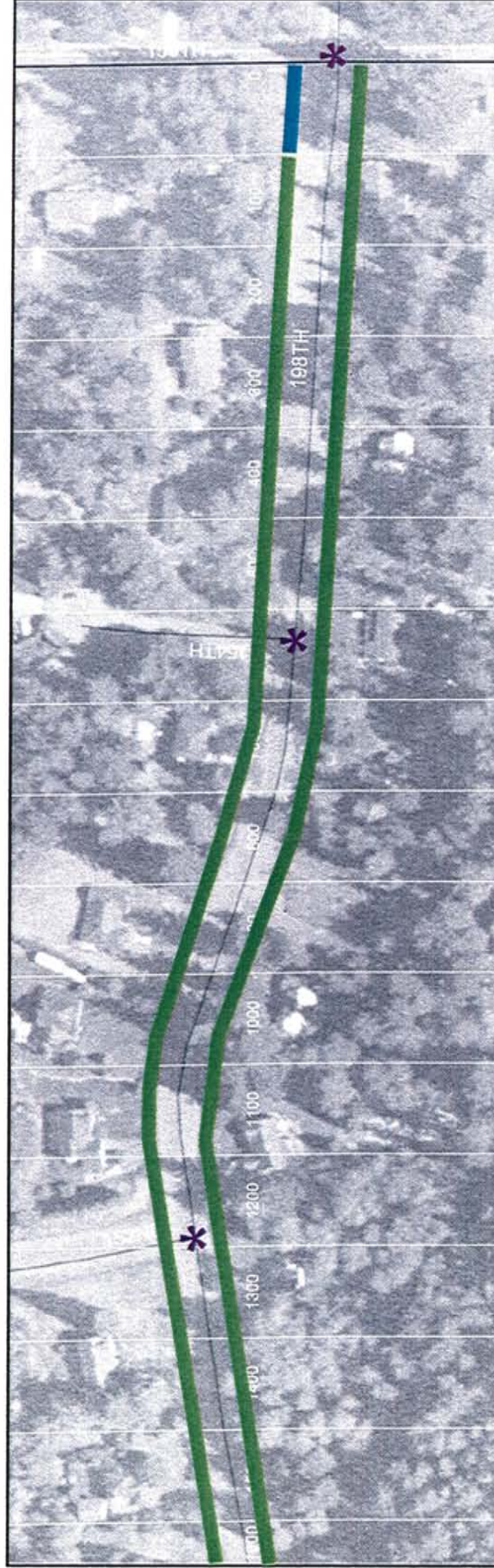
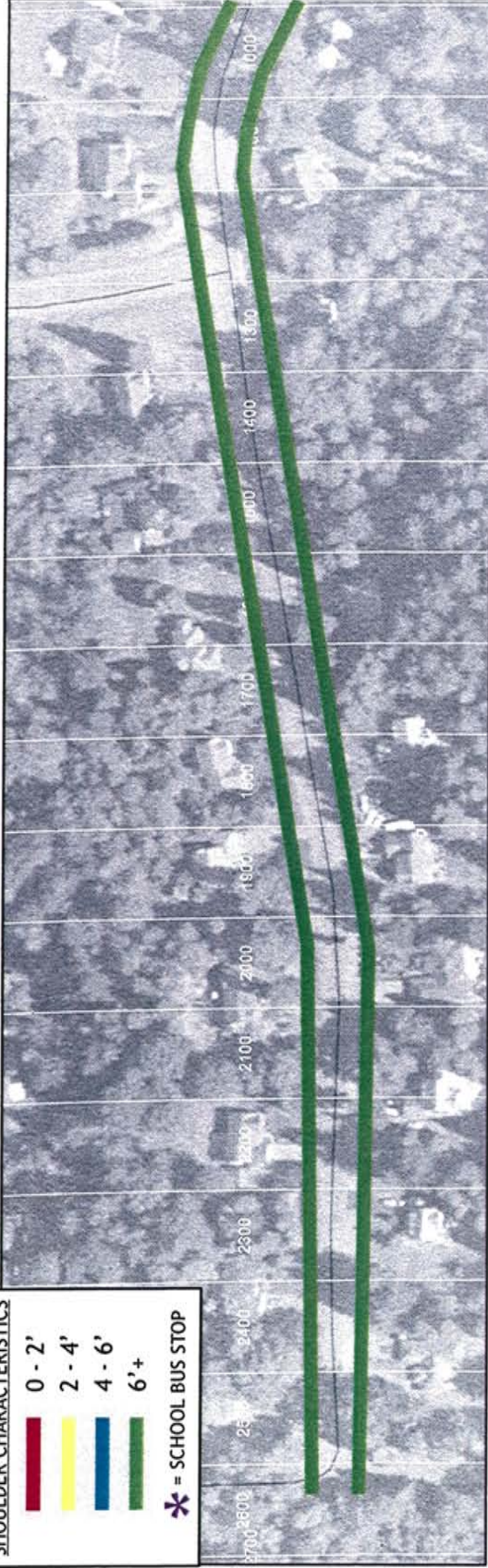
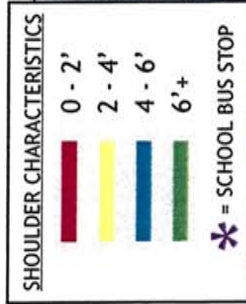
SHOULDER CHARACTERISTICS

- 0 - 2'
- 2 - 4'
- 4 - 6'
- 6' +
- * = SCHOOL BUS STOP



Appendix T-4a Roadway Shoulder Inventory (195th Street)

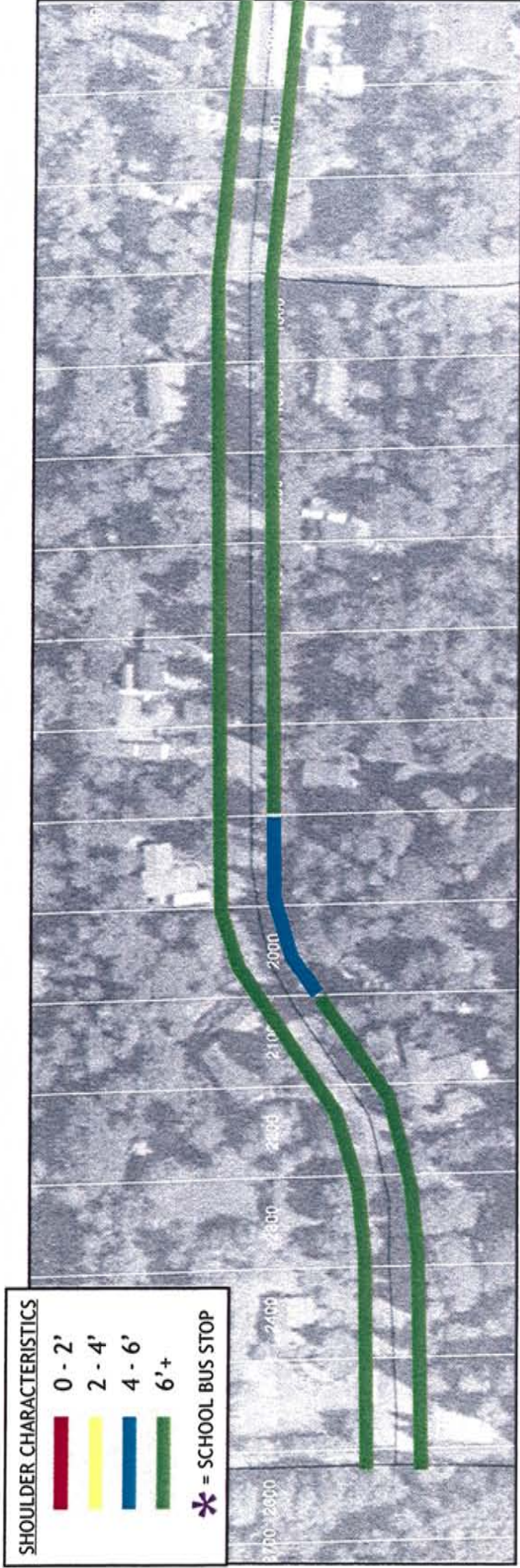
Wood Trails

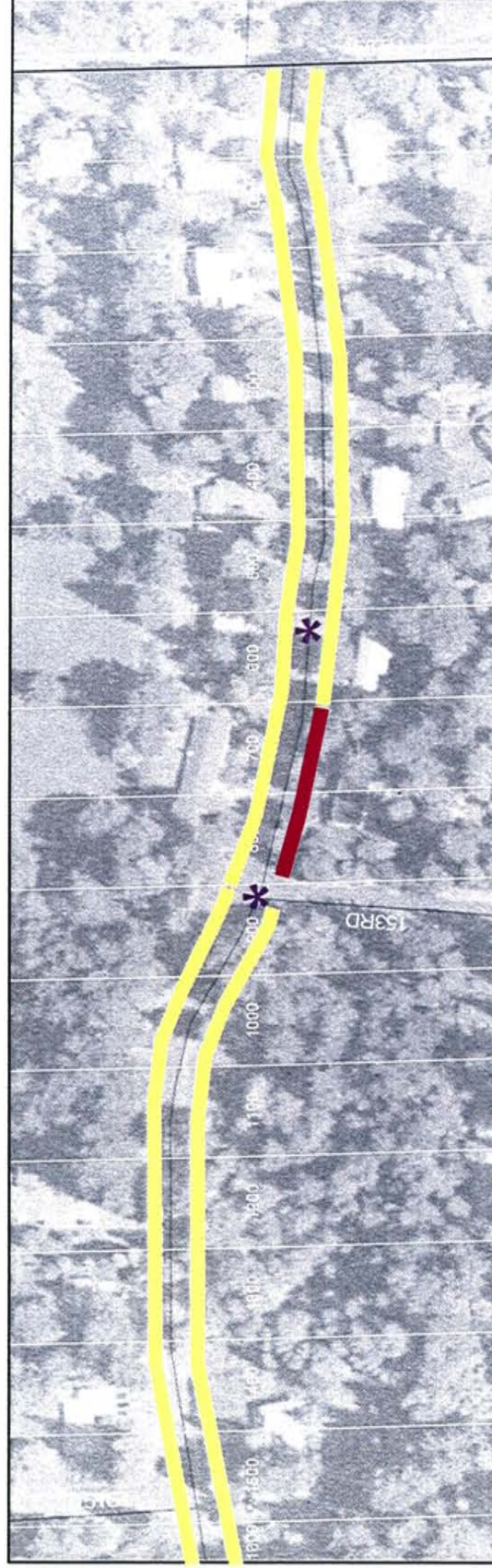
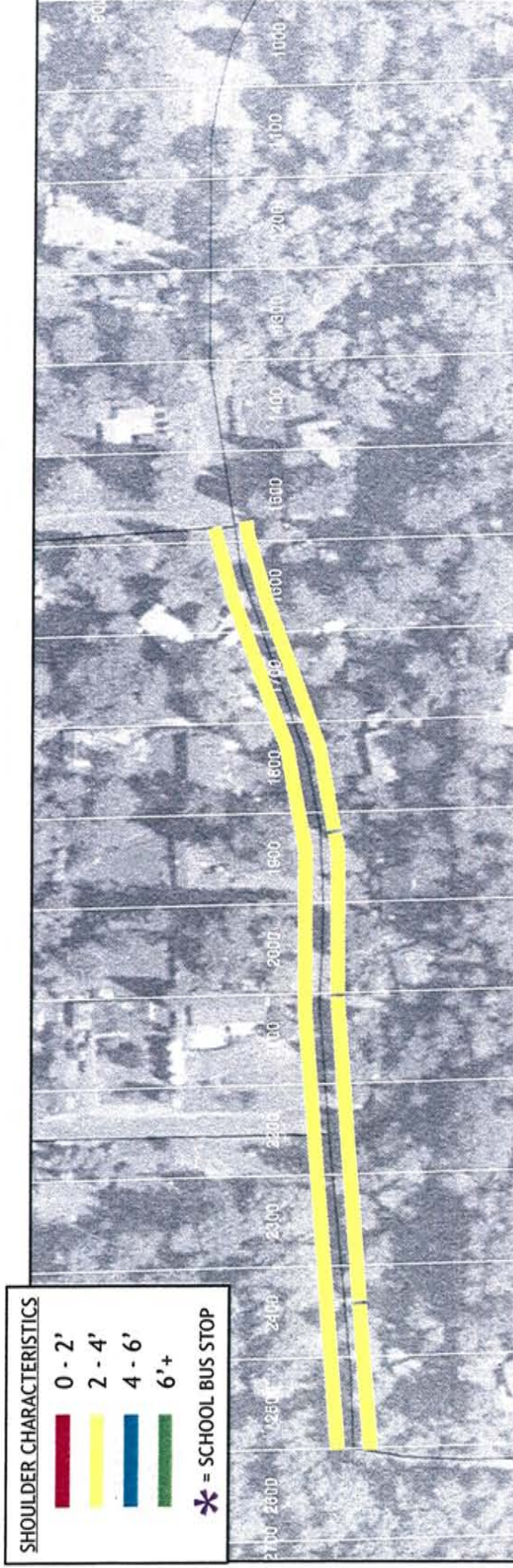


Appendix T-4b

Roadway Shoulder Inventory (198th Street)

Wood Trails & Montevillo





APPENDIX T-5: TECHNICAL MEMORANDUM

To:	File	Date:	February 15, 2005
From:	Mike Swenson, P.E., P.T.O.E. Brandon Moen, AICP	TG:	04007.00
Subject:	Wood Trails/Montevallo EIS: Sight Distance Conditions		

The purpose of this technical memorandum is to provide a summary of the stopping sight distance conditions of local residential roadways in the area of the proposed developments, particularly the roadways that could connect the Wood Trails site to 156th Avenue NE, including:

- NE 202nd Street
- NE 201st Street
- NE 198th Street
- NE 195th Street

The estimated stopping sight distance along each roadway is discussed below.

Sight Distance

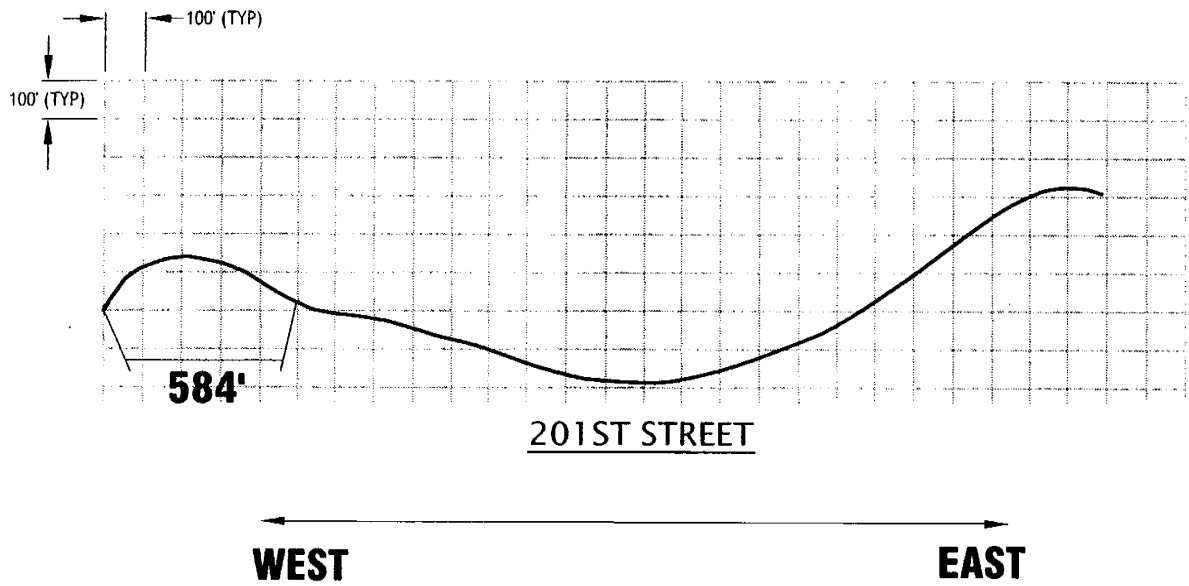
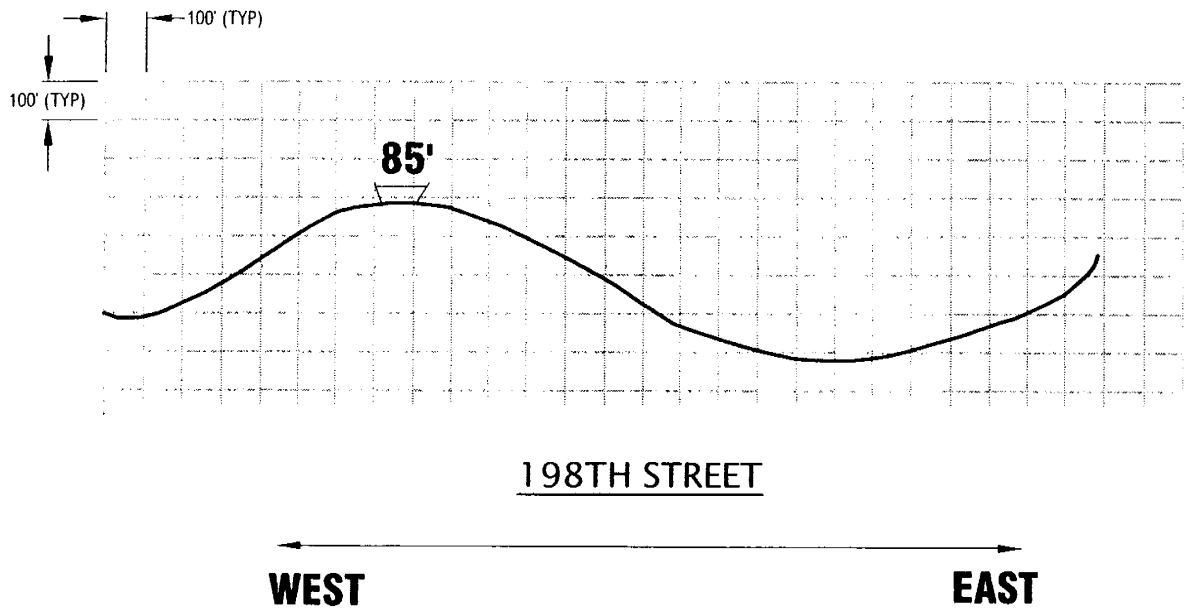
Stopping sight distance along NE 202nd Street, NE 201st Street, NE 198th Street, and NE 195th Street was calculated using information obtained through field collection efforts. Existing roadway profiles were estimated using Global Positioning System (GPS) technology. All four roadways were traveled multiple times while collecting GPS data using a handheld GPS unit. This GPS unit has an accuracy within one to two meters depending on the positioning of the satellites and current coverage. The roadway profiles and subsequent sight distance calculations reflect only the vertical alignment of the roadway. If a horizontal curve exists (such as on the west end of NE 201st Street) that would influence the SSD, it is not reflected in these calculations. Observations in the field indicated both horizontal curves and vertical curves at the west end of NE 201st Street.

The calculated sight distance measurements were then compared to City of Woodinville sight distance requirements, which are based on American Association of State Highways and Transportation Officials (AASHTO) standards. The design speed of the roadway used in the calculations was assumed to be the posted speed limit (25 mph) plus eight mph, per City of Woodinville standards. Using these assumptions, City of Woodinville stopping sight distance standards are met at all locations along NE 201st Street with the exception of the west end of the road, near the connection to the proposed development. Along NE 198th Street only one location, extending 85 feet, is shown to be deficient in the estimated stopping sight distance. Along NE 195th Street, one segment of 468 feet in length is shown to be deficient. Along NE 202nd Street, two segments are shown to be deficient, each extending 357 feet and 389 feet

in length. A graphical representation of the most restricted stopping sight distance location along NE 198th Street and NE 201st Street are shown in Figure C-5a, while Figure C-5b shows the same information for NE 195th Street and NE 202nd Street.

As noted, the roadway profiles generated for this analysis are not exact and were not surveyed. Thus, the precise location and extents of the sight distance restrictions are provided for general information only.

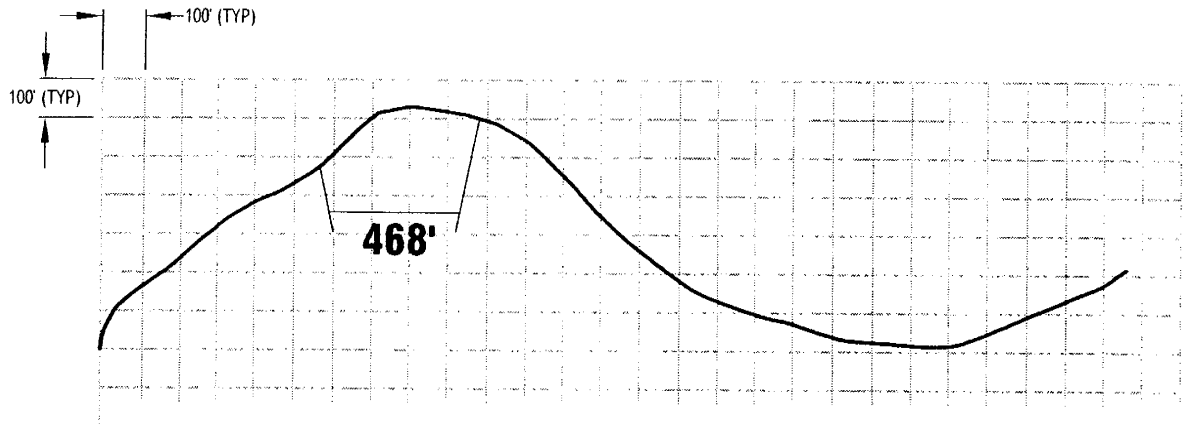
A review of historic accident records along each roadway over the past three complete years of which data is available (2001-2003), shows that two accidents were reported along these four roadways. However, neither accident appears to have been affected by sight distance limitations. One of the accidents involved a vehicle striking a pole, which likely wasn't affected by sight distance. The other accident occurred 150 feet west of the 156th Avenue NE/NE 201st Street intersection, which has not been identified as an area with a sight distance deficiency. Therefore, the accident records provided suggest that no accident history directly attributable to sight distance limitations exists along these four local roadways.



LEGEND

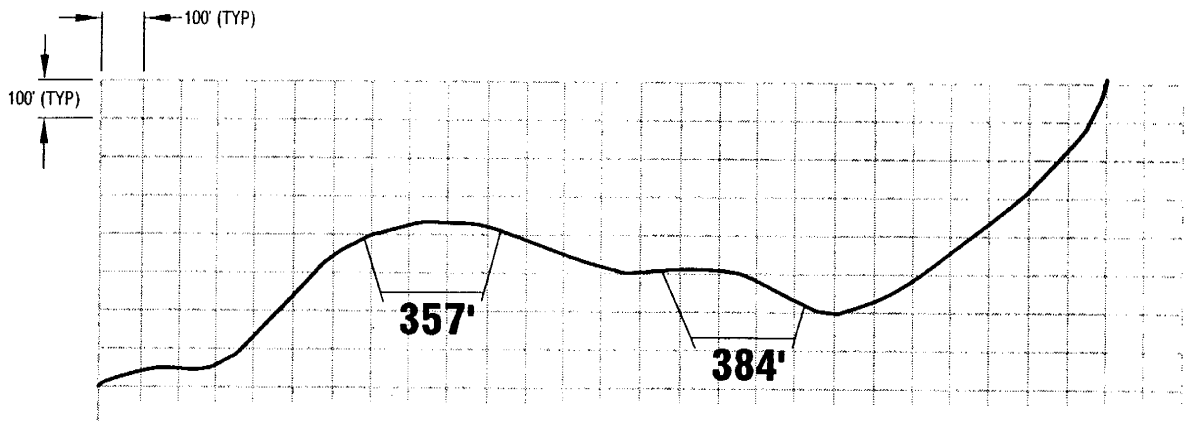
XX' = LENGTH OF ROADWAY WITH A
SIGHT DISTANCE LIMITATION (FEET)





195TH STREET

WEST EAST



202ND STREET

WEST EAST

LEGEND

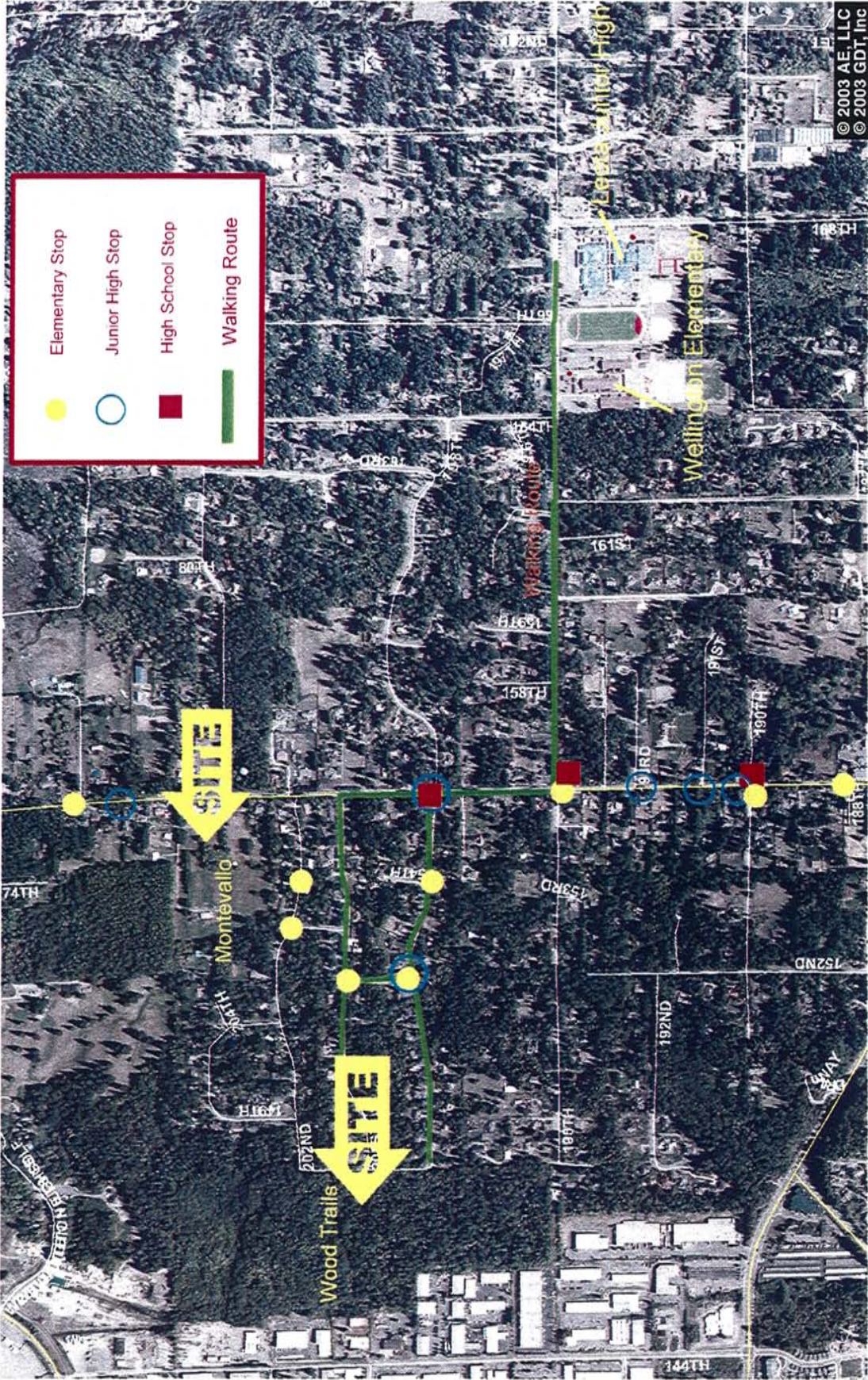
XX' = LENGTH OF ROADWAY WITH A
SIGHT DISTANCE LIMITATION (FEET)

Appendix T-5b

Stopping Sight Distance - Roadway Profiles

Wood Trails & Montevallo

The
Transpo
Group



↑ N
NOT TO SCALE

Appendix T-6

School Bus Stop Locations

Wood Trails & Montevilla

This map illustrates the travel demand model for the City of Woodinville. It features a network of roads with associated travel demand values. Key roads include NE 130th Ave NE, NE 132nd Ave NE, NE 138th Ave NE, NE 140th Pl NE, NE 160th St, NE 175th St, NE 180th St, NE 156th Ave NE, NE 164th Ave NE, NE Wood-Duvall Rd, and Wood-Snohomish Rd. Travel demand values are indicated by numbers along the road segments, such as 17, 22, 33, 61, 100, 28, 11, 6, and 19. The map also shows a road labeled 'R 522' and 'ville Dr' on the left side.

The map displays the travel demand model for the City of Woodinville. It shows a network of roads with associated travel demand values. Key roads include 130th Ave NE, 135th Ave NE, Wood-Snohomish Rd, 156th Ave NE, NE Wood-Duvall Rd, NE 180th St, NE 175th St, 140th Pl NE, and NE 164th Ave NE. Travel demand values are indicated by numbers along the road segments, ranging from 3 to 100. The map also shows the location of the city center and the surrounding area.

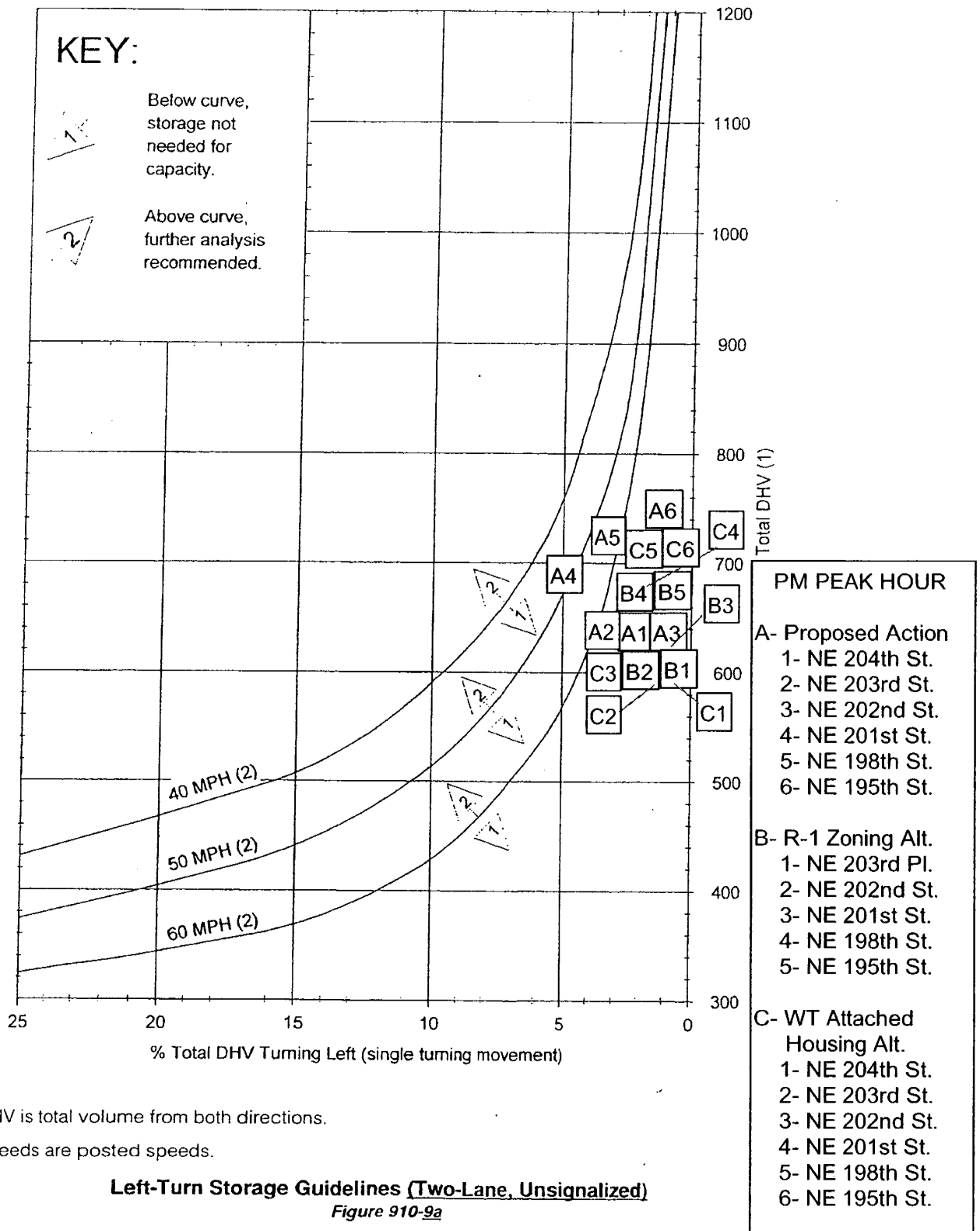
VISUM 8.10 PTV AG	Transpo	WD_Master_2012HE (Wood
Date:01/23/04	2000 Travel Assignment	1: 16967

APPENDIX T-8: Development LOS Summary

Weekday AM Peak Hour	2006 No Action Conditions			2006 with Proposed Action			2006 with R-I Zoning			2006 with Attached Housing		
	LOS ¹	Delay ²	WM or V/C ³	LOS	Delay	WM or V/C	LOS	Delay	WM or V/C	LOS	Delay	WM or V/C
156 th Ave NE/NE 203 rd Pl	B	10.0	WB App.	B	10.2	WB App.	B	10.7	EB App.	B	10.2	WB App.
156 th Ave NE/NE 202 nd St	B	10.1	EB App.	B	10.3	EB App.	B	10.2	EB App.	B	10.3	EB App.
156 th Ave NE/NE 201 st St	B	10.5	EB App.	B	11.1	EB App.	B	10.6	EB App.	B	10.9	EB App.
156 th Ave NE/NE 198 th St	B	11.7	WB App.	B	12.6	WB App.	B	11.9	WB App.	B	12.3	WB App.
156 th Ave NE/NE 195 th St	B	12.5	WB App.	B	13.1	WB App.	B	12.7	WB App.	B	13.1	WB App.
156 th Ave NE/NE Woodinville-Duvall Rd	C	20.5	0.79	C	21.6	0.82	C	20.9	0.80	C	21.4	0.81
NE Woodinville-Duvall Rd/NE Woodinville Wy	A	6.9	0.45	A	7.0	0.46	A	6.9	0.45	A	6.9	0.46
NE Woodinville- Snohomish Rd/NE 195 th St	C	29.8	0.91	C	30.0	0.91	C	29.8	0.91	C	30.0	0.91
Weekday PM Peak Hour	2006 No Action Conditions			2006 with Proposed Action			2006 with R-I Zoning			2006 with Attached Housing		
	LOS ¹	Delay ²	WM or V/C ³	LOS	Delay	WM or V/C	LOS	Delay	WM or V/C	LOS	Delay	WM or V/C
156 th Ave NE/NE 203 rd Pl	B	11.3	WB App.	B	11.7	WB App.	B	12.3	EB App.	B	11.5	WB App.
156 th Ave NE/NE 202 nd St	B	11.0	EB App.	B	11.4	EB App.	B	11.3	EB App.	B	11.5	EB App.
156 th Ave NE/NE 201 st St	B	11.3	EB App.	B	12.2	EB App.	B	11.5	EB App.	B	11.9	EB App.
156 th Ave NE/NE 198 th St	C	15.3	WB App.	C	17.9	WB App.	C	15.8	WB App.	C	16.9	WB App.
156 th Ave NE/NE 195 th St	C	15.3	WB App.	C	17.2	WB App.	C	15.9	WB App.	C	16.8	WB App.
156 th Ave NE/NE Woodinville-Duvall Rd	C	26.3	0.93	C	32.7	0.97	C	27.5	0.94	C	30.7	0.94
NE Woodinville-Duvall Rd/NE Woodinville Wy	C	28.8	0.83	C	30.3	0.85	C	29.2	0.83	C	29.9	0.85
NE Woodinville- Snohomish Rd/NE 195 th St	C	30.0	0.81	C	30.7	0.82	C	30.2	0.81	C	30.6	0.82

1. Level of Service
2. Average vehicle delay (seconds)
3. Volume to capacity ratio reported at signalized intersections; worst movement at unsignalized intersections.

APPENDIX T-9



(1) DHV is total volume from both directions.

(2) Speeds are posted speeds.