

116th Street NE Interchange Access Point Decision Report



**Washington State
Department of Transportation**

116th Street NE Interchange Access Point Decision Report

Prepared for

Interstate 5
116th Street NE Interchange
M.P. 202.47
Snohomish County



**Washington State
Department of Transportation**

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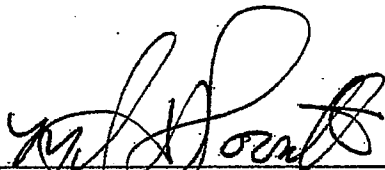
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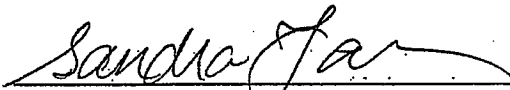
May 2005

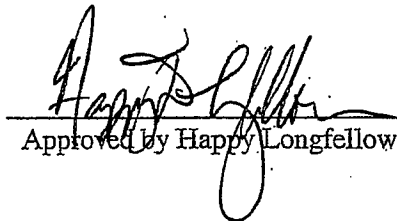
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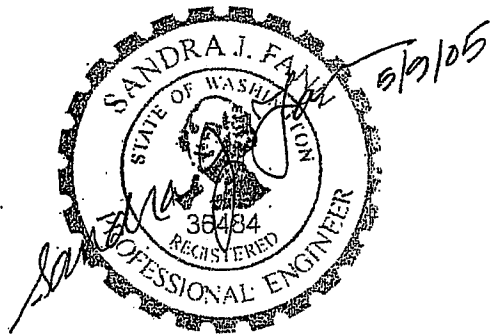
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The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.


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EXPIRES 6 - 23 - 2006

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ACRONYMS

acc/mvm	accident per million vehicle miles
ADT	average daily traffic
APDR	access point decision report
BIA	Bureau of Indian Affairs
CT	Community Transit
EA	environmental assessment
FHWA	Federal Highway Administration
HAC	high accident corridor
HAL	high accident location
HCM	highway capacity manual
HCS	highway capacity software
HOV	high-occupancy vehicle
HSP	State Highway System Plan
I-5	Interstate 5
LOS	level of service
MP	milepost
MTP	metropolitan transportation plan
NEPA	National Environmental Policy Act
PAL	pedestrian accident location
PS&E	plans, specifications, and estimates
PSRC	Puget Sound Regional Council
ROD	record of decision
ROW	right-of-way
RR	Railroad
SEPA	State Environmental Policy Act
SnoCAN	Snohomish County Arterial Network
SPUI	single point urban interchange
SR	state route
TDM	Travel Demand Management
TIP	transportation improvement plan
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

Washington State Department of Transportation (WSDOT) and the Bureau of Indian Affairs (BIA) are proposing to modify the existing Interstate 5 (I-5)/116th Street NE interchange to improve the interchange's level of service (LOS), remove ramp queuing impacts onto the I-5 mainline and to provide better access between the I-5 mainline and 116th Street NE. The interchange is located between the Tulalip Reservation and the City of Marysville (in Snohomish County) at I-5 milepost 202.47. The following Access Point Decision Report (APDR) constitutes a request for a finding of engineering and operational acceptability of a revised access point to I-5 at 116th Street NE. This APDR is written to provide the necessary documentation and justification for the proposed access changes on I-5 in accordance with the eight policy points identified by WSDOT.

EXISTING FACILITY

The existing full diamond interchange at 116th Street NE is located in the Tulalip/Marysville area between the I-5/88th Street NE interchange and the I-5/172nd Street NE (SR-531) interchange (Figure E-1).

Improvements to 116th Street NE were made in early 2000. These improvements, identified by the Tulalip Tribes, Snohomish County, and WSDOT, included widening 116th Street NE to four lanes east of Quil Ceda Boulevard, signalizing the 34th Avenue NE/116th Street NE intersection, and improving the I-5/116th Street NE undercrossing by adding bicycle and pedestrian facilities and making safety improvements including signalizing/channelizing both ramp intersections. The existing 116th Street NE bridge at the I-5 undercrossing is three lanes wide and has a sidewalk on the north side only. This bridge creates a bottleneck for traffic moving in both directions, trying to access or cross I-5.

PROJECT NEED

Widening the I-5/116th Street NE undercrossing and making additional improvements to accommodate high-volume traffic is essential to the operation of this interchange and reduction of queuing impacts of the ramps onto the mainline, and will provide continuity with improvements that have been made or are planned to 116th Street NE by the Tulalip Tribes/City of Marysville.

LAND USE

The Washington State Office of Fiscal Management projects that Snohomish County's population (<http://www.ofm.wa.gov/pop/gma/countypop.pdf>) will increase to approximately 1,063,000 by 2025, an increase of more than 450,000, or 75 percent, from the 2000 population of 606,000. The Puget Sound Regional Council (PSRC) projects the population of the Tulalip/Marysville/Arlington area will increase from approximately 75,000 to 135,000, or 76 percent, by year 2030. Employment in the area is projected to increase by 50 percent, from approximately 23,000 to approximately 34,000 jobs. These projections do not, however, account for the growth potential of the Tulalip Tribes' Quil Ceda Business Park.

The 2,000-acre Quil Ceda Business Park currently houses a 227,000 square-foot casino, two large retail stores, a smaller retail complex and Tulalip Bingo. A 500,000 square-foot outlet mall is scheduled to open in May 2005. The initial phase of business park development was recently completed on approximately 635 acres adjacent to the west side of I-5, just south of 116th Street NE. Designated uses include retail, casino, office, light industrial, distribution, warehousing, and a destination resort. Later phases include additional areas for office and light industrial use with a development capacity of over 6.7 million square feet.

The City of Marysville has currently designated the 116th Street NE corridor for community business development as part of a master plan and has zoned over 1,000 acres for industrial use north of 123rd Street, between I-5 and 43rd Avenue NE (Marysville 2001). Most of this area is currently undeveloped. The zoning capacity of this area is several million square feet of commercial and industrial development.

The proposed improvements to the interchange will provide the additional capacity needed to accommodate the traffic growth resulting from increased population and employment in the area, according to the existing zoning.

PREFERRED ALTERNATIVE

Over a dozen alternatives were originally developed to provide the additional capacity at the 116th Street NE interchange. These alternatives were screened down to three alternatives for further analysis, and a preferred alternative was selected in July 2003. A description of the three alternatives considered is provided in Policy Point 3, Reasonable Alternatives. The selection of the preferred alternative was revisited at the end of 2004 to ensure that recent developments in interchange design (tight urban diamond interchanges), changes in proposed land uses/local comprehensive plans, or delayed opening dates did not change the conclusions for the selection of the preferred alternative.

The preferred alternative would convert the existing 116th Street NE conventional diamond interchange to a single point urban interchange (SPUI). This new configuration would improve access to the regional arterial system without significant impacts to surrounding residential and business areas. In addition, the access improvements would help alleviate upstream traffic congestion and delays anticipated from the additional trips generated on I-5 by projected employment and population growth that would occur with or without the interchange improvement. Figures E-2, E-3, E-4, E-5, E-6, E-7, and E-8 show the layout of the modified I-5/116th Street NE interchange and the 34th Avenue NE intersection. Figure E-4 shows the proposed bridge layout of the SPUI.

The preferred alternative also includes the extension of Quil Ceda Boulevard from 116th Street NE north and east to intersect with 34th Avenue NE approximately 2,000 feet north of 116th Street NE and a reconfiguration of 34th Avenue NE to accommodate right-in and right-out movements only at 116th Street NE. The Quil Ceda Boulevard extension will accommodate the majority of north-south traffic volumes currently using 34th Avenue NE. Figure E-7 shows the proposed channelization at the revised Quil Ceda Boulevard/116th Street NE intersection. These changes will alleviate the existing conflicts on 116th Street NE between the 34th Avenue NE intersection and the southbound ramp terminals.

I-5 Northbound

The northbound I-5 mainline alignment would remain unchanged. The proposed northbound off-ramp would continue to be a single lane, but would flare out to three lanes (two left-turn lanes and one right-turn lane) at the terminal. The northbound on ramp would be two-lanes at the terminal, tapering to a single lane on-connection. Figures E-2 through E-6 show the proposed channelization on the northbound on- and off-ramps at the 116th Street NE interchange.

I-5 Southbound

The I-5 southbound mainline alignment would remain unchanged. The proposed southbound off-ramp would continue to be a single lane, but would flare out to two lanes (one left-turn lane and one right-turn lane) at the terminal. The southbound on ramp would be two-lanes at the terminal, tapering to a single lane on-connection with I-5. Ramp metering is also proposed. Figures E-2 through E-6 show the proposed channelization on the southbound on- and off-ramps at the interchange.

Proposed Improvements

The following is a list of the improvements proposed in this project.

- Replace the existing 116th Street NE three-lane undercrossing with a new SPUI with two east-west through lanes in each direction; two northbound to westbound left-turn lanes; two westbound to southbound left-turn lanes; two eastbound to northbound left-turn lanes; and a single southbound to eastbound left-turn lane.

- Provide a realigned one-lane southbound I-5 off-ramp that widens to two lanes at the ramp terminal: one lane onto eastbound 116th Street NE and one lane onto westbound 116th Street NE.
- Realign the northbound I-5 off-ramp that widens to three lanes at the ramp terminal: two lanes onto westbound 116th Street NE and one lane onto eastbound 116th Street NE.
- Widen and realign the northbound I-5 on ramp to meet current design guidelines for the two-lane eastbound to northbound movement and provide a new right-turn pocket for westbound traffic accessing this ramp.
- Redesign the southbound I-5 on ramp to meet current design guidelines for the two-lane westbound to southbound movement and tapering to a single lane on connection to southbound I-5. Ramp metering is also proposed for the southbound on-ramp.
- Construct a new right-turn lane for eastbound traffic destined for southbound I-5.
- Install a new permanent signal at the SPUI.
- Maintain access to the existing Park and Ride lot from the realigned 34th Avenue NE.
- Reconfigure the 34th Avenue NE/116th Street NE intersection to accommodate right-in and right-out movements only. Eliminate through and left-turn movements onto and from 116th Street NE at 34th Avenue NE with a curb at the 116th Street NE centerline. Provide a westbound to northbound free right turn and a stop-sign controlled southbound to westbound right turn.
- Extend Quil Ceda Boulevard approximately 3,400 feet to the north, from the existing northern terminus of Quil Ceda Boulevard at 116th Street NE to the proposed connection with 34th Avenue NE. The Quil Ceda Boulevard extension will accommodate the majority of traffic currently using 34th Avenue NE. Construct channelization and signal improvements to accommodate the roadway extension.
- Construct storm water detention and water quality facilities that meet current storm water management guidelines.

Figures E-2 through E-6 show the proposed channelization on the southbound on- and off-ramps at the interchange. Figure E-7 shows the proposed channelization at the Quil Ceda Boulevard/116th Street NE intersection.

SUMMARY OF CONCLUSIONS

The overall findings contained in this report include:

Policy Point 1: Future Interchanges – The proposed interchange modifications are compatible with and support the existing and future system design for the I-5 corridor.

Policy Point 2: Land Use and Transportation Plans – The proposed interchange modifications are consistent with and support the goals and objectives of both regional and local land use and transportation plans.

Policy Point 3: Reasonable Alternatives – A wide range of reasonable alternatives were considered for the interchange design and the selected alternative best meets the project and regional goals and objectives while maintaining flexibility for future improvements.

Policy Point 4: Need for the Access Point Revision – The existing interchange has design, LOS, and queuing deficiencies that are projected to worsen significantly through the design year (2030).

Policy Point 5: Access Connections and Design – The proposed interchange modifications will improve or maintain LOS (as compared to the No Build Alternative) for all traffic movements through the year 2030 design year.

Policy Point 6: Operational and Accident Analyses No Build – The proposed interchange modifications of the Build Alternatives will reduce congestion and accidents and improve LOS on the I-5 mainline and surrounding arterial systems.

Policy Point 7: Coordination – The proposed interchange modifications have been coordinated among the Federal Highway Administration (FHWA), WSDOT, and local agencies (Snohomish County, Tulalip Tribes, City of Marysville, and Community Transit).

Policy Point 8: Planning and Environmental Process –The environmental process and review is occurring concurrent with the development of the APDR and a draft environmental assessment (EA) is scheduled to be released in spring 2005.

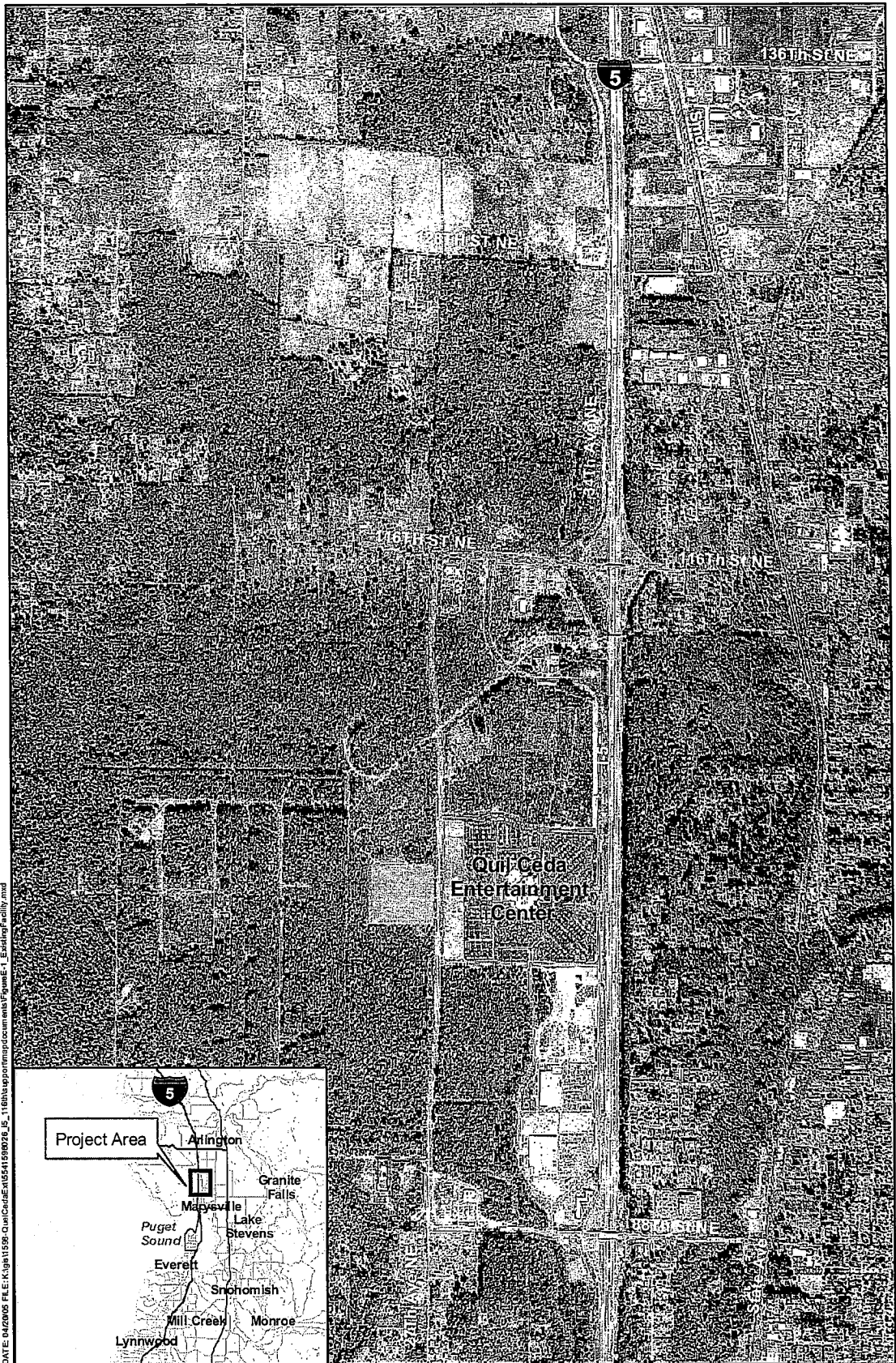
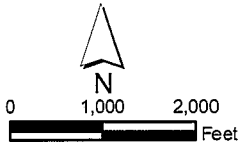
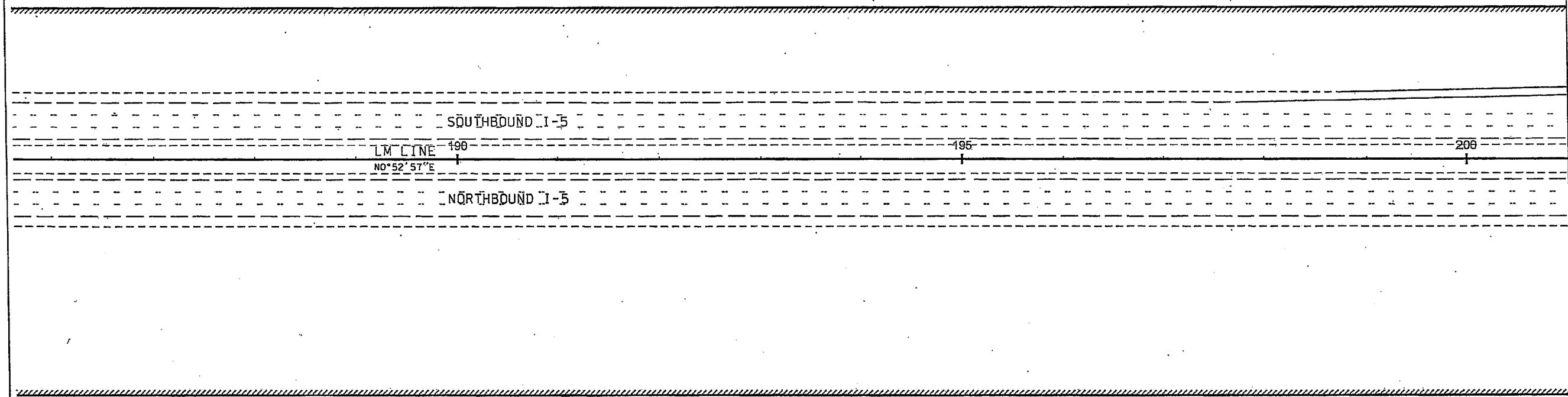
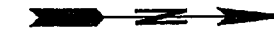


Figure E-1
Existing Facility



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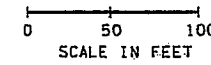


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DESIGN PARAMETERS

	I-5	RAMPS	116TH STREET NE
FUNCTIONAL CLASS	P-1 (NHS)	-	URBAN MINOR ARTERIAL
DESIGN SPEED	80 MPH	70 MPH *	40 MPH
POSTED SPEED	70 MPH	N/A	35 MPH **

* DESIGN SPEED 25 MPH AT SPUI INTERSECTION
 ** SNOHOMISH COUNTY DESIGN STANDARDS
 DESIGN VEHICLE WB-67
 I-5, DESIGN MATRIX 1



WSDOT NORTHWEST REGION
CHANNELIZATION PLAN

Approved _____ Date _____
Area Traffic Engineer

Approved _____ Date _____
Area Engineering Manager

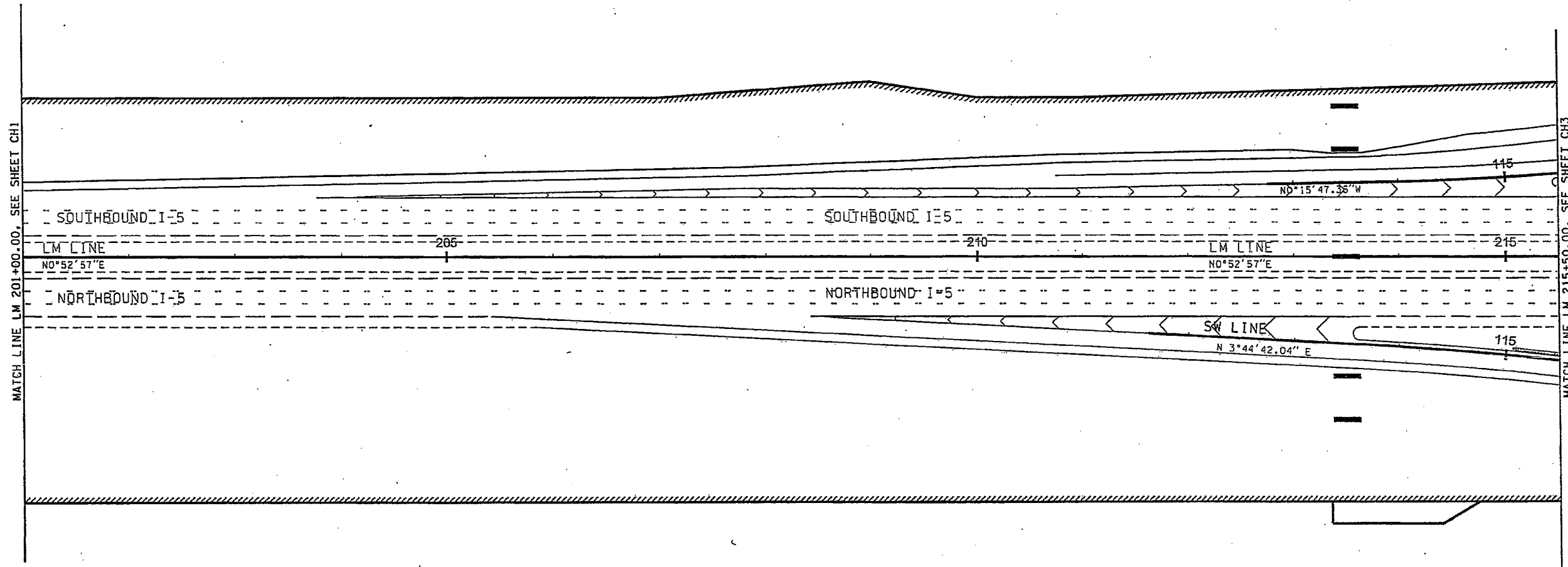
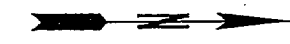
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TIME	9:33:12 AM			10	WASH					CH1
DATE	7/27/2005			JOB NUMBER		LOCATION NO.				SHEET
DESIGNED BY	S. RUSTAGI			CONTRACT NO.						OF
ENTERED BY	M. BENSON									SHEETS
CHECKED BY	R. FENTON									
PROJ. ENGR.										
REGIONAL ADM.		REVISION	DATE	BY						

Parametrix APDR 554-1598-026/03(05) 7/05 (B)

Figure E-2
Proposed I-5 / 116th Street NE
Interchange Improvements

CURVE DATA					
P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH	S
SW 114+63.05	3°51'34" RT	3000.00	101.08	202.08	4%

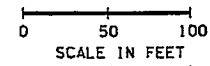
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WSDOT NORTHWEST REGION
CHANNELIZATION PLAN

Approved _____ Date _____
Area Traffic Engineer

Approved _____ Date _____
Area Engineering Manager

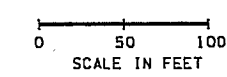
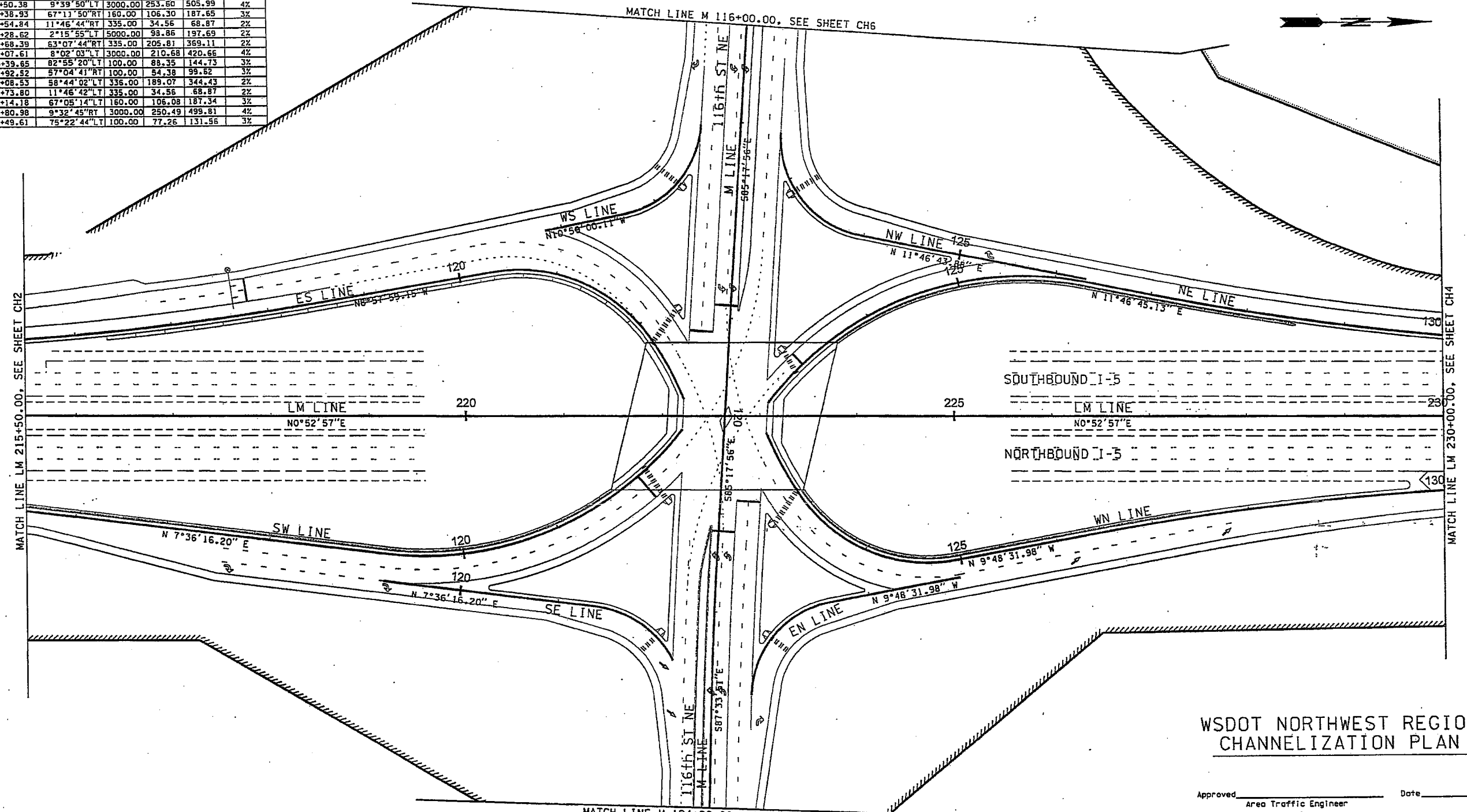


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TIME	9:30:34 AM	JOB NUMBER		CONTRACT NO.		LOCATION NO.					CH 2	
DESIGNED BY	S. RUSTAGI	PROJ. ENGR.		REGIONAL ADM.		REVISION		DATE		BY		SHEET
ENTERED BY	M. BENSON											OF
CHECKED BY	R. FENTON											SHEETS
PARAMETRIX APDR 554-1598-026/03(05) 7/05 (B)												

Figure E-3
Proposed I-5 / 116th Street NE
Interchange Improvements

P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH	S
EN 123+03.78	77°19'53"RT	100.00	79.90	134.82	3%
ES 116+50.38	9°39'50"LT	3000.00	253.60	505.99	4%
ES 121+38.93	67°11'50"RT	160.00	106.30	187.65	3%
ES 122+54.84	11°46'44"RT	335.00	34.56	68.87	2%
M 122+28.62	2°15'55"LT	5000.00	98.86	197.69	2%
NE 124+68.39	63°07'44"RT	335.00	205.81	369.11	2%
NE 129+07.61	8°02'03"LT	3000.00	210.68	420.66	4%
NW 123+39.65	82°55'20"LT	100.00	88.35	144.73	3%
SE 121+92.52	57°04'41"RT	100.00	54.38	99.62	3%
SW 121+08.53	58°44'02"LT	335.00	189.07	344.43	2%
WN 122+73.80	11°46'42"LT	335.00	34.56	68.87	2%
WN 124+14.18	67°05'14"LT	160.00	106.08	187.34	3%
WN 128+80.98	9°32'45"RT	3000.00	250.49	499.81	4%
WS 122+49.61	75°22'44"LT	100.00	77.26	131.56	3%

SEC 8, T.30N.R.5E.W.M.



WSDOT NORTHWEST REGION
CHANNELIZATION PLAN

Approved _____ Date _____
Area Traffic Engineer

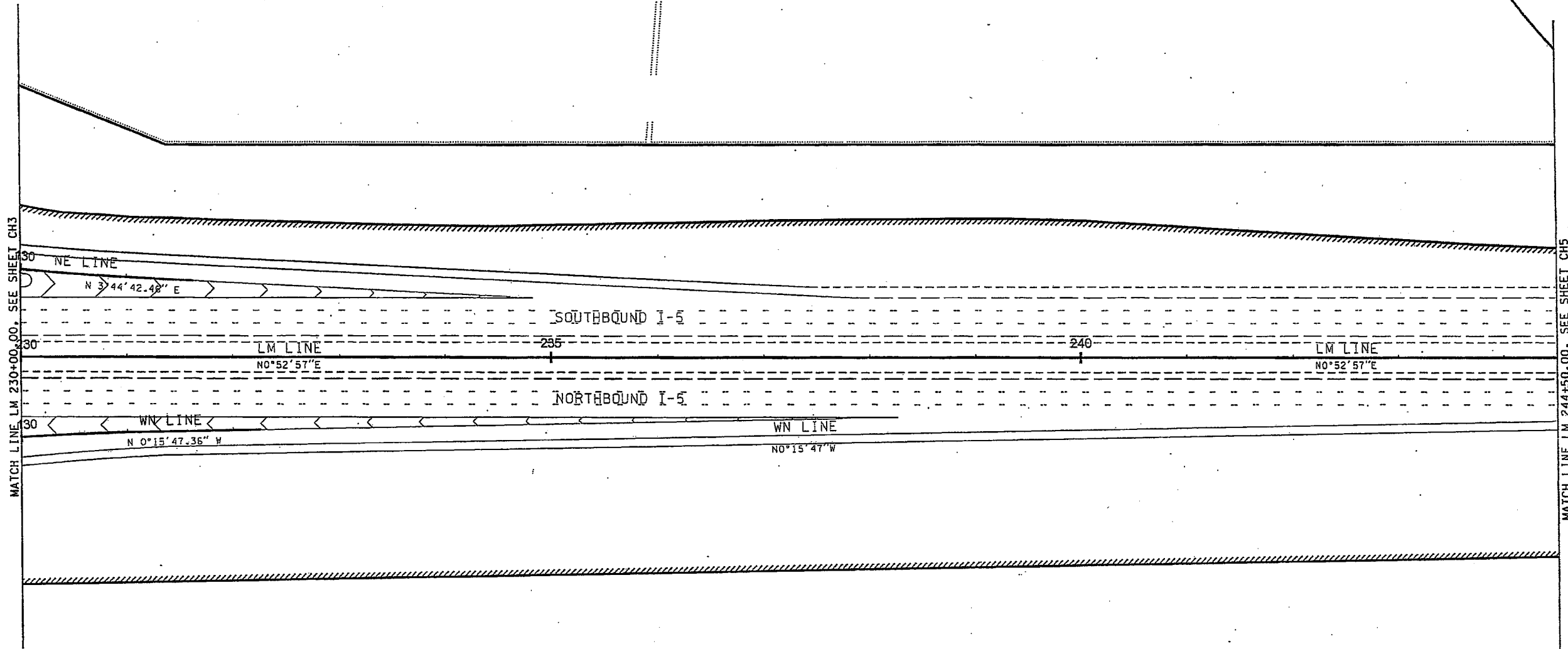
Approved _____ Date _____
Area Engineering Manager

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DATE	7/27/2005	JOB NUMBER			Parametrix ENGINEERING INC.	CHANNELIZATION PLAN	SHEET OF SHEETS
DESIGNED BY	S. RUSTAGI	CONTRACT NO.					
ENTERED BY	M. BENSON	LOCATION NO.					
CHECKED BY	L. LARSON						
PROJ. ENGR.							
REGIONAL ADM.							
REVISION		DATE	BY				

Parametrix APDR 554-1598-026/03(05) 7/05 (B)

Figure E-4
Proposed I-5 / 116th Street NE
Interchange Improvements

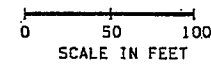
SEC 8, T.30N.R.5E.W.M.



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CHANNELIZATION PLAN

Approved _____ Date _____
Area Traffic Engineer

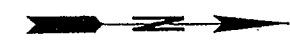
Approved _____ Date _____
Area Engineering Manager



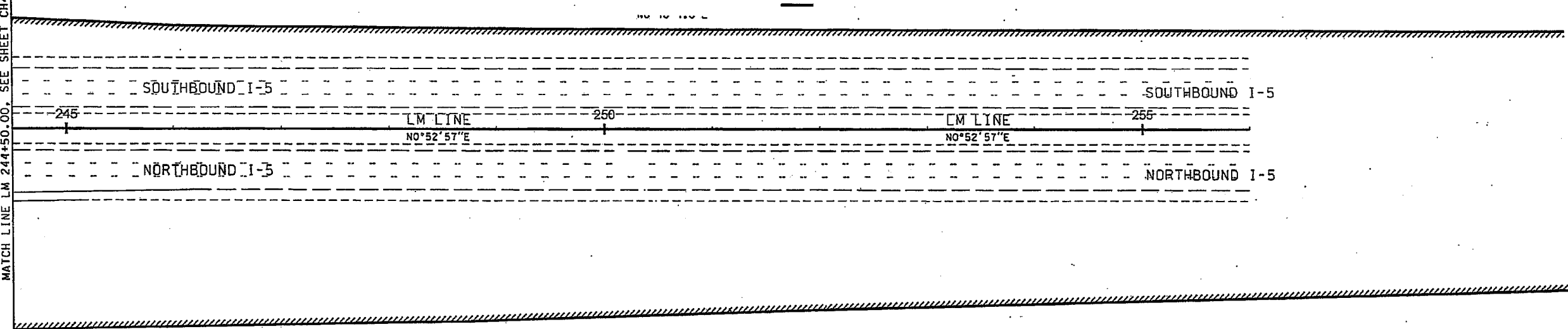
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DATE	7/27/2005	DESIGNED BY	S. RUSTAGI	ENTERED BY	M. BENSON	CHECKED BY	R. FENTON	PROJ. ENGR.			
REGIONAL ADM.		REVISION		DATE		BY					

Figure E-5
Proposed I-5 / 116th Street NE
Interchange Improvements

SEC 8, T.30N.R.5E.W.M.



MATCH LINE L.M. 244+50.00, SEE SHEET CH4



WSDOT NORTHWEST REGION
CHANNELIZATION PLAN

Approved _____ Date _____
Area Traffic Engineer

Approved _____ Date _____
Area Engineering Manager

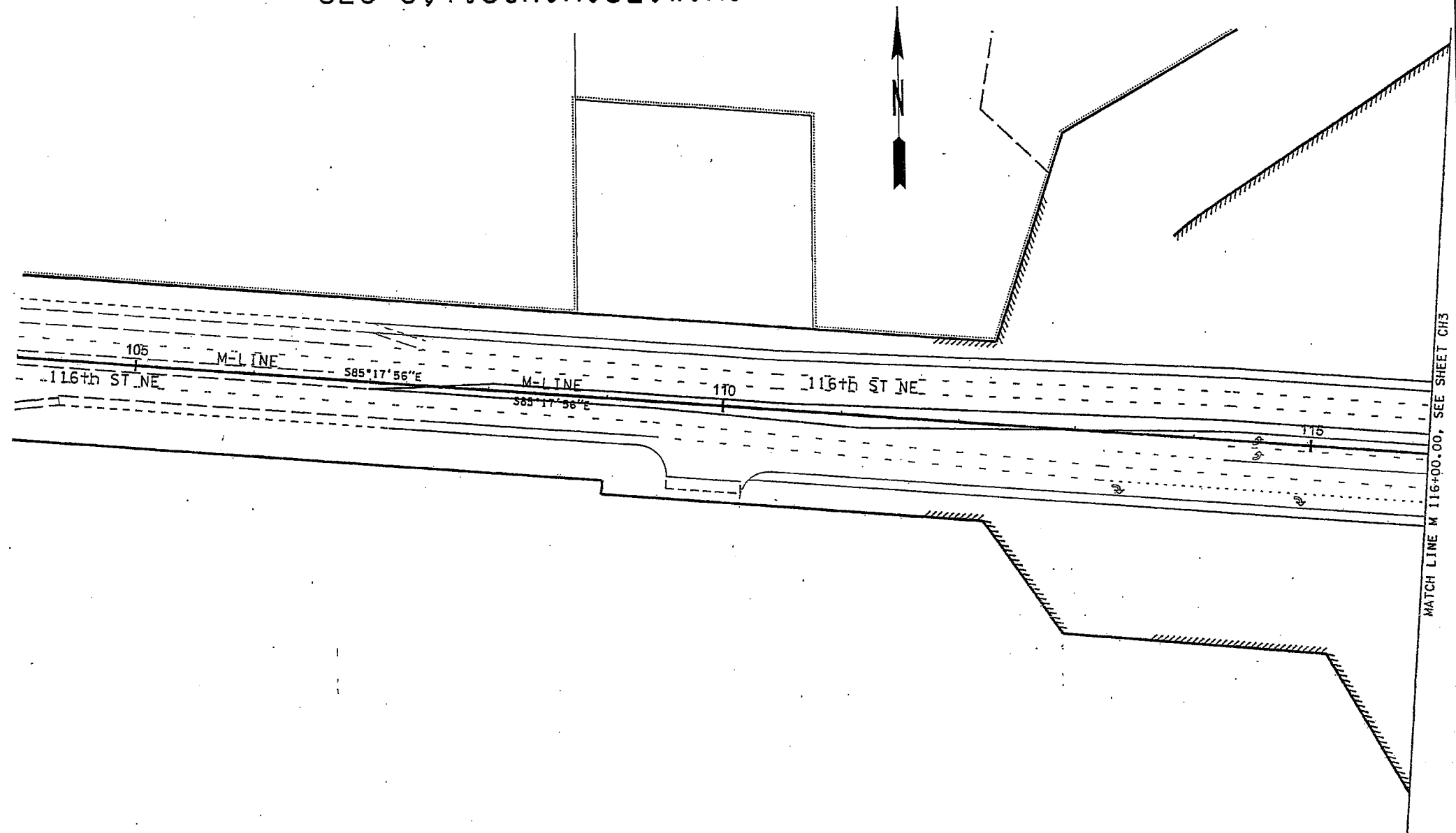
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ENTERED BY	M. BENSON							SHEETS
CHECKED BY	R. FENTON							
PROJ. ENGR.								
REGIONAL ADM.		REVISION	DATE	BY			CHANNELIZATION PLAN	

Parametrix APDR 554-1598-026/03(05) 7/05 (B)

Figure E-6
Proposed I-5 / 116th Street NE
Interchange Improvements

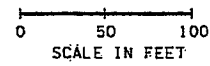
SEC 8, T.30N.R.5E.W.M.



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Area Traffic Engineer

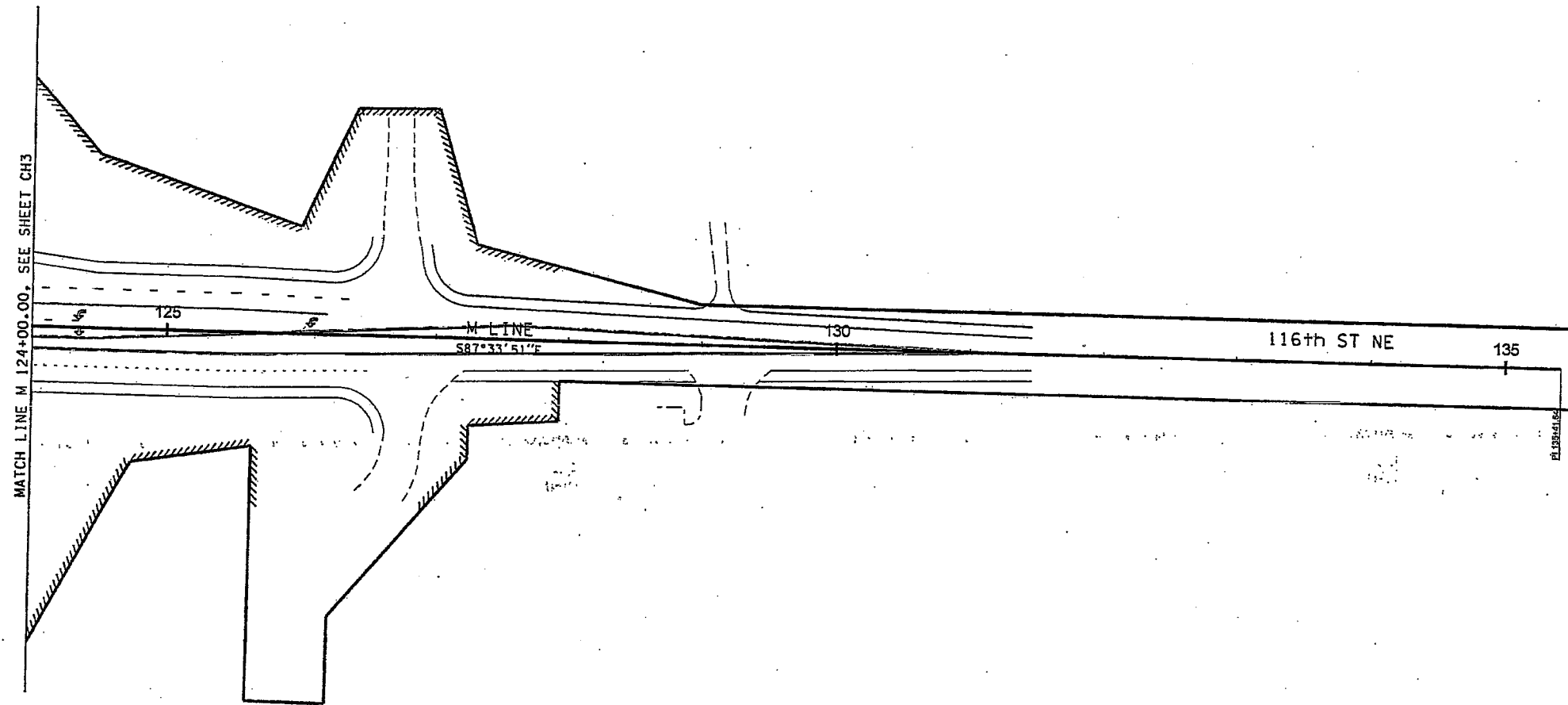
Approved _____ Date _____
Area Engineering Manager



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DATE	7/27/2005	DESIGNED BY	S. RUSTAGI	PROJ. ENGR.	R. FENTON	REVISION	DATE	BY			SHEETS	

Figure E-7
Proposed I-5 / 116th Street NE
Interchange Improvements

SEC 8, T.30N. R.5E. W.M.



WSDOT NORTHWEST REGION
CHANNELIZATION PLAN

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Area Traffic Engineer

Approved _____ Date _____
Area Engineering Manager

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SCALE IN FEET

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CHECKED BY	R. FENTON									
PROJ. ENGR.										
REGIONAL ADM.				REVISION	DATE	BY			CHANNELIZATION PLAN	

Figure E-8
Proposed I-5 / 116th Street NE
Interchange Improvements

1. INTRODUCTION

1.1 PURPOSE

This report describes the justifications for improving the interchange of 116th Street NE and Interstate 5 (I-5). It includes a technical analysis supporting these justifications and demonstrates that the proposed facility will operate efficiently for both the year of opening (2009) and the forecasted design year (2030).

1.2 EXISTING CORRIDOR

I-5 is a major interstate highway that allows people and goods to move throughout the region, connecting Oregon, Washington, and California. There are two east/west state routes that connect to I-5 in the vicinity of 116th Street NE: State Route (SR) 531 (172nd Street NE), located approximately 3.6 miles north of the interchange with 116th Street NE, and SR 528 (4th Street), located approximately 3 miles south. In addition to these interchanges, there is an interchange with 88th Street NE located approximately 1.7 miles south of the 116th Street NE interchange. Figure 1-1 shows the existing regional transportation network.

1.3 EXISTING INTERCHANGE

The 116th Street NE interchange is located at milepost 202.47 on I-5 and is targeted for the improvements described in this Access Point Decision Report (APDR). The interchange currently has a conventional diamond configuration, with traffic signals at the northbound and southbound ramp intersections with 116th Street NE. A three-lane structure over the I-5 mainline provides a connection between the northbound and southbound ramps and allows for access east and west of the interchange (Figure 1-2).

1.4 PREFERRED ALTERNATIVE

Over a dozen alternatives were developed to provide additional capacity at the 116th Street NE interchange. These alternatives were screened down to three alternatives for further analysis, and a preferred alternative was selected in July 2003. A description of the three alternatives is provided in Policy Point 3, Reasonable Alternatives. The selection of the preferred alternative was revisited at the end of 2004 to ensure that recent developments in interchange design (tight urban diamond interchanges), changes in proposed land uses/local comprehensive plans, or delayed opening dates did not change the conclusions for selection of the preferred alternative.

The preferred alternative would convert the existing 116th Street NE conventional diamond interchange to a single point urban interchange (SPUI). This new configuration would improve access to the regional arterial system without significant impacts to surrounding residential and business areas. In addition, the access improvements would help alleviate upstream traffic congestion and delays anticipated to arise from employment and population growth. Figures 1-3 through 1-9 show the proposed layout of the SPUI.

The preferred alternative also includes the extension of Quil Ceda Boulevard from 116th Street NE north and east to connect with 34th Avenue NE, approximately 2,000 feet north of 116th Street NE and a reconfiguration of 34th Avenue NE to accommodate right-in and right-out movements only at 116th Street NE. These changes will alleviate the existing conflicts on 116th Street NE between the 34th Avenue NE intersection and the southbound ramp terminals.

1.4.1 I-5 Northbound

The northbound I-5 mainline alignment would remain unchanged. The proposed northbound off-ramp would continue to be a single lane, but would flare out to three lanes (two left-turn lanes and one right-turn lane) at the terminal. The northbound on ramp would be two lanes at the terminal, tapering to a single

lane on-connection. Figures 1-3 through 1-7 shows the proposed channelization on the northbound on- and off-ramps at the 116th Street NE interchange.

1.4.2 I-5 Southbound

The southbound I-5 mainline alignment would remain unchanged. The proposed southbound off-ramp would continue to be a single lane, but would flare out to two lanes (one left-turn lane and one right-turn lane) at the terminal. The southbound on ramp would be two-lanes at the terminal, tapering to a single lane on-connection with I-5. Ramp metering and an inside HOV bypass lane are also proposed. Figures 1-3 through 1-7 show the proposed channelization on the southbound on- and off-ramps at the interchange.

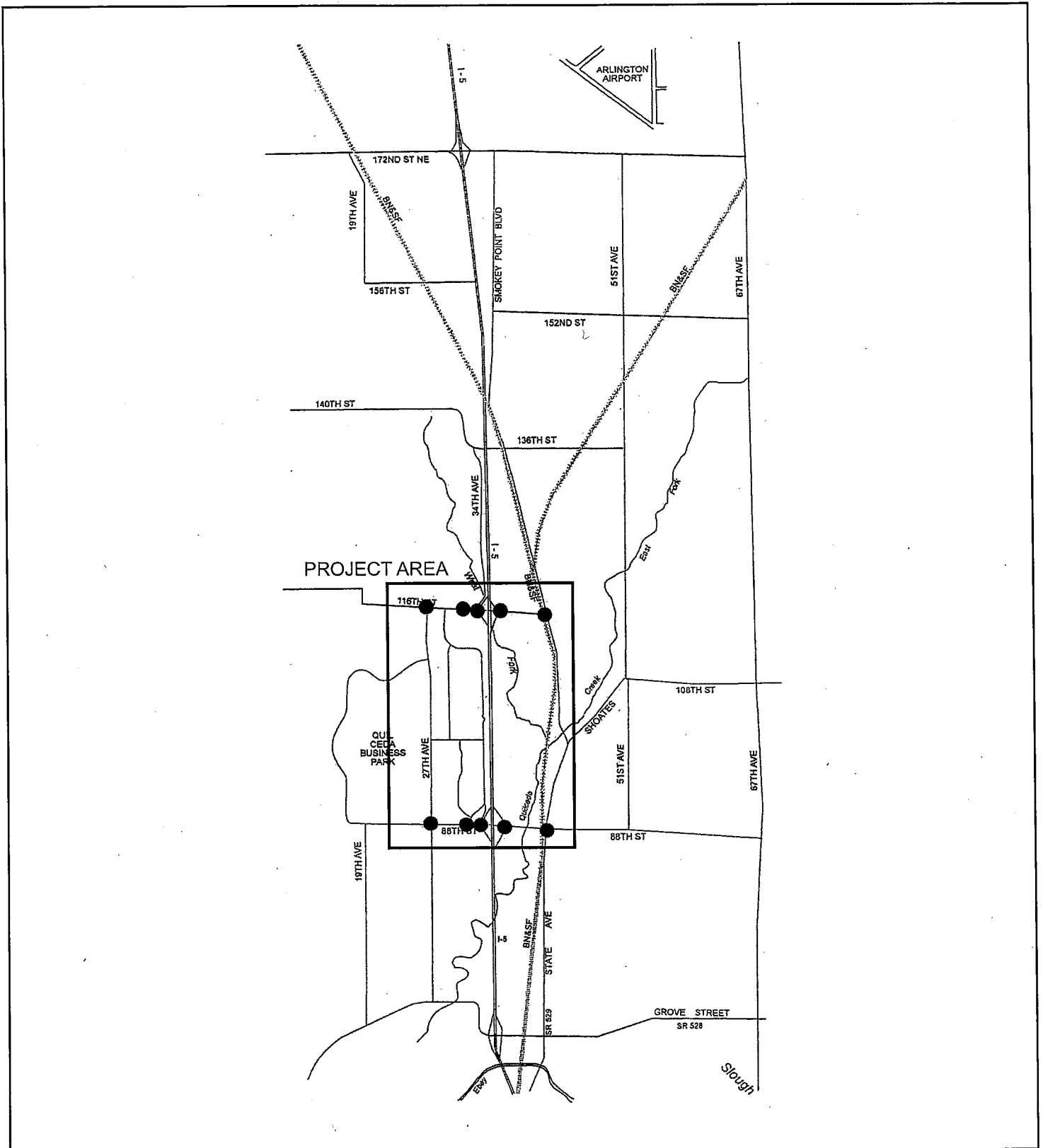
1.5 REPORT OVERVIEW

This report follows the standard APDR format suggested by the Federal Highway Administration (FHWA). The following is a list of the policy topics included in this report, referred to as *policy points*.

- Policy Point 1: Future Interchanges
- Policy Point 2: Land Use and Transportation Plan
- Policy Point 3: Reasonable Alternatives
- Policy Point 4: Need for the Access Point Revision
- Policy Point 5: Access Connections and Design
- Policy Point 6: Operational and Accident Analyses
- Policy Point 7: Coordination
- Policy Point 8: Planning and Environmental Processes

Report Appendices A through E include:

- First and Second Level Screening Backup Memos and Tables
- Meeting Minutes
- Traffic Analysis and Traffic Volume Forecasting Memos
- Intersection Level of Service Calculation Sheets (Synchro 5.0 Software)
- Freeway Level of Service Calculation Sheets (Highway Capacity Software)

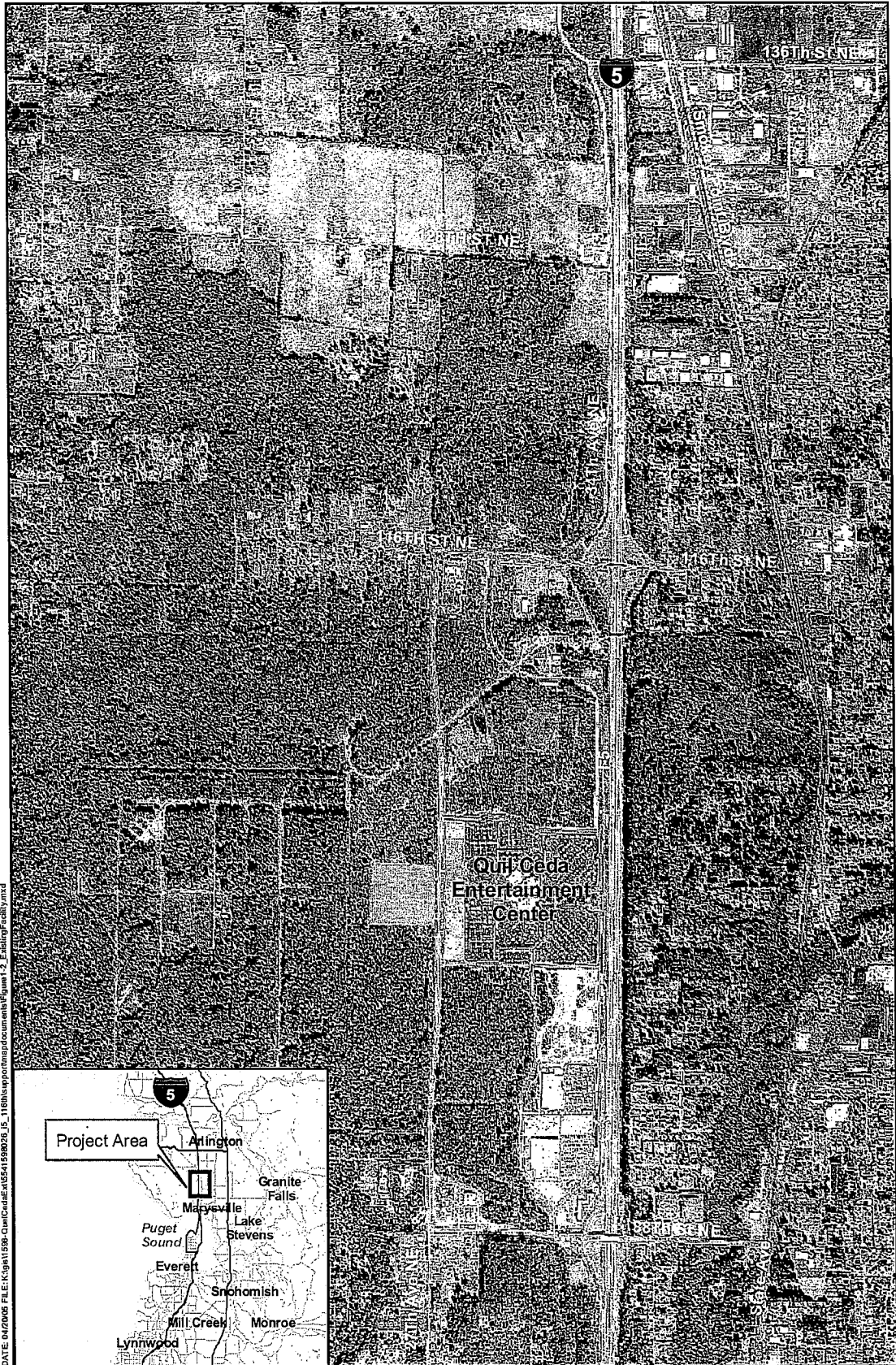


Parametrix 554-1596-017/08(103) 4/05 (B)

Note:

- Intersections Analyzed

Figure 1-1
Regional Highways
and Arterial Network



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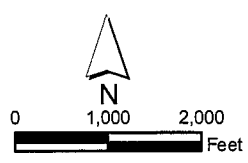
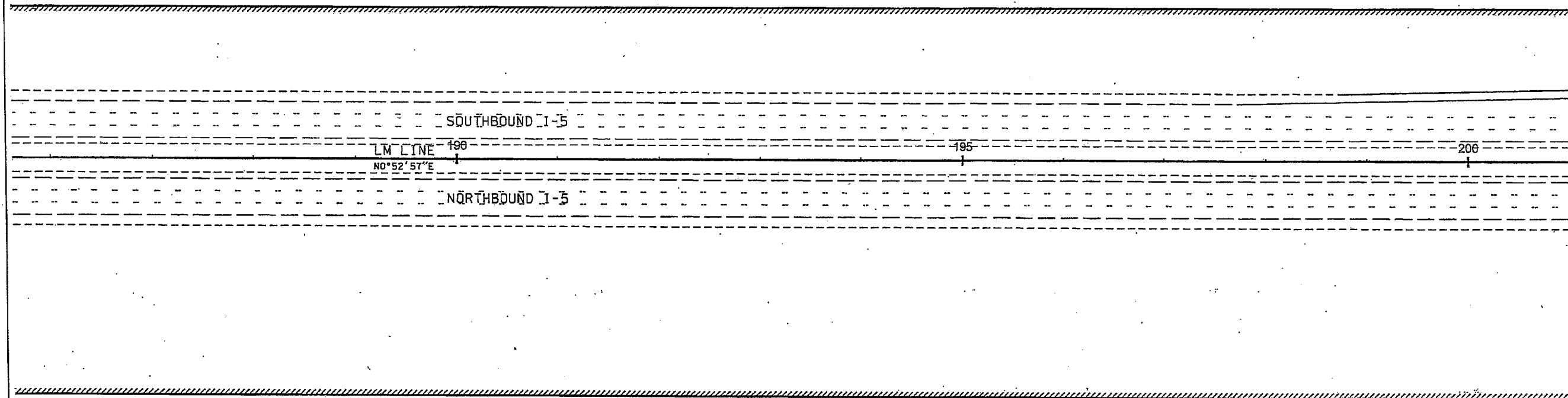


Figure 1-2
Existing Facility

SEC 8, T.30N.R.5E.W.M.

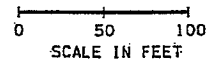


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DESIGN PARAMETERS

	I-5	RAMPS	116TH STREET NE
FUNCTIONAL CLASS	P-1 (NHS)	-	URBAN MINOR ARTERIAL
DESIGN SPEED	80 MPH	70 MPH *	40 MPH
POSTED SPEED	70 MPH	N/A	35 MPH **

* DESIGN SPEED 25 MPH AT SPUI INTERSECTION
 ** SNOHOMISH COUNTY DESIGN STANDARDS
 DESIGN VEHICLE WB-67
 I-1, DESIGN MATRIX 1



**WSDOT NORTHWEST REGION
CHANNELIZATION PLAN**

Approved _____ Date _____
 Area Traffic Engineer

Approved _____ Date _____
 Area Engineering Manager

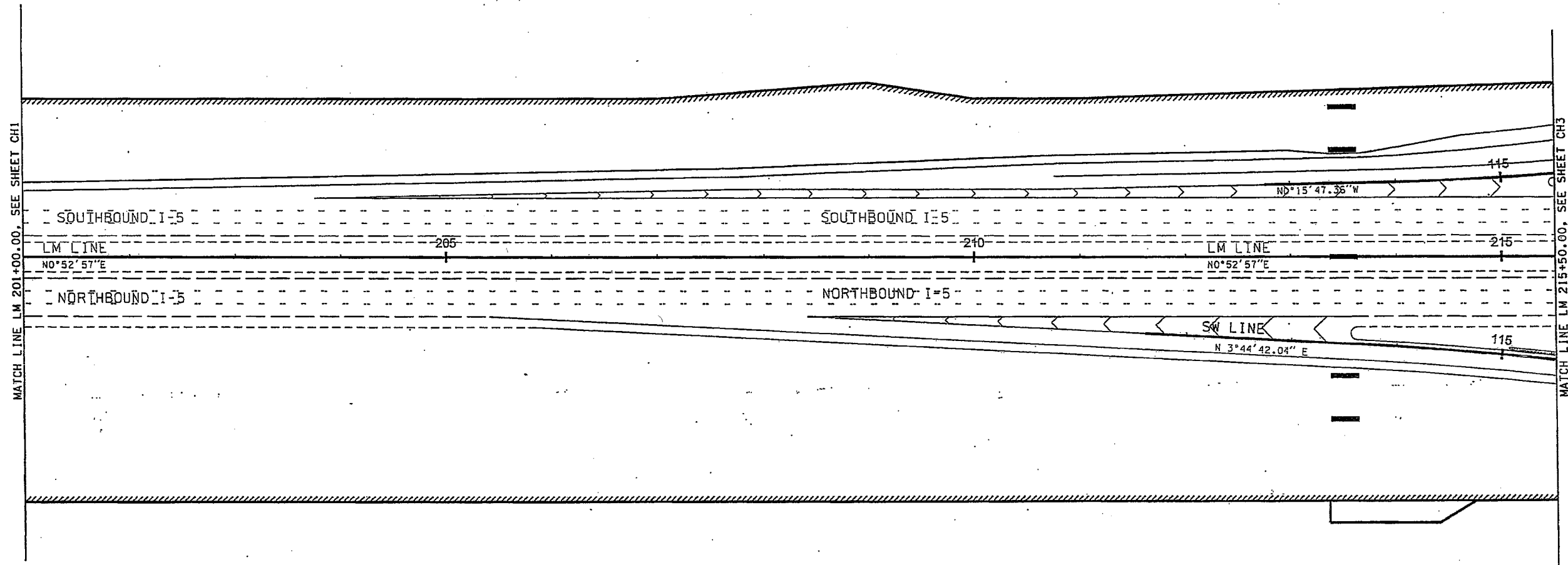
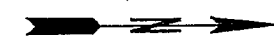
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CHECKED BY R. FENTON	PROJ. ENGR.	REVISION		LOCATION NO.		CHANNELIZATION PLAN		OF	
REGIONAL ADM.		DATE	BY	P.E. STAMP BOX				SHEETS	

Parametrix APDR 554-1598-026/03(05) 7/05 (B)

**Figure 1-3
Proposed I-5 / 116th Street NE
Interchange Improvements**

CURVE DATA					
P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH	S
SW 114+63.05	3°51'34" RT	3000.00	101.08	202.08	4%

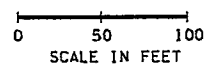
SEC 8, T.30N. R.5E. W.M.



WSDOT NORTHWEST REGION
CHANNELIZATION PLAN

Approved _____ Date _____
Area Traffic Engineer

Approved _____ Date _____
Area Engineering Manager



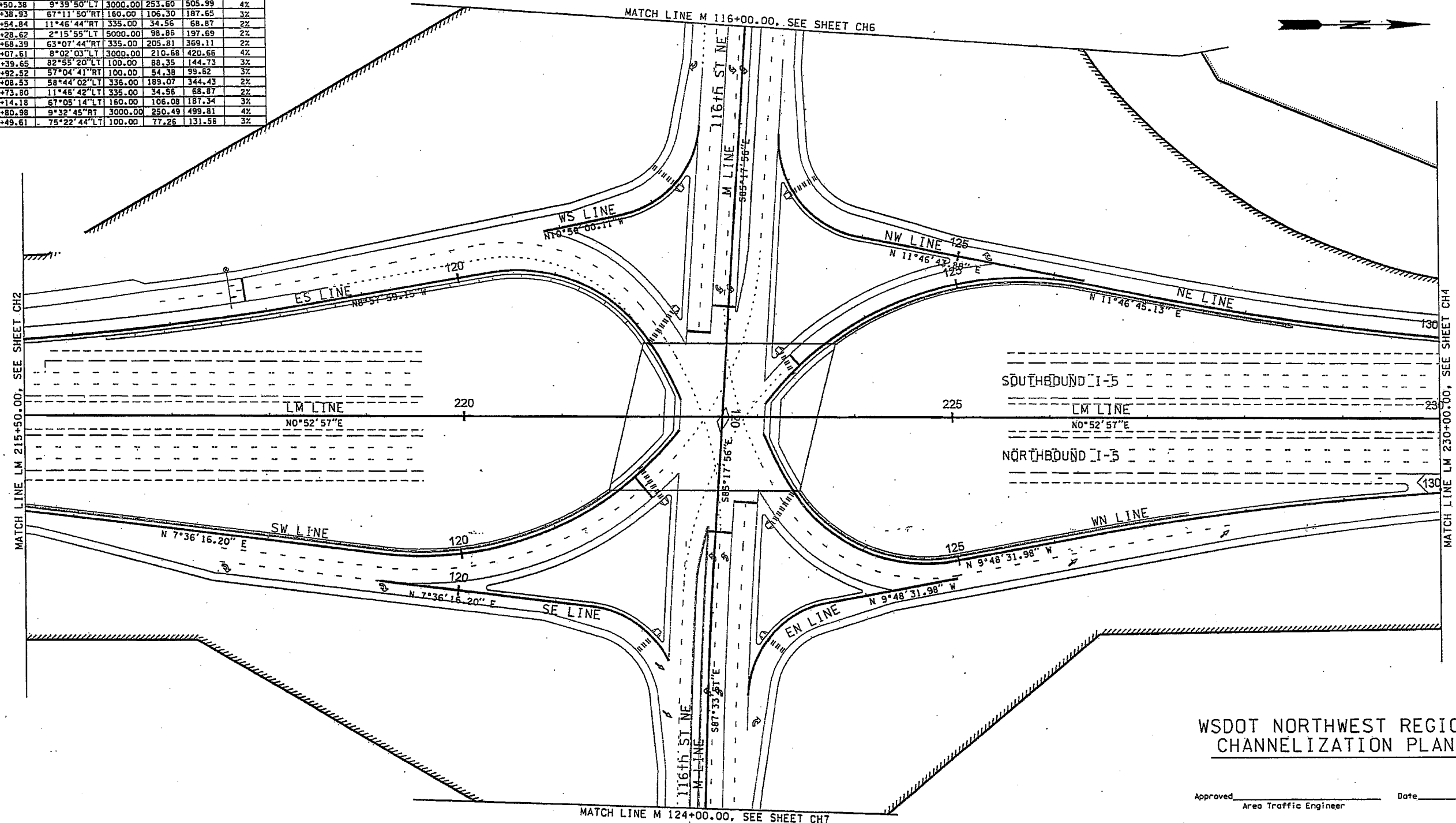
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Parametrix APDR 554-1598-026/03(05) 7/05 (B)

Figure 1-4
Proposed I-5 / 116th Street NE
Interchange Improvements

SEC 8, T.30N.R.5E.W.M.

CURVE DATA					
P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH	S
EN 123+03.78	77°19'53"RT	100.00	79.90	134.82	3%
ES 116+50.38	9°39'50"LT	3000.00	253.60	505.99	4%
ES 121+38.93	67°11'50"RT	160.00	106.30	187.65	3%
ES 122+54.84	11°46'44"RT	335.00	34.56	68.87	2%
M 122+28.62	2°15'55"LT	5000.00	98.86	197.69	2%
NE 124+68.39	63°07'44"RT	335.00	205.81	369.11	2%
NE 129+07.61	8°02'03"LT	3000.00	210.68	420.66	4%
NW 123+39.65	82°55'20"LT	100.00	88.35	144.73	3%
SE 121+92.52	57°04'41"RT	100.00	54.38	99.62	3%
SW 121+08.53	58°44'02"LT	335.00	189.07	344.43	2%
WN 122+73.80	11°46'42"LT	335.00	34.56	68.87	2%
WN 124+14.18	67°05'14"LT	160.00	106.08	187.34	3%
WN 128+80.98	9°32'45"RT	3000.00	250.49	499.81	4%
WS 122+49.61	75°22'44"LT	100.00	77.26	131.56	3%



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CHANNELIZATION PLAN

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Area Traffic Engineer

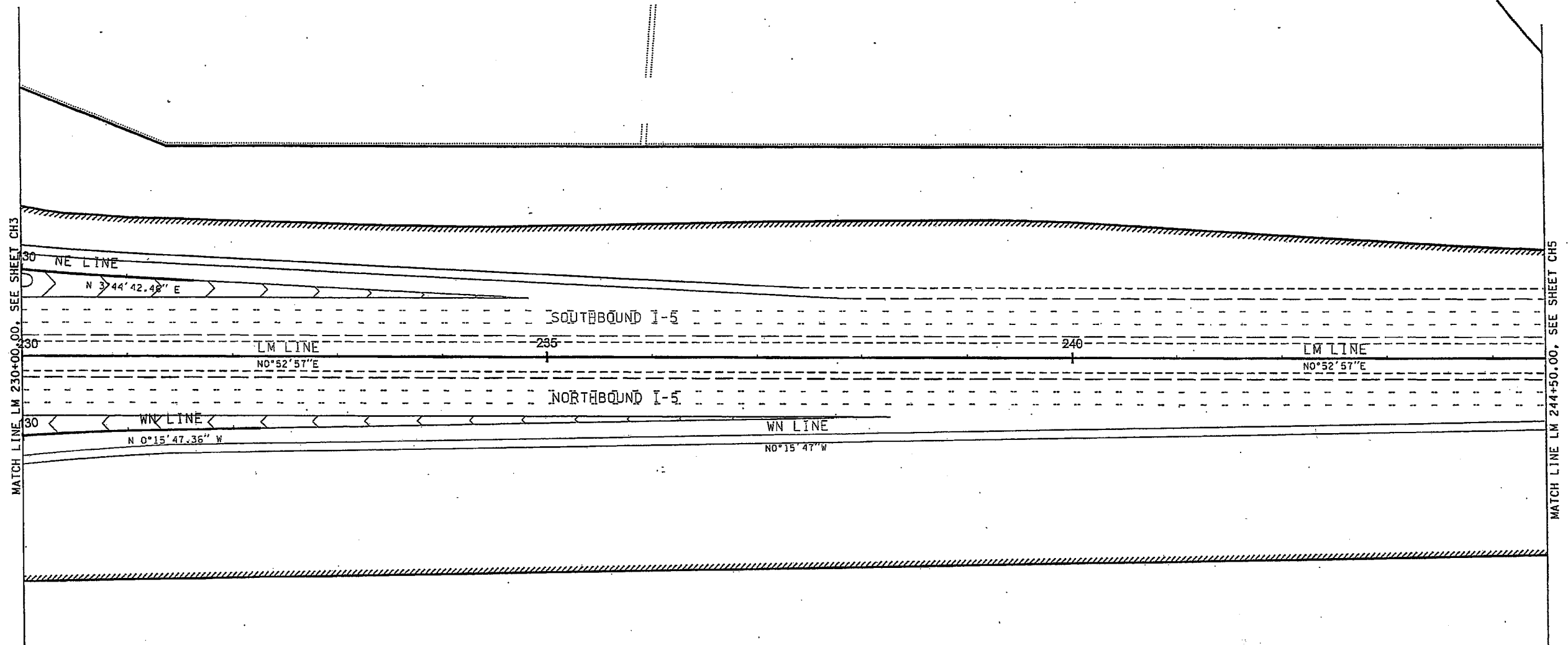
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Area Engineering Manager

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DESIGNED BY	S. RUSTAGI	CHECKED BY	L. LARSON	REVISION		DATE				
ENTERED BY	M. BENSON	REGIONAL ADM.		DATE		BY				

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Figure 1-5
Proposed I-5 / 116th Street NE
Interchange Improvements

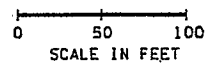
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CHANNELIZATION PLAN

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Area Traffic Engineer

Approved _____ Date _____
Area Engineering Manager

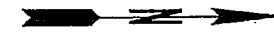


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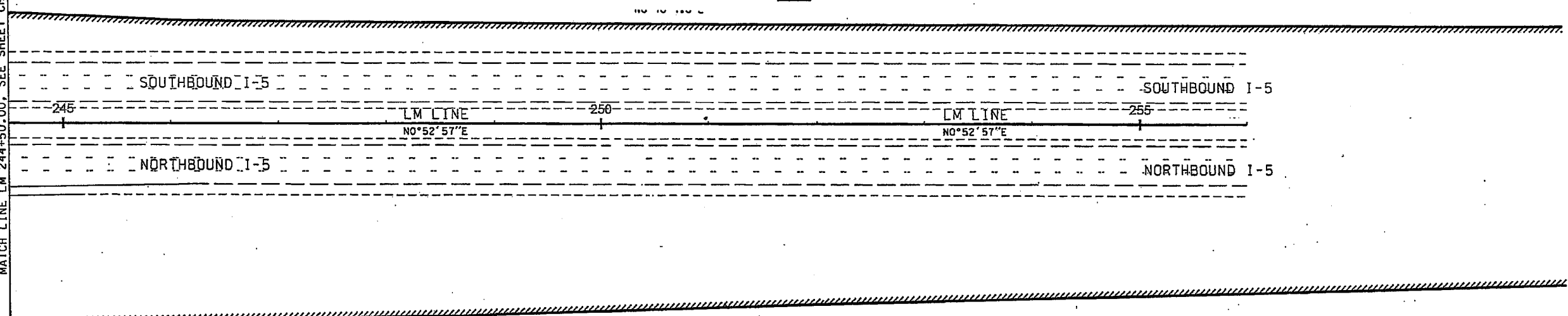
Parametrix APDR 554-1598-026/03(05) 7/05 (B)

Figure 1-6
Proposed I-5 / 116th Street NE
Interchange Improvements

SEC 8, T.30N. R.5E. W.M.



MATCH LINE L.M. 244+50.00, SEE SHEET CH4



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Approved _____ Date _____
Area Traffic Engineer

Approved _____ Date _____
Area Engineering Manager

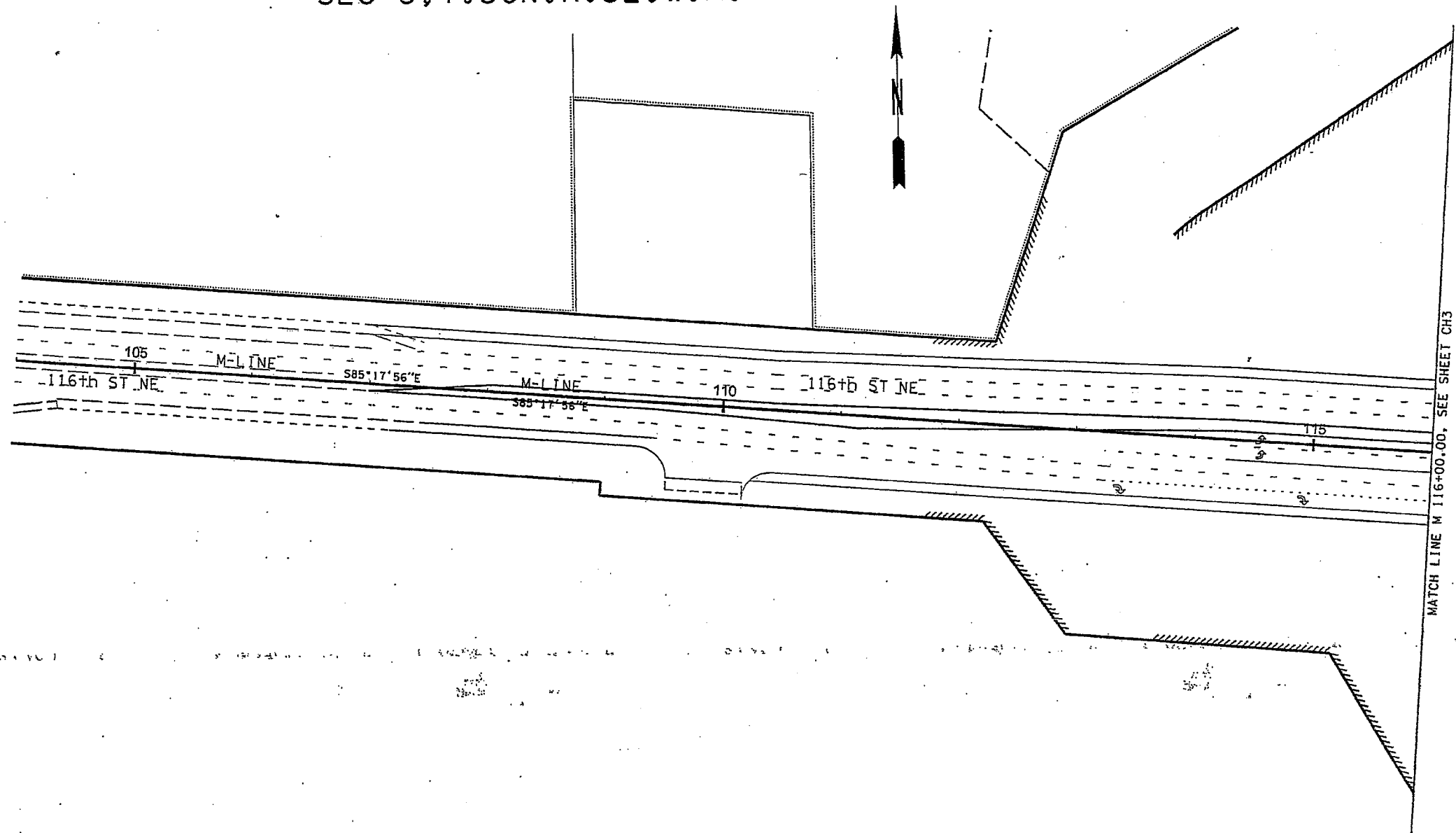
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CHECKED BY	R. FENTON			CONTRACT NO.		LOCATION NO.	
PROJ. ENGR.							
REGIONAL ADM.	REVISION	DATE	BY	EXPIRES	DATE		

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Figure 1-7
Proposed I-5 / 116th Street NE
Interchange Improvements

SEC 8, T.30N. R.5E. W.M.

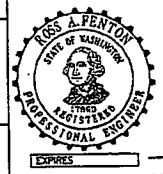



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Area Engineering Manager

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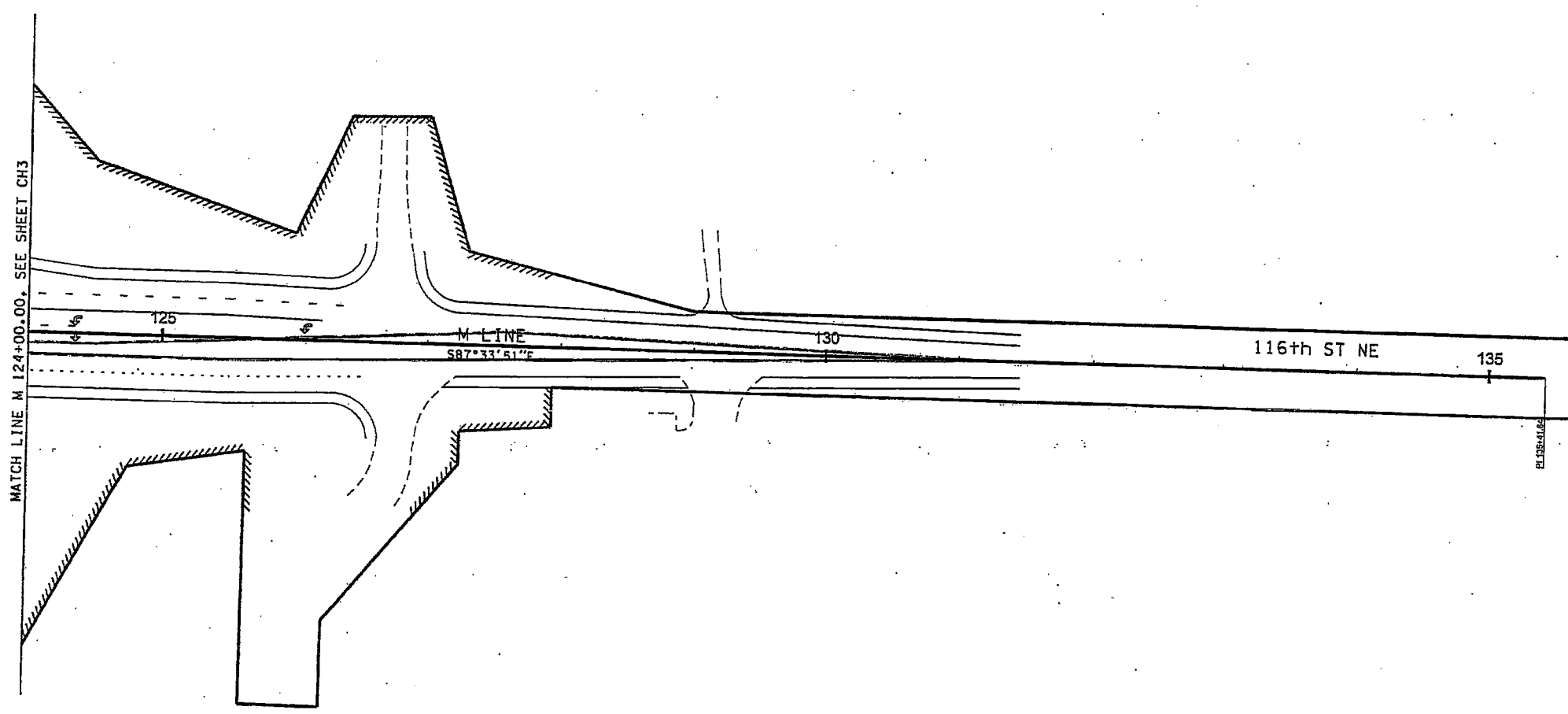
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ENTERED BY	M. BENSON			LOCATION NO.						SHEETS
CHECKED BY	R. FENTON									
PROJ. ENGR.										
REGIONAL ADM.		REVISION	DATE	BY						

HDR Parametrix
ENGINEERING INC.

CHANNELIZATION PLAN

Figure 1-8
Proposed I-5 / 116th Street NE
Interchange Improvements

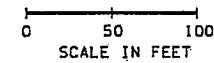
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Area Engineering Manager



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ENTERED BY	M. BENSON	LOCATION NO.						SHEETS
CHECKED BY	R. FENTON							
PROJ. ENGR.								
REGIONAL ADM.								
	REVISION	DATE	BY					

Figure 1-9
Proposed I-5 / 116th Street NE
Interchange Improvements

2. POLICY POINT 1: FUTURE INTERCHANGES

Is the proposed access point revision compatible with a comprehensive network plan?

The I-5/116th Street NE Interchange Project includes the area of I-5 between milepost (MP) 202.06 and MP 202.87 and 116th Street between Quil Ceda Boulevard and 36th Avenue NE. The 116th Street NE/I-5 undercrossing bridge is located at I-5 MP 202.47. Proposed interchange improvements cover a distance of approximately 0.5 mile south of the bridge to 0.5 mile north of the bridge. The cross-road improvements cover a distance of approximately 0.23 mile west of the interchange and 0.14 mile east of the interchange. I-5/116th Street NE interchange improvements are included in PSRC's regional transportation improvement plan (TIP).

The I-5 interchanges adjacent to 116th Street NE (MP 202.47) are the 172nd Street NE/SR 531 interchange (MP 206.20), located 3.6 miles to the north, and the 88th Street NE interchange (MP 200.78), located 1.7 miles to the south. The improvements to 116th Street NE are not expected to significantly affect traffic volumes using any of the three interchanges or the sections of I-5 between them. The improvements to the interchange do not change the overall access opportunities of the transportation network in this area. The improvements would not be anticipated to change traffic volumes at the 172nd Street NE/SR 531 and 88th Street NE interchanges. Even after project completion, the distances to adjacent interchanges far exceed the operational influence areas of merging/diverging (1,500 feet) and weaving (2,500 feet). No new interchanges are proposed in the vicinity of the I-5/116th Street NE interchange. Capacity and safety improvements are under construction for the 172nd Street NE interchange, located 3.6 miles north of the 116th Street NE interchange. Development is continuing within and around Arlington, along the east side of the freeway, and unincorporated Snohomish County is growing to the east and north of this interchange. This expansion has resulted in the determination that the existing 172nd Street NE interchange is inadequate to serve the current and projected growth in the region. Design for the interim project, which includes the removal and replacement of the existing two-lane bridge with a six-lane bridge and ramp improvements, was completed in May 2004 and construction began August 16, 2004. Construction of these interim improvements is expected to be complete in October 2005. The complete long-range project is in design and has been allocated \$900,000 from the State's 2005 Transportation Partnership Account for the 2005 – 2009 biennium. This project is viewed as a regional transportation improvement and does appear on the regional and local comprehensive plans. The proposed 116th Street NE interchange improvements would not substantially affect nor be affected by the improvements proposed at the 172nd NE interchange.

3. POLICY POINT 2: LAND USE AND TRANSPORTATION PLANS

Is the proposed access point revision compatible with all land use and transportation plans for the area?

WSDOT requires that the proposed interchange improvements be consistent with local and regional land use and transportation plans. Those plans, and their applicability to this project, are discussed in this section.

3.1 LAND USE

The Washington State Office of Fiscal Management projects that Snohomish County's population (<http://www.ofm.wa.gov/pop/gma/countypop.pdf>) will increase to approximately 1,063,000 by 2025, an increase of more than 450,000, or 75 percent, from the 2000 population of 606,000. The population of the Tulalip/Marysville/Arlington area is projected by the Puget Sound Regional Council (PSRC) to grow from about 75,000 to 135,000, about 76 percent, by 2030. Employment in the area is projected to increase by 50 percent, from about 23,000 to about 34,000 jobs. (These projections do not, however, consider the growth potential of the Tulalip Tribes Quil Ceda Business Park).

The 2,000-acre Quil Ceda Business Park houses a 227,000 square-foot casino, two large retail stores, a smaller retail complex, and Tulalip Bingo. A 500,000 square-foot outlet mall is scheduled to open in May 2005. The initial phase of business park development was recently completed on approximately 635 acres adjacent to the west side of I-5, just south of 116th Street NE. Designated uses include retail and casino, office, light industrial, distribution, warehousing, and a destination resort. Later phases include adding areas for office and light industrial use with a development capacity of over 6.7 million square feet.

The City of Marysville has currently designated the 116th Street NE corridor for community business development as part of a master plan and has zoned over 1,000 acres for industrial use north of 123rd Street, between I-5 and 43rd Avenue NE. Most of this area is currently undeveloped. The zoning capacity of this area is several million square feet of potential commercial and industrial development.

The proposed improvements to the interchange will provide the additional capacity to accommodate the traffic growth resulting from increased population and employment in the area that is already identified in the adjacent cities' comprehensive plans.

3.1.1 Washington State Growth Management Act

The Washington State Growth Management Act requires the development of transportation infrastructure that provides adequate capacity to serve projected growth at a locally defined level of service. Local agencies must prohibit development if it causes a local transportation facility to decline below the standards adopted in the transportation element of the comprehensive plan (RCW36.70A.070(6)(b)). This concurrency standard does not apply to state highways.

3.1.2 Puget Sound Regional Council Vision 2020

PSRC adopted Vision 2020 (PSRC 1995), the Puget Sound region's long-range growth management, economic, and transportation strategy. The plan calls for growth containment, preventing urban sprawl from extending into surrounding farmlands, and preserving open space. The PSRC plans to concentrate new employment in major activity centers connected by a regional multi-modal transportation system.

3.1.3 City of Marysville Comprehensive Plan

The east side of I-5 in the project area is within the City of Marysville. Although zoned community business, both the north and south sides of 116th Street NE on the east side of I-5 are primarily single-family residential. With the exception of the freeway service zone under the jurisdiction of the Washington State Department of Transportation (WSDOT), the City of Marysville controls zoning throughout the entire project area on the east side of I-5. This area falls within the 116th Street NE planning area, and is zoned for a mixture of community business, single family, neighborhood business, and freeway service. The Comprehensive Plan designations are further defined as mixed use, multi-family, freeway service, and commercial business (City of Marysville 2001). The freeway service zone includes the area on the east side of I-5 between 116th Street NE on the south and 120th Street NE on the north and 36th Drive NE on the east.

The City of Marysville is currently in the process of updating its Comprehensive Plan to be adopted in April 2005. The 2004 Draft Comprehensive Plan includes the widening of 116th Street NE to five lanes from I-5 to State Avenue, and the addition of an eastbound right-turn lane at State Avenue. Additionally, the city has written a letter of support for the 116th Street NE interchange improvement and is in the process of adding the interchange to the transportation element of their comprehensive plan.

3.1.4 Tulalip Comprehensive Plan

The west side of I-5 in the project area is within the Tulalip Indian Reservation and is under the jurisdiction of the Tulalip Tribes as tribal trust and tribal member land. The Snohomish County Zoning Map shows this land to be zoned Tribal Trust Land, and the Tulalip zoning map designates this land as rural and commercial. The area north of 116th Street NE is primarily commercial. Just south of the project area is the Quil Ceda Business Park, a commercial development owned by the Tulalip Tribes.

3.1.5 Urban Growth Area

The 116th Street NE interchange is within the urban growth area established by Snohomish County. The interchange improvements are designed to serve traffic relating to both existing and planned development within the City of Marysville, Snohomish County, and the Tulalip Reservation.

3.2 TRANSPORTATION PLANS

This section describes how the proposed improvements to the 116th Street NE interchange are consistent with local and regional transportation plans.

3.2.1 Tulalip Tribes

The need for improvements to the 116th Street NE interchange was identified in the Tulalip Tribes Transportation Plan (Tulip Tribes 1999). It is also included in the Tulalip Strategic Transportation Plan (Tulip Tribes 2003).

3.2.2 Snohomish County

Snohomish County is currently in the process of preparing the Ten-Year Update to the Comprehensive Plan, to be completed in Fall 2005. The DEIS for the Comprehensive Plan Update includes I-5 from SR

528 to SR 531 in the list of WSDOT improvements to be completed in the next 20 years. The five-lane widening of 116th Street NE between 27th Avenue and State Avenue is also included in the Draft EIS.

3.2.3 Washington State Department of Transportation (WSDOT)

The current *Washington State Highway System Plan: 2003–2022* (WSDOT 2002a) describes the transportation plan for state-owned highways. The following is a list of projects near the I-5/116th Street NE Interchange Project limits that are shown in this plan:

WSDOT 20-Year Mobility Strategies

- I-5: MP 199.58 to MP 205.63, SR-528 to SR-531
Widen from three to four lanes in each direction. Reconstruct interchange ramps.
- I-5: MP 205.63 to MP 208.99, SR-531 to SR-530
Widen from three to four lanes in each direction. Reconstruct interchange ramps. Park and Ride Lot by others.
- I-5: MP 206.1 to MP 206.1, I-5/SR-531 Interchange
172nd Street interchange modifications; widen structure to 5 or 6 lanes.

3.2.4 Puget Sound Regional Council

The Metropolitan Transportation Plan (MTP) for the Central Puget Sound Region is titled *Destination 2030* and was adopted by PSRC in May 2001 (PSRC 2001). The MTP contains policies aimed at improving mobility and access and identifies local, regional, and state transportation improvements and programs required to meet the region's transportation needs. Specific improvements identified by the MTP in the vicinity of the I-5/116th Street NE Interchange project include:

Sponsor: City of Marysville

- 88th Street NE – Marysville West City Limits to Marysville East City Limits
Project Description: Class 2 bike lanes (not in local plans).

Sponsor: Snohomish County

- 88th Street NE – I-5 to Marysville City Limits
Project Description: Class 2 bike lanes (not in local plans).

Sponsor: WSDOT

- I-5 – SR 531 to SR 530
Project Description: Widen from 3 to 4 lanes in each direction. Reconstruct interchange ramps. Park and Ride lot by others.
- I-5 – SR 528 to SR 531
Project Description: Widen from 3 to 4 lanes in each direction. Reconstruct interchange ramps.
- I-5 – SR 531 Interchange
Project Description: 172nd Street interchange modifications; widen structure to 5/6 lanes.
- SR 531 – I-5 to SR 9
Project Description: Widen to 5 lanes.
- I-5 – Marysville Park and Ride and Transit Center

Project Description: 350 new stalls split between Marysville 4th Street #1 and Marysville 4th Street #2 Park and Rides (2006 completion).

- Marysville Park and Ride

Project Description: 300 new stalls split between Marysville 4th Street #1 and Marysville 4th Street #2 Park and Rides (2020 completion).

- Marysville Park and Ride

Project Description: 250 new stalls split between Marysville 4th Street #1 and Marysville 4th Street #2 Park and Rides (2015 completion).

- Marysville Park and Ride

Project Description: 350 new stalls split between Marysville 4th Street #1 and Marysville 4th Street #2 Park and Rides (2030 completion).

The 116th Street NE interchange improvements are included in the regional TIP.

The following WSDOT project is not currently listed in the State Highway System Plan (HSP) (WSDOT 2002a) or the MTP (PSRC 2001) but is planned in response to a 2000 WSDOT High Accident Location analysis.

- SR-531: 33rd Ave. vicinity To 43rd Ave. NE – Access Management

An open house was held April 9, 2003 to provide public input and help determine the best solution for the access management issues.

This project is funded and is expected to begin construction in October 2004.

3.3 SUMMARY

From the above information, it is clear that the I-5/116th Street NE Interchange Project is consistent with local and regional land use and transportation plans. The proposed project does not conflict or interfere with any other proposed projects in the local or state plans and is consistent with the various widening and capacity enhancement projects that are planned for local roads.

Improvements to the I-5 mainline and ramps in the vicinity of the I-5/116th Street NE interchange are included in WSDOT's State Highway System Plan and PSRC's Destination 2030; however, these plans do not currently specify the type of interchange improvements that are proposed. The widening of 116th Street NE is also in the process of being added to the Snohomish County and City of Marysville Transportation Plans that are being adopted this year. The 116th Street NE SPUI is included in the Tulalip Tribes' 10-Year Strategic Transportation Plan and is in the process of being incorporated into Snohomish County and the City of Marysville transportation plans as part of their 10-Year Comprehensive Plan Updates, to be completed in the year 2005. Additionally, the description of proposed improvements has been recommended for refinement in WSDOT's State Highway System Plan and PSRC's TIP.

4. POLICY POINT 3: REASONABLE ALTERNATIVES

Have all reasonable alternatives been assessed and provided for?

The WSDOT requires that all possible, reasonable alternatives be evaluated. This section will describe the alternatives considered and rejected and will also describe how the preferred proposal provides for future needs at the interchange.

Project scoping included a screening process involving over a dozen potential alternatives. The alternatives for review were discussed at a team meeting in October 2002 with representatives from FHWA, WSDOT, and the Bureau of Indian Affairs (BIA), as well as Snohomish County, Community Transit, and the City of Marysville. The three alternatives that were selected for further consideration were screened at a subsequent meeting in July 2003, where the preferred alternative was selected. The alternatives were evaluated based primarily on traffic operations and environmental impacts. Refer to Appendix A for a copy of the screening table and explanation of ratings for the initial twelve alternatives from the October 2002 meeting, as well as the explanation of ratings and screening table used in the July 2003 meeting for the final three alternatives. These three alternatives are described in the following section.

4.1 ALTERNATIVES CONSIDERED

The improvements to the 116th Street NE interchange are intended to provide the additional capacity required to support projected economic and population growth in Marysville, Snohomish County, and the Tulalip Reservation. These improvements will increase the capacities of the on- and off-ramps and the crossing structure over I-5.

A descriptive summary of all twelve preliminary alternatives and their ratings from the first-level screening process, conducted in October 2002, is included in Appendix A. Based on a review of the agreed-upon screening criteria, also included in Appendix A, the twelve preliminary alternatives were narrowed down to three alternatives.

The following is a listing of the nine out of twelve preliminary alternatives that were eliminated during the first-level screening process. As compared to the top three alternatives, these alternatives had substantially greater impacts on streams and wetlands, did not provide as effective operation of the local arterial system or I 5, or had potential safety impacts, as summarized below:

- **Loop ramps in the northwest and southeast quadrants** -This alternative would require substantial new right-of-way, displace a large portion of the existing mobile home park in the southeast quadrant, and encroach on Quilceda Creek in the northwest quadrant.
- **Button-hook ramps to the east with a loop ramp in the northwest quadrant** - As with the alternative above, this alternative would require substantial new right-of-way and would encroach on Quilceda Creek in the northwest quadrant. The button-hook ramps connecting to the east would pose a potential operational hazard due to wrong-way traffic entering the freeway.
- **Full diamond with 800-foot ramp spacing** - This alternative would require additional right-of-way to move the ramps further from the mainline, displace commercially zoned property at all quadrants, and encroach on Quilceda Creek buffer areas in the southwest quadrant. Intersections at the ramps would have substantial level of service (LOS) limitations and queues extending between the intersections, thus impeding local arterial circulation.
- **Three-quarter diamond, southbound off-ramp connects to Quil Ceda Boulevard with overcrossing** - This alternative would require additional right-of-way to move the ramps further from the mainline and would displace commercially zoned property in three quadrants. The off-

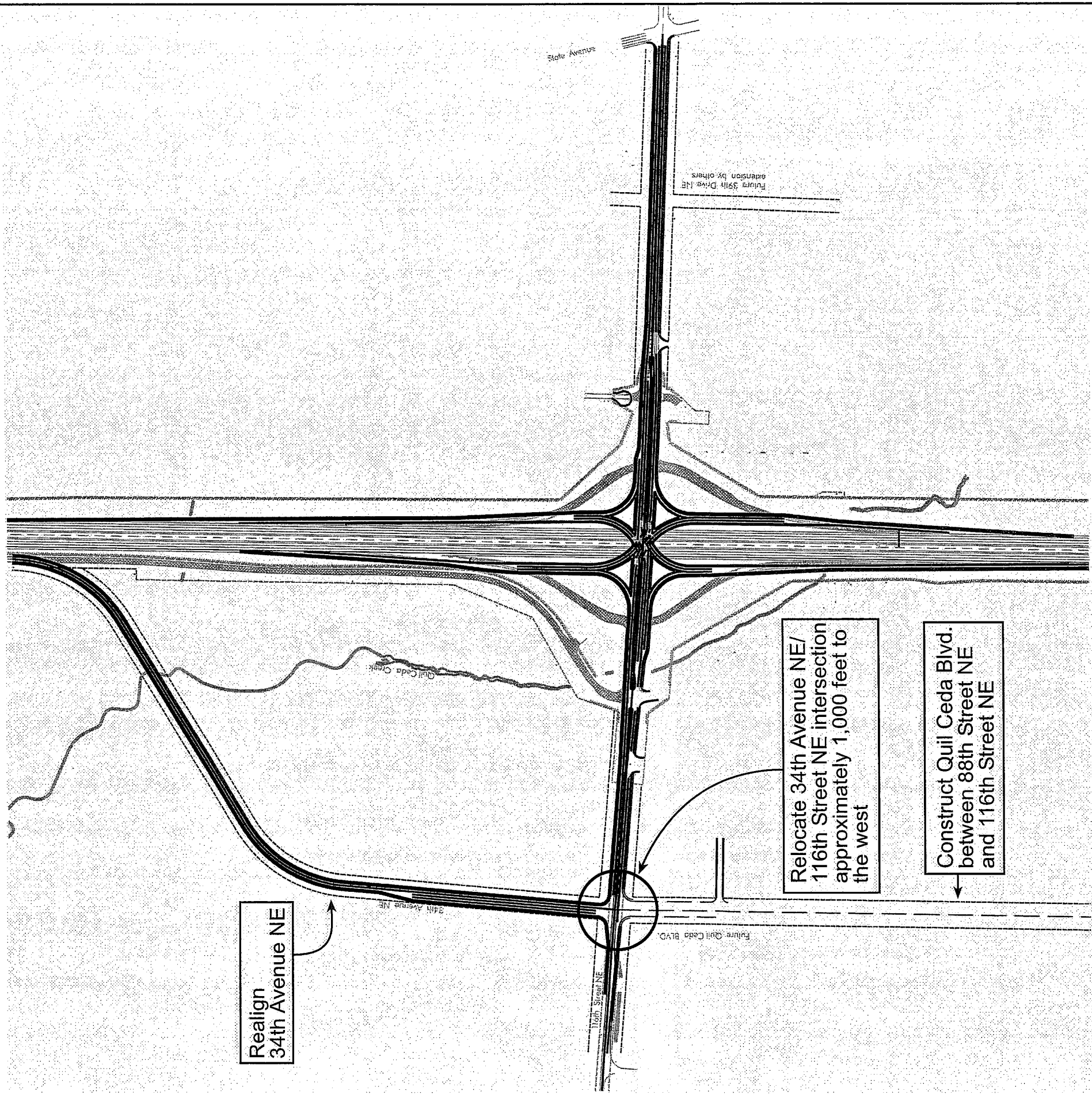
ramp merging onto 34th Avenue NE with an overcrossing would avoid encroachment on Quilceda Creek in the northwest quadrant, but would require an additional creek crossing and would increase travel times for southbound traffic on I 5 to access Marysville to the east. Intersections with on-ramps would have substantial LOS limitations and impede local arterial circulation.

- **Three-quarter diamond, southbound off-ramp connects to Quil Ceda Boulevard with “T” intersection** - This alternative is similar to the concept above; it would require additional right-of-way to move the ramps further from the mainline and would displace commercially zoned property in three quadrants. The off-ramp to 34th Avenue NE would avoid encroachment on Quilceda Creek in the northwest quadrant, but would require an additional creek crossing and would increase travel times for southbound traffic on I 5 to access Marysville to the east. The “T” intersection connection with the Quil Ceda Boulevard Extension would increase congestion slightly.
- **Button-hook ramps to the southeast with one-quarter diamond to the southwest** - The button-hook ramps connecting to the east pose a potential operational hazard due to wrong-way traffic entering the freeway. The off-ramp to 34th Avenue NE would avoid encroachment on Quilceda Creek in the northwest quadrant, but would require an additional creek crossing and would increase travel times for southbound traffic on I 5 to access Marysville to the east.
- **Full diamond moved to the north** - This alternative with 1,200-foot ramp spacing would avoid most of the encroachment on Quilceda Creek in the southwest quadrant, while increasing encroachment slightly in the northwest quadrant. It would require acquisition of substantially more right-of-way from the commercial area north and would have the same operational limitations as the full diamond alternative.
- **Button-hook ramps to the northeast with loop ramp in the northwest quadrant** - The button-hook ramps connecting to the northeast would pose a potential operational hazard due to wrong-way traffic entering the freeway. The off-ramp to 34th Avenue NE would avoid encroachment on Quilceda Creek in the northwest quadrant, but would require an additional creek crossing and would increase travel times for southbound traffic on I 5 to access Marysville to the east.
- **Retain existing ramps, widen overpass to six lanes** - This alternative would avoid additional right-of-way acquisition or displacement, but intersections at the ramps would have substantial LOS limitations and queues extending between the intersections, thus impeding local arterial circulation.

The top three alternatives resulting from the first-level screening process were further evaluated at a subsequent meeting in July 2003. The results of the second-level screening process are also included in Appendix A. This report discusses the three alternatives that passed the first-level screening process and were further evaluated to select a preferred alternative. In addition, a Transportation Demand Management (TDM) Alternative and an alternative that includes local arterial improvements only were considered as standalone alternatives and later determined to best be included in all Build Alternatives. These alternatives are also described in this section.

4.1.1 Alternative No. 1 – Single-Point Urban Interchange (SPUI)

This alternative features a SPUI with double left-turn lanes for all left-turn movements with the exception of the southbound-to-eastbound single left-turn lane. It also includes an eastbound-to-southbound right-turn lane and a westbound-to-northbound right-turn pocket. The northbound off-ramp intersection approach would be widened to three lanes (two left-turn, one right-turn lane). The I-5 undercrossing would be widened to accommodate two through lanes in each direction in addition to the left-turn lanes. Figure 4-1 shows the proposed single point urban interchange design.



Realign
34th Avenue NE

Relocate 34th Avenue NE/
116th Street NE intersection
approximately 1,000 feet to
the west

Construct Quil Ceda Blvd.
between 88th Street NE
and 116th Street NE

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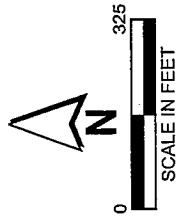


Figure 4-1
Alternative 1
Single Point Urban Interchange

4.1.2 Alternative No. 2 – Loop Ramps

This alternative would remove the existing diamond ramps in the north half of the interchange, and replace them with two loop ramps. The loop ramps would serve the westbound-to-southbound movement and the northbound-to-westbound movement. The undercrossing would be widened to accommodate two through lanes in each direction. An eastbound-to-southbound right-turn lane and a westbound-to-northbound right-turn pocket would also be added. Figure 4-2 shows the proposed loop ramp interchange design.

4.1.3 Alternative No. 6 – Expanded Diamond

This alternative would rebuild the existing diamond interchange to meet full design standards. The distance between ramp termini would be increased to 1,200 feet. The undercrossing would be widened to accommodate back-to-back double left-turn lanes. An eastbound-to-southbound right-turn lane and westbound-to-northbound right-turn pocket would also be added. The northbound off-ramp intersection approach would be widened to three lanes (two left-turn, one right-turn lane). Figure 4-3 shows the proposed expanded diamond interchange design.

4.1.4 Transportation Demand Management (TDM) Alternative

A transit service alternative was first considered as a stand alone alternative to alleviate congestion at the I-5/NE 116th Street NE interchange; however, it was determined that improved transit service would not provide the necessary additional capacity needed to accommodate year 2030 traffic projections. Transit improvements are instead included in all Build alternatives. With this alternative, enhanced transit service would be provided by Community Transit to serve trips into and out of the development area west of I-5. This additional transit service would likely remove a small amount of vehicle trips from the arterial system, ultimately providing for additional signal time to serve traffic accessing I-5. This traffic reduction was not accounted for in the traffic analysis conducted as part of this APDR.

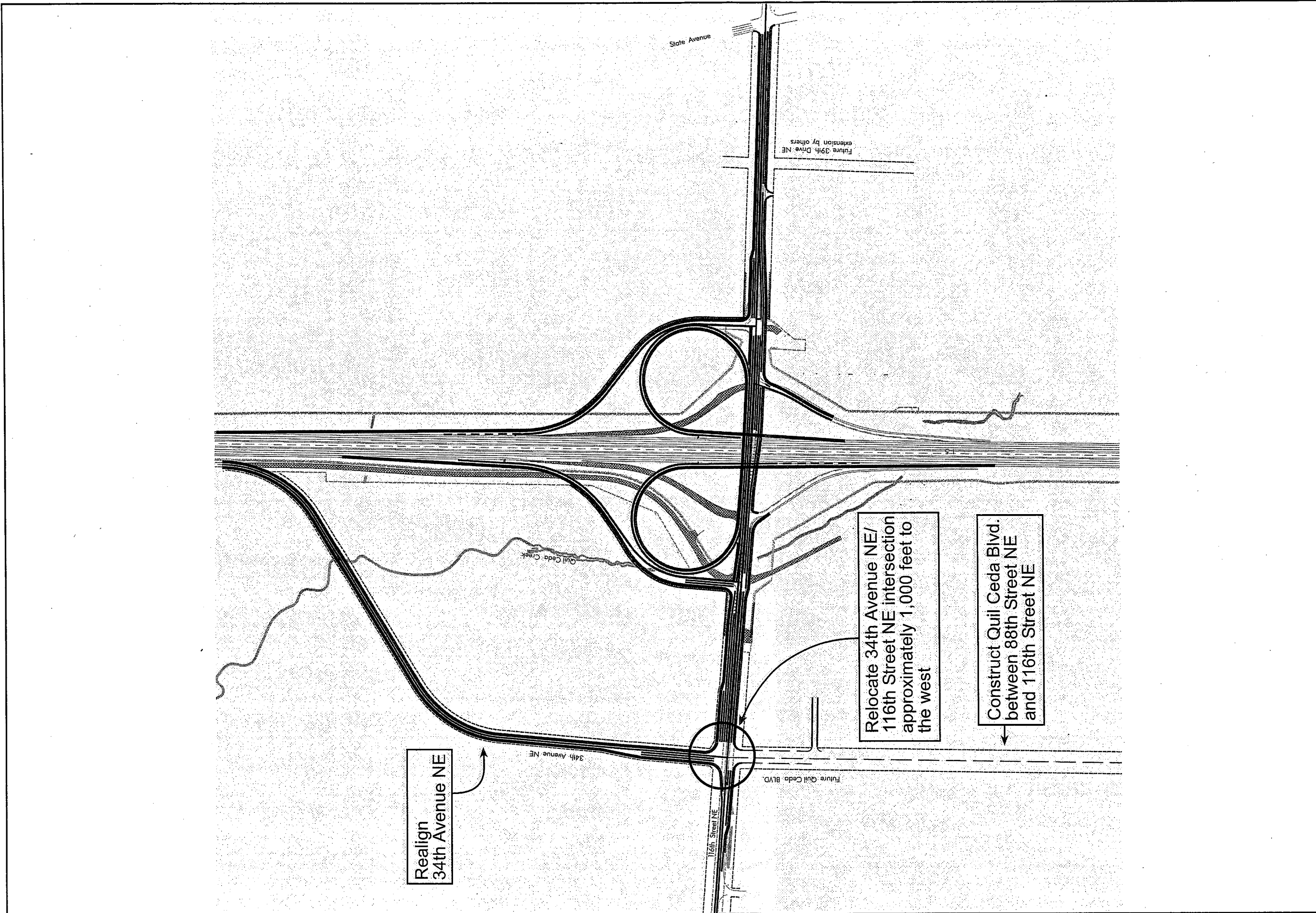
4.1.5 Local Arterial Improvements Alternative

This component was also considered as a stand alone alternative; however, the project team determined that all changes proposed with this alternative were not adequate in themselves to accommodate year 2030 traffic projections. Local arterial improvements were included in all Build alternatives. Proposed changes to the arterial network include the following:

- *Extend Quil Ceda Boulevard to the north of 116th Street NE to reconnect with 34th Avenue, approximately 2,000 feet north of 116th Street NE.* -This modification would provide standard intersection spacing for limited access facilities and would eliminate the existing conflict on 116th Street NE between the I-5 southbound ramps and the 34th Avenue NE intersections.
- *Construction of Quil Ceda Boulevard between 88th Street NE and 116th Street NE* - This improvement provides a north/south link between 88th Street NE and 116th Street NE that would reduce the number of trips using I-5 as an arterial to traverse between the two adjacent interchanges. It also increases the potential for traffic volumes to distribute more evenly between the two interchanges.

In addition to the above improvements, some interchange alternatives would also remove the existing railroad bridge over I-5, located south of the interchange. The preferred alternative, the SPUI, would not impact the railroad bridge and would maintain right-in, right-out access only at the current 34th Avenue

NE intersection location. The local arterial improvements associated with the three alternatives are shown in Figures 4-1 through 4-3, and were included in the analysis of the preferred alternative in this APDR.



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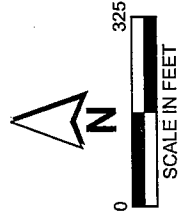
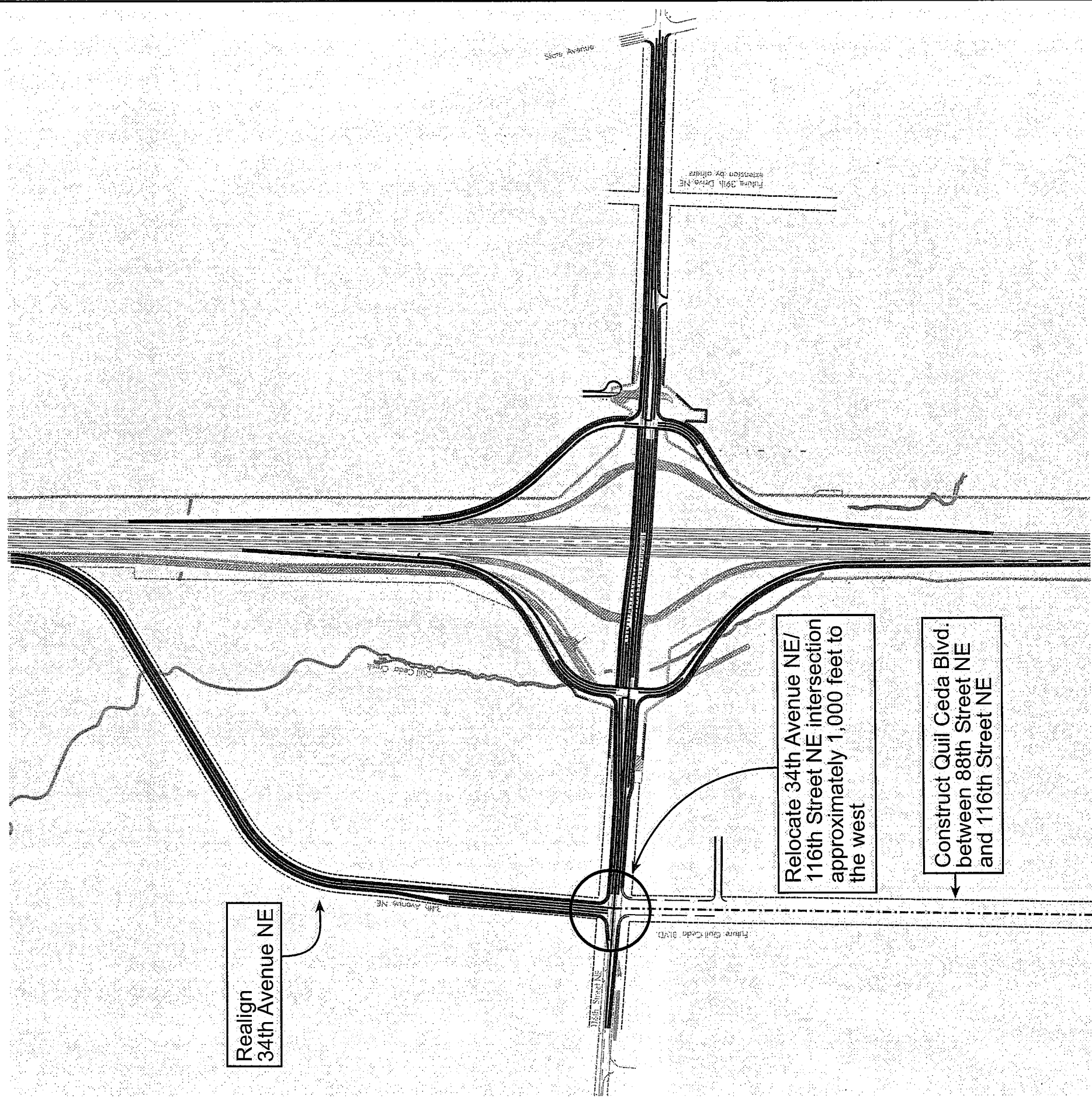


Figure 4-2
Alternative 2
Loop Ramps



Realign
34th Avenue NE

Relocate 34th Avenue NE/
116th Street NE intersection
approximately 1,000 feet to
the west

Construct Quil Ceda Blvd.
between 88th Street NE
and 116th Street NE

5. POLICY POINT 4: NEED FOR THE ACCESS POINT REVISION

What are the current and projected capacity needs and why won't the existing access points and existing or improved local system meet these needs? Is the anticipated demand short or long trip?

WSDOT requires demonstration that the proposed interchange improvements will benefit long trips, rather than short trips, and that the existing network is unable to accommodate the additional traffic volumes projected for 2030.

5.1 EXISTING CONDITIONS

The I-5/116th Street NE interchange is currently a full diamond interchange, and the I-5/116th Street NE undercrossing is a three-lane (one lane each direction plus a left-turn lane) structure with signals at ramp terminals, serving northbound and southbound I-5.

The interchange is located in the rapidly growing Marysville/Smokey Point area. I-5 is the region's primary north-south highway, connecting the communities of Smokey Point and Mount Vernon north to the City of Marysville/Tulalip Indian Reservation and south to the City of Everett. 116th Street NE is a minor east/west arterial route providing access to the Cities of Arlington and Marysville to the east and to the Tulalip Indian Reservation (via 34th Avenue and 140th Street) and Quil Ceda Village to the west.

116th Street NE falls within Snohomish County and the Tulalip Indian Reservation west of I-5 and is in the City of Marysville's jurisdiction east of I-5. Within the last several years, WSDOT has installed signals at the ramp terminal intersections, and Snohomish County has installed signals at the 34th Avenue NE/116th Street NE intersection, while the Tulalip Tribe has widened 116th Street west of 34th Avenue NE to a four/five-lane roadway with 10-foot shoulders.

5.2 EXISTING VOLUMES

Table 5-1 shows the existing AM and PM peak hour traffic volumes at key points near the interchange. Existing traffic volumes were obtained from WSDOT and new traffic counts were conducted in June and July, 2003. The traffic counts reflect traffic from the newly opened casino, Wal-Mart, and Home Depot in the Tulalip Business Park. Figure 5-1 shows the existing year 2003 average annual daily traffic (AADT) volumes at the I-5/116th Street NE and I-5/88th Street NE interchanges. Figures 5-2 and 5-3 show the existing year 2003 PM peak hour link and turning movement volumes at the I-5 northbound and southbound on- and off-ramps, and at all the intersections within the study area, respectively.

Existing traffic volumes show that the heaviest movements at the 116th Street NE interchange are the eastbound-to-southbound on ramp movement in the AM peak hour traffic, and the northbound off-ramp movements (to both eastbound and westbound movements on 116th Street NE) in the PM peak hour traffic. The overall volumes at both interchange ramps are approximately equal.

Level of service (LOS) is a measure of the quality and overall congestion of a particular section of road or intersection. LOS is calculated using the method outlined in the *2000 Highway Capacity Manual* (HCM, TRB 2000). Six letters (A through F) are used to describe the capacity, density, and travel speed of the freeway. In this evaluation, the LOS, density, and speed are used to document the existing conditions of the corridor. Table 5-2 describes the six LOS ratings and the corresponding operational description of the traffic flow associated with them.

Table 5-1. Existing 2003 Peak Hour Traffic Volumes

Location	Peak Hour Volume (vehicles per hour)	
	AM	PM
I-5 Southbound – South of 116th Street NE I/C	4,555	3,345
I-5 Southbound – North of 116th Street NE I/C	3,710	2,885
I-5 Northbound – South of 116th Street NE I/C	2,020	4,735
I-5 Northbound – North of 116th Street NE I/C	1,850	3,935
116th Street NE/Northbound Off-ramp	310	1,100
116th Street NE/Northbound On-ramp	140	350
116th Street NE/Southbound Off-ramp	155	300
116th Street NE/Southbound On-ramp	1,000	760
Westbound 116th Street NE west of I-5	245	740
Westbound 116th Street NE east of I-5	480	540
Eastbound 116th Street NE west of I-5	745	755
Eastbound 116th Street NE east of I-5	300	850
88th Street NE/Northbound Off-ramp	315	1,225
88th Street NE/Northbound On-ramp	200	415
88th Street NE/Southbound Off-ramp	325	440
88th Street NE/Southbound On-ramp	865	750
Westbound 88th Street NE west of I-5	225	970
Westbound 88th Street NE east of I-5	1,050	1,125
Eastbound 88th Street NE west of I-5	185	990
Eastbound 88th Street NE east of I-5	595	1,400

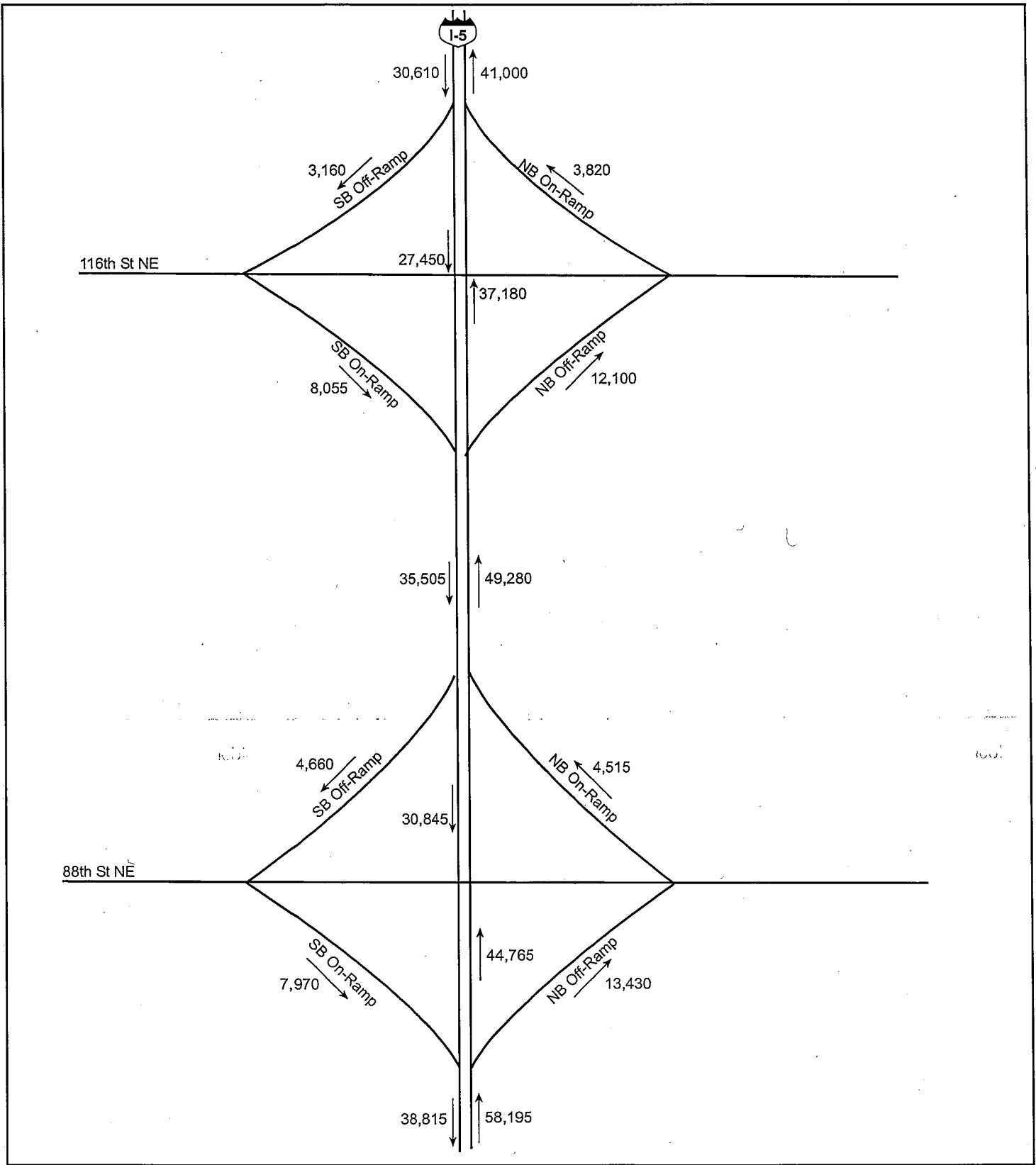
Source: WSDOT, 2002b.

Table 5-2. Level of Service Definition

Rating	Description	Traffic
A	Free Flow	No restriction
B	Reasonably free flow	Minor restriction
C	Stable Flow	Some restriction
D	Approaching Unstable Flow	Increasing restriction and congestion
E	Unstable Flow	Substantial restriction and delays
F	Forced or Breakdown Flow	Jammed conditions, extreme delays

Source: Transportation Research Board 2000.

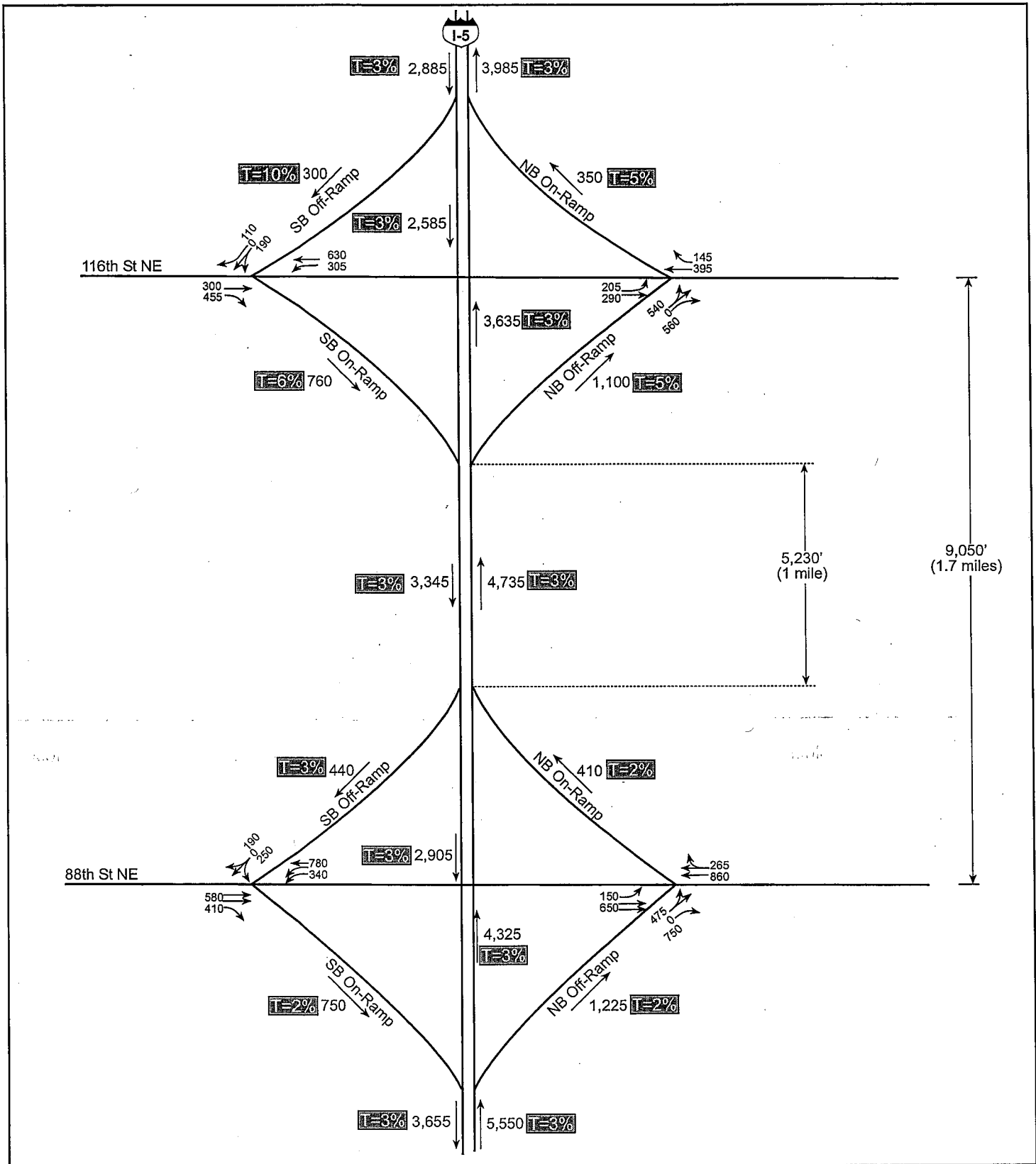
Table 5-3 shows the LOS and average intersection delay for the ramp terminal intersections at the 116th Street NE and 88th Street NE interchanges. As shown in Table 5-3, all ramp terminal intersections currently operate acceptably at LOS D or better during the AM and PM peak hours. However, LOS is generally worse during the PM peak traffic hour than during the AM peak traffic hour. The poorer LOS is due to greater traffic volumes in the PM peak traffic hour. Refer to Appendix D for the Synchro intersection LOS and delay calculation sheets.



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Note: Existing Year 2003 daily counts were determined based on Existing Year 2003 turning movements provided by Gibson Traffic Consultants and WSDOT's average daily traffic volumes.

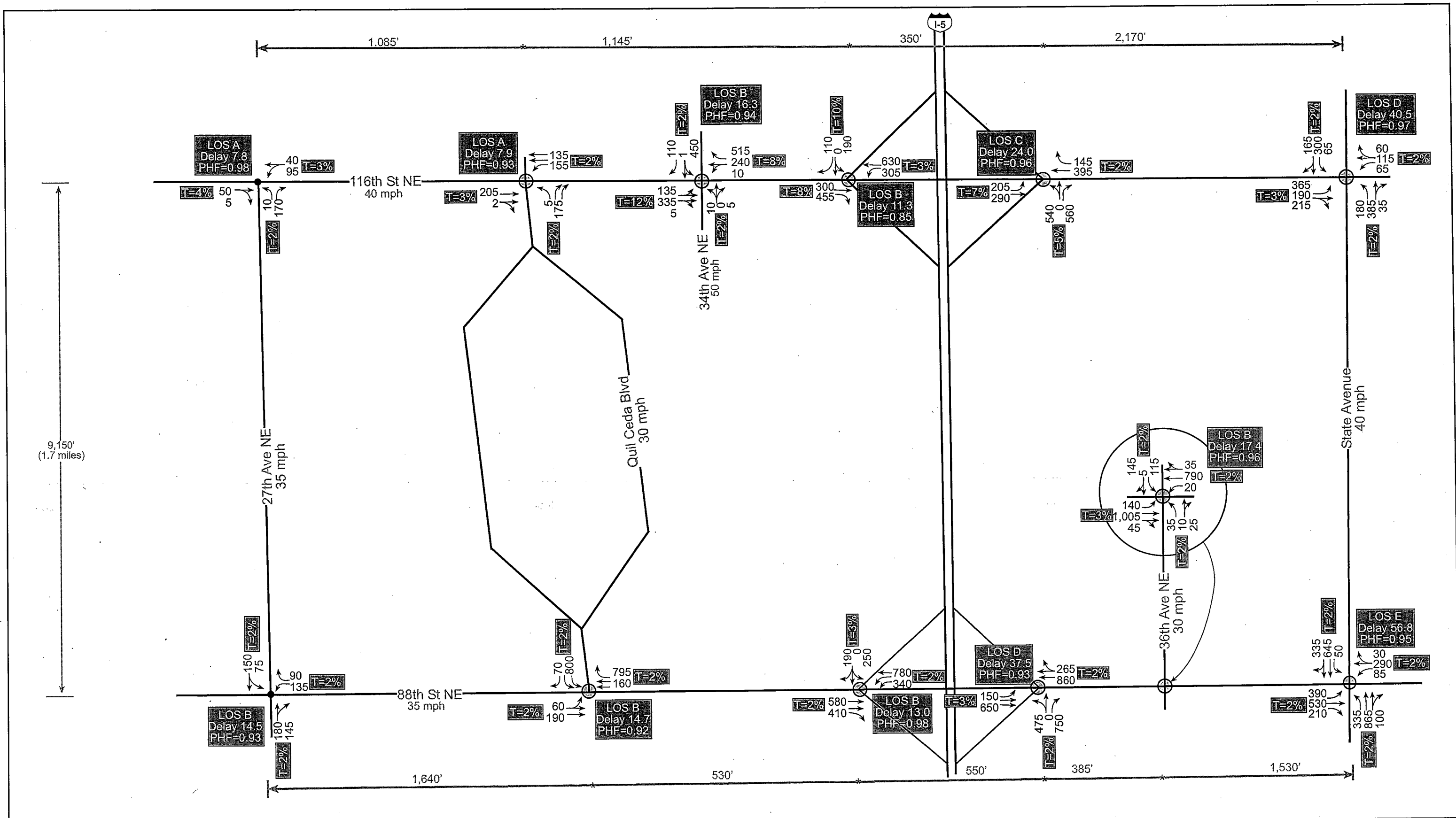
Figure 5-1
Existing Year 2003
I-5 Average Daily
Traffic Volumes



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Note: PHF = 0.98
 T = Percent Heavy Vehicles
 Speed (Ramps) = 35 mph
 Speed (Mainline) = 70 mph
 Grade is level

Figure 5-2
Existing Year 2003
I-5 PM Peak Hour Volumes



Note: PHF=Peak Hour Factor
 T = Percent Heavy Vehicles
 Grade is level
 ● Unsignalized Intersection
 ⊙ Signalized Intersection
 Arterial volumes may not balance because of midblock entry and exit points.

Figure 5-3
Existing Year 2003
Arterial PM Peak Hour Level of
Service and Traffic Volumes

Table 5-3. Existing 2003 LOS and Delay at Ramp Terminal Intersections

Location	AM Peak Hour		PM Peak Hour	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
116th Street NE/I-5 Southbound Ramps	A	3.7	B	11.3
116th Street NE/I-5 Northbound Ramps	A	9.8	C	24.0
88th Street NE/I-5 Southbound Ramps	C	23.2	B	13.0
88th Street NE/I-5 Northbound Ramps	B	13.2	D	37.5

Table 5-4 shows the freeway operations by providing data on LOS, density, and speed for the PM peak hour at key locations. This information quantifies the current level of congestion in the corridor. As vehicle density increases, average travel speeds decrease and LOS worsens in the corridor.

The AM peak hour was not evaluated because the PM peak hour was determined sufficient to evaluate existing and future traffic operations and the potential effects of a modified interchange configuration at 116th Street NE. As shown in Table 5-4, all ramp merge and diverge areas evaluated currently operate at acceptable levels during the PM peak hour. Refer to Appendix E for the HCS freeway ramp LOS calculation sheets.

Table 5-4. Existing 2003 Freeway Ramp Operations

Location	PM Peak Hour		
	LOS	Density (pcpmp)	Speed (mph)
Northbound			
88th Street Off-Ramp	C	25.9	55
88th Street On-Ramp	C	26.1	60
116th Street Off-Ramp	D	28.5	55
116th Street On-Ramp	C	22.4	61
Southbound			
116th Street Off-Ramp	B	17.9	57
116th Street On-Ramp	C	20.6	61
88th Street Off-Ramp	C	20.5	57
88th Street On-Ramp	C	21.9	61

pcpmp: passenger car per mile per lane

mph: mile per hour

5.3 NEED FOR ACCESS

Between 1990 and 2000, Snohomish County's population increased 30 percent, a gain of 140,400 residents. Major employers in Snohomish County include the Boeing aircraft manufacturing plant in the Everett area, the U.S. Navy Homeport, timber and pulp related industries, high-technology, and communications.

The Washington State Office of Fiscal Management projects that Snohomish County's population (<http://www.ofm.wa.gov/pop/gma/countypop.pdf>) will increase to approximately 1,063,000 by 2025, an increase of more than 450,000, or 75 percent, from the 2000 population of 606,000. PSRC projects the population of the Tulalip/Marysville/Arlington area will increase from approximately 75,000 to 135,000, or 76 percent, by year 2030. Employment in the area is projected to increase by 50 percent, from approximately 23,000 to approximately 34,000 jobs. (These projections do not, however, consider the growth potential of the Tulalip Tribes' Quil Ceda Business Park).

The 2,000-acre Quil Ceda Business Park houses two large retail stores, a smaller retail complex, and Tulalip Bingo; a 227,000-square-foot casino opened on June 5, 2003. The initial phase of business park development was recently completed on approximately 635 acres adjacent to the west side of I-5, just south of 116th Street NE. Designated uses include retail and casino, office, light industrial, distribution, warehousing, and a destination resort. Later phases include additional areas for office and light industrial use with a development capacity of over 6.7 million square feet.

Most of this area is currently undeveloped, and the zoning capacity of this area is several million square feet of potential commercial and industrial development. The City of Marysville has designated the 116th Street NE corridor for Community Business development as part of a master plan, and has zoned over 1,000 acres for industrial use north of 123rd Street, between I-5 and 43rd Avenue NE (Marysville 2001).

5.4 TRAFFIC VOLUME FORECASTS

The Snohomish County Arterial Network (SnoCAN) model was used to forecast traffic volumes in the region for the No Build and Build Alternatives. The model was modified to account for the additional traffic volume from the Quil Ceda Business Park and for additional growth in the greater Marysville area. Table 5-5 provides a comparison of existing study area 2003 traffic volumes obtained from WSDOT and 2030 No Build traffic volumes estimated using data from the SnoCAN model. Model forecasts of future trips to and from the 116th Street NE interchange during the PM peak hour show that the majority of traffic volume growth will take place north of the 116th Street NE interchange. The increased number of shopping trips associated with increased retail land use in the vicinity of the interchange adds to the growth. Congestion to the south in combination with limited retail areas to the south limit the amount of growth to and from that area. A similar growth pattern is identified at the Smokey Point interchange that displays more pronounced growth to the north than to the south.

Table 5-5. Future Traffic Volume Increases at the I-5/116th Street NE Interchange

Location	PM Peak Hour Volume (vehicles per hour)		No Build Percent Increase in Traffic Volumes over Existing Conditions
	2003 Existing	2030 No Build	
I-5 South of 116th Street NE	8,080	11,395	41%
I-5 North of 116th Street NE	6,870	10,285	50%
I-5/116th Street NE NB Off-Ramp	1,100	1,400	27%
I-5/116th Street NE NB On-Ramp	350	710	103%
I-5/116th Street NE SB Off-Ramp	300	590	97%
I-5/116th Street NE SB On-Ramp	760	1,010	33%

5.5 TRAFFIC OPERATIONS

Even though less growth from the south is expected on I-5, the I-5/116th Street NE interchange northbound off-ramp continues to operate with the highest volume. A detailed analysis of the forecast volumes and future traffic operations is presented under Policy Point 6. Table 5-6 summarizes the results of the I-5/116th Street NE interchange ramp LOS analysis for existing and year 2030 No Build conditions. As shown in Table 5-6, the northbound off-ramp would operate at LOS E with the No Build Alternative even with the local improvements listed in Table 7-2. LOS and delays would also continue to degrade at all other interchange ramps by the year 2030.

Table 5-6. I-5/116th Street NE Interchange Ramps PM Peak Hour LOS Analysis Summary - Existing and Year 2030 No Build Alternative

Location	Existing 2003			2030 No Build Alternative		
	LOS	Density (pcpmpl)	Speed (mph)	LOS	Density (pcpmpl)	Speed (mph)
116th Street Northbound Off-Ramp	D	28.5	55	E	36.3	54
116th Street Northbound On-Ramp	C	22.4	61	D	32.3	57
116th Street Southbound Off-Ramp	B	17.9	57	C	25.9	56
116th Street Southbound On-Ramp	C	20.6	61	D	28.3	59

While most ramps at the I-5/116th Street NE interchange (with the exception of the northbound off-ramp) would continue to operate at LOS D or better in the year 2030, the additional traffic volumes expected in the 116th Street NE interchange area would cause many intersections along 116th Street NE to degrade to LOS F by the year 2030. A detailed analysis of the forecast volumes and future intersection traffic operations is also presented under Policy Point 6. Table 5-7 shows the existing, year 2009 and year 2030 No Build Alternative intersection LOS results near the I-5/116th Street NE interchange for the PM peak hour.

Table 5-7. PM Peak Hour Intersection LOS Analysis Summary

Intersection	Existing 2003		2009 No Build		2030 No Build	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
116th Street NE/27th Ave. NE ¹	A	7.8	A	8.7	B	11.8
116th Street NE/Quil Ceda Blvd.	A	7.9	A	5.8	F	101.8
116th Street NE/34th Ave. NE	B	16.3	B	18.5	F	176.8
116th Street NE/I-5 SB Ramps	B	11.3	C	23.5	F	137.0
116th Street NE/I-5 NB Ramps	C	24.0	D	44.9	F	115.3
116th Street NE/State Ave.	D	40.5	D	44.9	F	120.9

¹ Unsignalized Intersection. Total intersection delay is reported.

As shown in Table 5-7, while all arterial intersections near the 116th Street NE interchange currently operate at LOS D or better during the PM peak hour, the projected increase in traffic volumes in the area would result in a worsening of PM peak hour LOS at most of these intersections to LOS F by the year 2030, even with the local improvements listed in Table 7-2.

The northbound queue extending from the I-5 northbound ramps/116th Street NE intersection is expected to exceed the available off-ramp storage capacity and spill into the I-5 mainline deceleration lane during the PM peak hour in the year 2030 if interchange improvements are not made beyond the local system improvements already assumed in the No Build Alternative. In addition, during the PM peak hour, eastbound queues on 116th Street NE are expected to extend well beyond the available intersection spacing and storage capacity near the I-5 northbound and southbound ramps intersections in the year 2030. Westbound queues at the 116th Street NE/34th Avenue NE intersection would also exceed the available storage capacity and extend through the I-5 southbound and northbound ramp intersections.

The Build Alternative would adequately accommodate year 2030 PM peak hour traffic volumes and would result in no spillover queues.

5.6 SUMMARY OF NEED FOR ACCESS

Population in Snohomish County increased by 30 percent between 1990 and 2000 and is projected to increase by an additional 75 percent by 2025. Traffic volumes at the 116th Street NE interchange are projected to increase dramatically, and interchange ramps and adjacent intersections on 116th Street NE are expected to operate at LOS E or F during the PM peak hour in the year 2030 without the proposed improvements. With the existing I-5/116th Street NE interchange configuration, local system improvements assumed to be in place, and anticipated traffic growth by the year 2030 (as assumed in the No Build Alternative), long queues are expected to form on the northbound off-ramp onto the I-5 mainline, and on 116th Street NE in the eastbound direction during the PM peak hour, resulting in highly congested conditions.

A revision to the I-5/116th Street NE interchange has been proposed, since these year 2030 operational deficiencies not be alleviated by local roadway improvements alone. With the proposed SPUI configuration (Preferred Alternative), year 2030 PM peak hour traffic volumes would be adequately accommodated, resulting in no spillover queues. As described under Policy Point 5, all intersections and ramps at the I-5/116th Street NE interchange would operate at LOS D or better in the year 2020 with the proposed interchange configuration.

6. POLICY POINT 5: ACCESS CONNECTIONS AND DESIGN

Will the proposal provide fully directional interchanges connected to public roads, spaced appropriately, and designed to full design level geometric control criteria?

The WSDOT requires demonstration that the proposed new or revised access is designed to meet or exceed current standards for the interstate system. This section provides a discussion of modifications to the I-5/116th Street NE interchange and associated improvements to the arterial system. This includes interchange spacing, ramp configuration, and channelization. Figures 1-3 through 1-9 show the layout of the modified I-5/116th Street NE interchange and the 34th Avenue NE intersection. All modifications and improvements proposed for the I-5/116th Street NE interchange and the affected arterial system will meet current design standards, as specified in the WSDOT Design Manual.

6.1 ACCESS CONNECTION AND DESIGN

The preferred alternative would convert the existing 116th Street NE conventional diamond interchange to a SPUI. This new configuration would improve interchange operations without affecting surrounding residential and business areas. In addition, the access improvements would help alleviate upstream traffic congestion and the projected delays caused by traffic on I-5 related to employment and population growth; these delays are not associated with the interchange improvements. Figure 1-5 shows the proposed bridge layout of the SPUI.

The preferred alternative also includes the extension of Quil Ceda Boulevard from 116th Street NE north and east to 34th Avenue NE approximately 2,000 feet north of 116th Street NE, and a reconfiguration of 34th Avenue NE to accommodate right-in and right-out movements only at 116th Street NE. The Quil Ceda Boulevard extension will accommodate the majority of north-south traffic volumes currently using 34th Avenue NE. Figure 1-8 shows the proposed channelization at this revised intersection. These changes will alleviate the existing conflicts on 116th Street NE between the 34th Avenue NE intersection and the southbound ramp terminals.

6.1.1 I-5 Northbound

The current alignment of the northbound I-5 mainline would not be changed. The proposed northbound off-ramp would continue to be a single lane, but would flare out to three lanes (two left-turn lanes and one right-turn lane) at the terminus. The northbound on ramp would function as two lanes, tapering to a single lane on-connection with I-5. Figures 1-3 through 1-7 show the proposed channelization on the northbound on- and off-ramps at the 116th Street NE interchange.

6.1.2 I-5 Southbound

The current alignment of the southbound I-5 mainline would not be changed. The proposed southbound off-ramp would continue to be a single lane, but would flare out to two lanes (one left-turn lane and one right-turn lane) at the terminus. The southbound on ramp would be two lanes at the origin, tapering to a single lane on-connection with I-5. Ramp metering is also proposed. Figures 1-3 through 1-7 show the proposed channelization on the southbound on- and off-ramps at the interchange.

6.1.3 Interchange Spacing

There would be no deviations to the interchange spacing for the preferred alternative. All ramp termini would enter and exit the I-5 mainline at current locations.

7. POLICY POINT 6: OPERATIONAL AND ACCIDENT ANALYSIS

How will the proposal affect safety and traffic operations now and for the next 20 years?

Under Policy Point 6, WSDOT requires detailed documentation of all the analysis performed on the preferred alternative. The following analyses are included:

- An operational analysis for both the opening year (2009) and design year (2030) of the existing interstate and affected surface street system (No Build Alternative).
- An operational analysis for 2009 and 2030 of the proposed interstate and surface street system (Build Alternative).
- Accident analysis of the interstate system.

Alternative 1 was selected as the preferred alternative. This alternative features a SPUI with double left-turn lanes for all left-turn movements with the exception of the southbound-to-eastbound single left-turn lane. It also includes an eastbound-to-southbound right-turn lane and a westbound-to-northbound right-turn pocket. The northbound off-ramp intersection would be widened to three lanes (two left-turn, one right-turn). The overpass would be widened to accommodate two through lanes in each direction in addition to the left-turn lanes.

7.1 ANALYSIS METHODOLOGY AND ASSUMPTIONS

This APDR is a joint effort by WSDOT and the BIA. Its methodology and scope were determined during monthly project meetings and meetings with the APDR Support Group, composed of representatives of WSDOT (both Northwest Region and Headquarters) and FHWA, over several months during a period from the end of 2002 through 2003. It was agreed that the analysis design year would be 2030 and its opening year would be 2006, and that the analysis would be performed using Highway Capacity Software (HCS) and Synchro, based on guidelines in the Highway Capacity Manual (Transportation Research Board 2000). Refer to the Traffic Operations Analysis Methodology Signature Paper and traffic forecasting memorandums documenting the above agreements, in Appendix C. Since these meetings, the projects opening year has been changed to 2009.

The 116th Street NE APDR study includes the 116th Street NE interchange and the 88th Street NE interchange. Because the 172nd Street interchange north of 116th Street NE is located over three miles to the north, it was not included in the analysis. The APDR Support Group agreed that the traffic distribution that results from modifying the 116th Street NE interchange would not introduce any significant changes to the 172nd Street interchange. Freeway analysis was conducted further to the south to demonstrate how freeway capacity with the No Build Alternative constrains the amount of traffic that could ultimately reach the 116th Street NE interchange. Refer to the technical memorandum in Appendix C, dated February 25, 2003, describing these assumptions. Figure 1-1 shows the locations of the intersections evaluated for this APDR.

This interchange improvement project will not fall within the area of influence of any other active interchange project in the future. During a meeting (July 11, 2002) with WSDOT Northwest Region and FHWA representatives, it was agreed that this APDR would acknowledge the possibility of constructing a new interchange between 116th Street NE and 172nd Street NE during this project's design life, but that it would not assume one was present for the purposes of the operational analysis of the proposed 116th Street NE interchange. It was also agreed that this APDR would document that any future access points

would need to be constructed outside the area of influence of the I-5/116th Street NE interchange and would need to consider and minimize or eliminate any weaving problems.

7.2 TRAFFIC VOLUME FORECASTS

Year 2002 interchange traffic volumes and year 2003 intersection turning movement count data were used to develop opening year (2009) and design year (2030) traffic volumes. As described in Section 5.4 under Policy Point 4, the SnoCAN model was used to forecast traffic volumes in the region for the year 2030 No Build and Build Alternatives. This EMME/2-based model was modified to account for additional growth in the greater Marysville area. Additional information regarding the assumptions used for modifying the year 2030 EMME/2 model and preparing year 2030 traffic forecasts is described in several technical memoranda, included in Appendix C.

7.2.1 Year of Opening (2009) Traffic Volumes

The proposed interchange is scheduled to open in the year 2009. However, traffic volume forecasts for this APDR were initially prepared assuming a 2006 opening year. The following process for developing the 2006 opening year AM and PM peak hour traffic volumes was used:

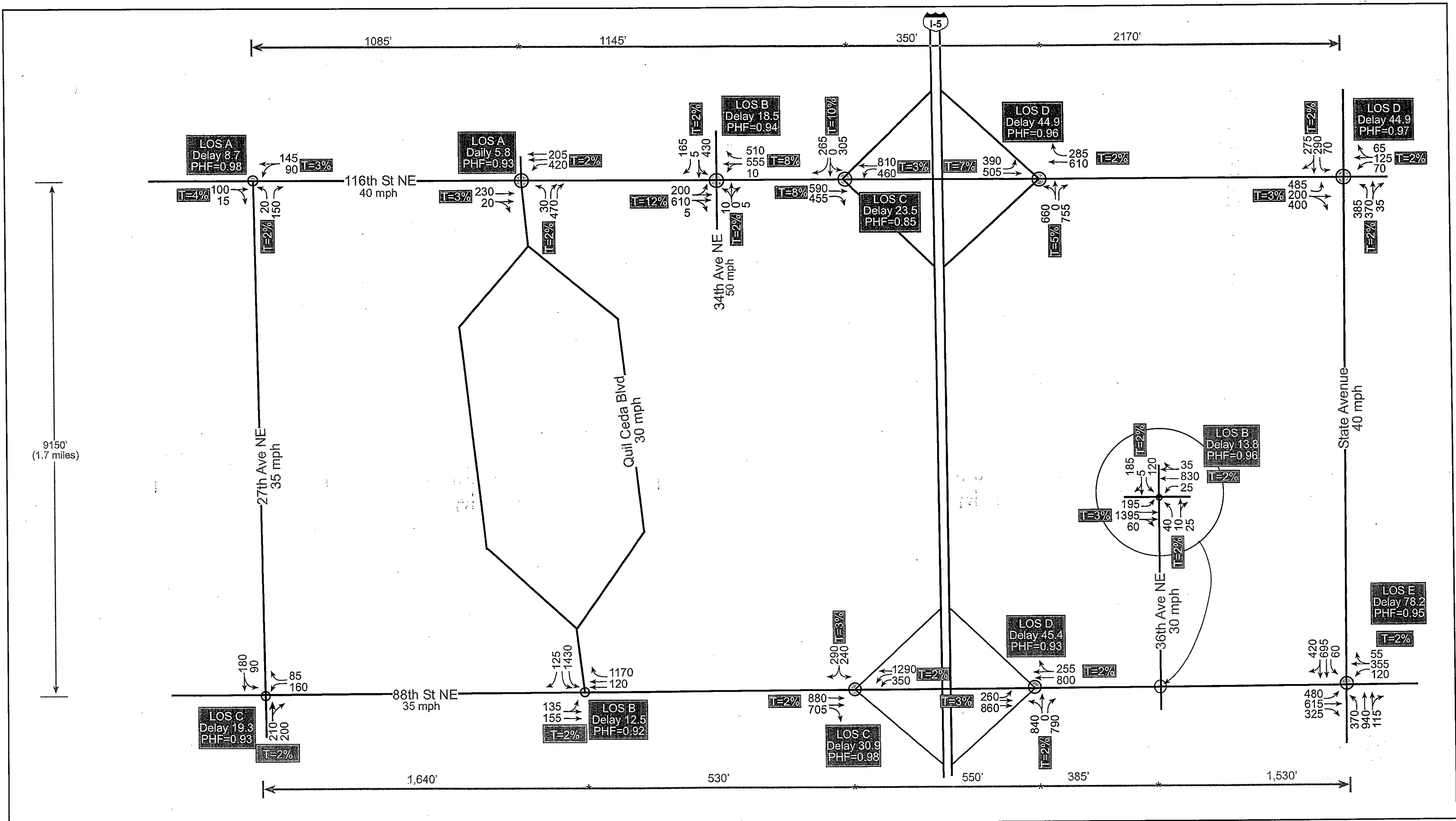
- Existing traffic volumes were assumed to increase approximately 1 percent annually in concurrence with anticipated local jurisdiction growth.
- The City of Marysville and Snohomish County provided all pipeline project trip data for all developments in the local area. In addition, the projected traffic from the Quil Ceda Village expansion identified in the *Traffic Impact Analysis for Quil Ceda Place* (Tulip Tribes 2003) was added. This pipeline data was added to the existing growth factored volumes.
- Based on the year 2030 EMME/2 model runs, the year 2006 and 2030 traffic volumes for the No Build and Build Alternatives would be similar, aside from changes due to design differences.

Since developing the year 2006 traffic volume forecasts, the project's opening year has been changed to 2009. As a result, a review of more recent traffic count data and new pipeline trip data from Snohomish County and the City of Marysville was conducted to determine how growth projections for the year 2009 would compare with the original year 2006 traffic volume forecasts. Traffic volume comparisons, as documented in a memorandum dated April 13, 2005 and included in Appendix C, showed that the year 2006 traffic volumes used for all traffic analysis in this APDR were, for the most part, higher than updated year 2009 traffic volumes. Therefore, it was determined that the use of the 2006 volumes for the new 2009 opening year would continue to provide a conservative analysis of opening year traffic conditions.

Year 2009 PM peak hour traffic volumes for the No Build Alternative are shown in Figure 7-1 and the 2009 PM peak hour traffic volumes for the Build Alternative are shown in Figure 7-2.

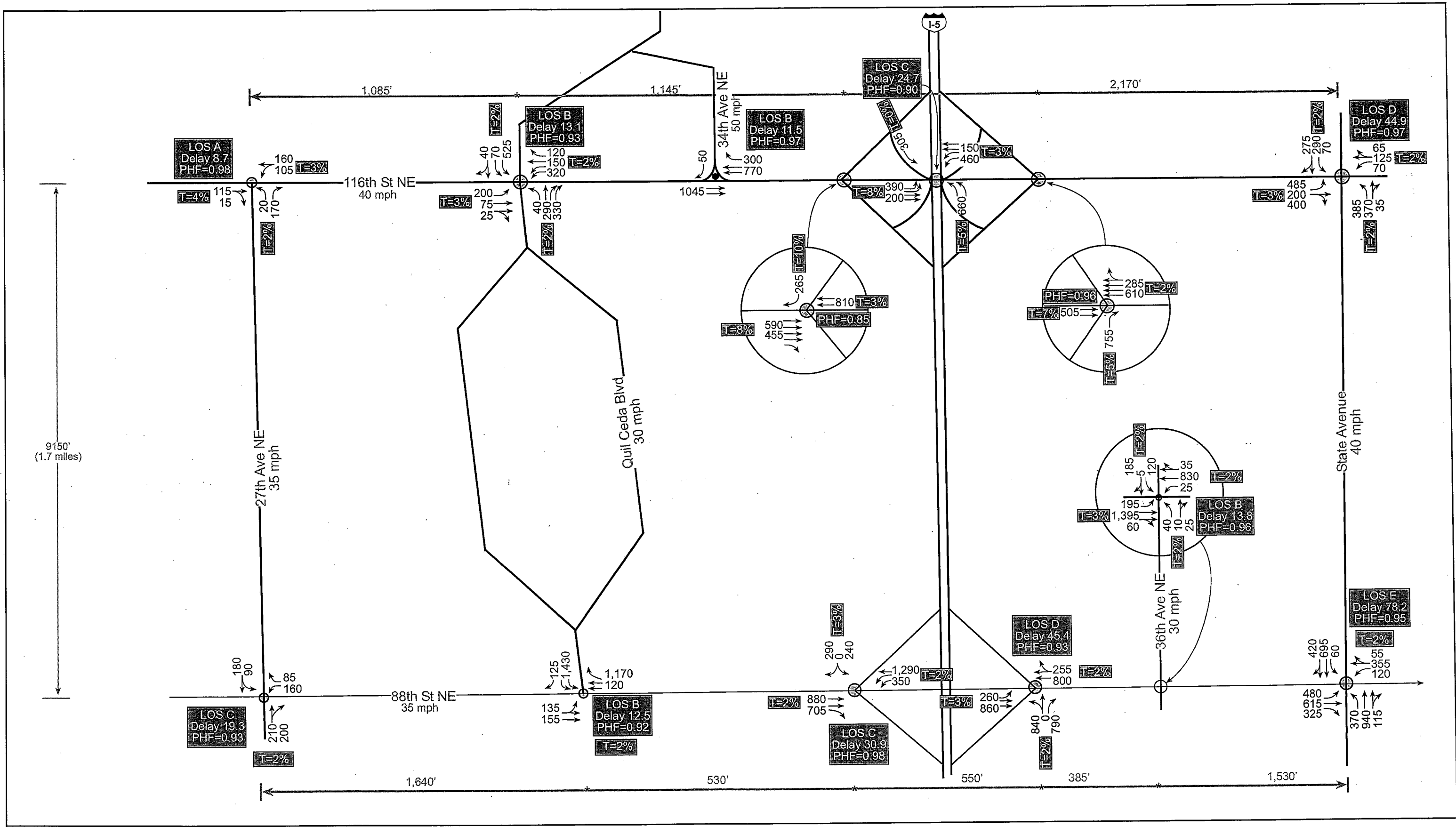
7.2.2 Design Year (2030) Volumes

The model predicts that future traffic demand will increase for both the Build and No Build Alternatives. Similar to existing conditions, future PM peak hour traffic volumes are predicted to be higher than the AM peak hour traffic volumes. Volumes on the interchange ramps are not expected to increase substantially by the year 2030. The most substantial volume increases on the ramps are expected to occur by the year 2009. The primary reason for the early increase is the inclusion of all pipeline trips from the proposed developments in the area that may have final phase occupancy dates in excess of 2009. Additionally, the 2030 model forecast includes improvements to the arterials and state highways that parallel I-5, thus reducing the short trips that would be using I-5 and the on-/off-ramps without these parallel arterial improvements assumed in the 2030 model. The greatest increases would occur on 116th Street NE, with average peak hour traffic volumes predicted to double between the years 2009 and 2030. Table 7-1 shows the year of opening and design year No Build and Build Alternative AM and PM peak



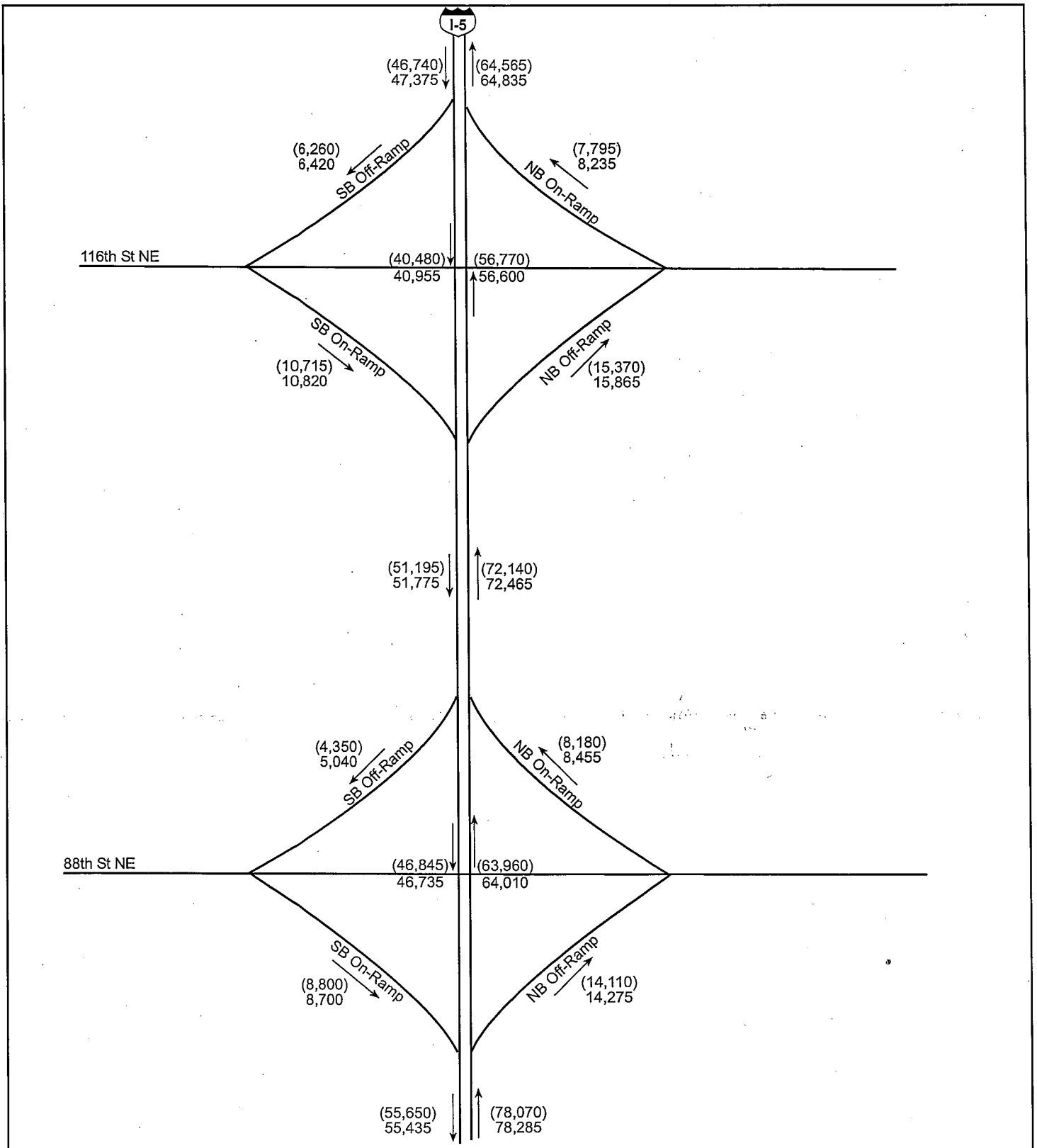
Note: PHF=Peak Hour Factor
 T = Percent Heavy Vehicles
 Grade is level
 ● Unsignalized Intersection
 ○ Signalized Intersection

Figure 7-1
 Opening Year 2009 No Build
 Arterial PM Peak Hour Level of
 Service and Traffic Volumes



Note: PHF=Peak Hour Factor
 T = Percent Heavy Vehicles
 Grade is level
 ● Unsignalized Intersection
 ⊙ Signalized Intersection

Figure 7-2
 Opening Year 2009 Build
 Arterial PM Peak Hour Level of
 Service and Traffic Volumes

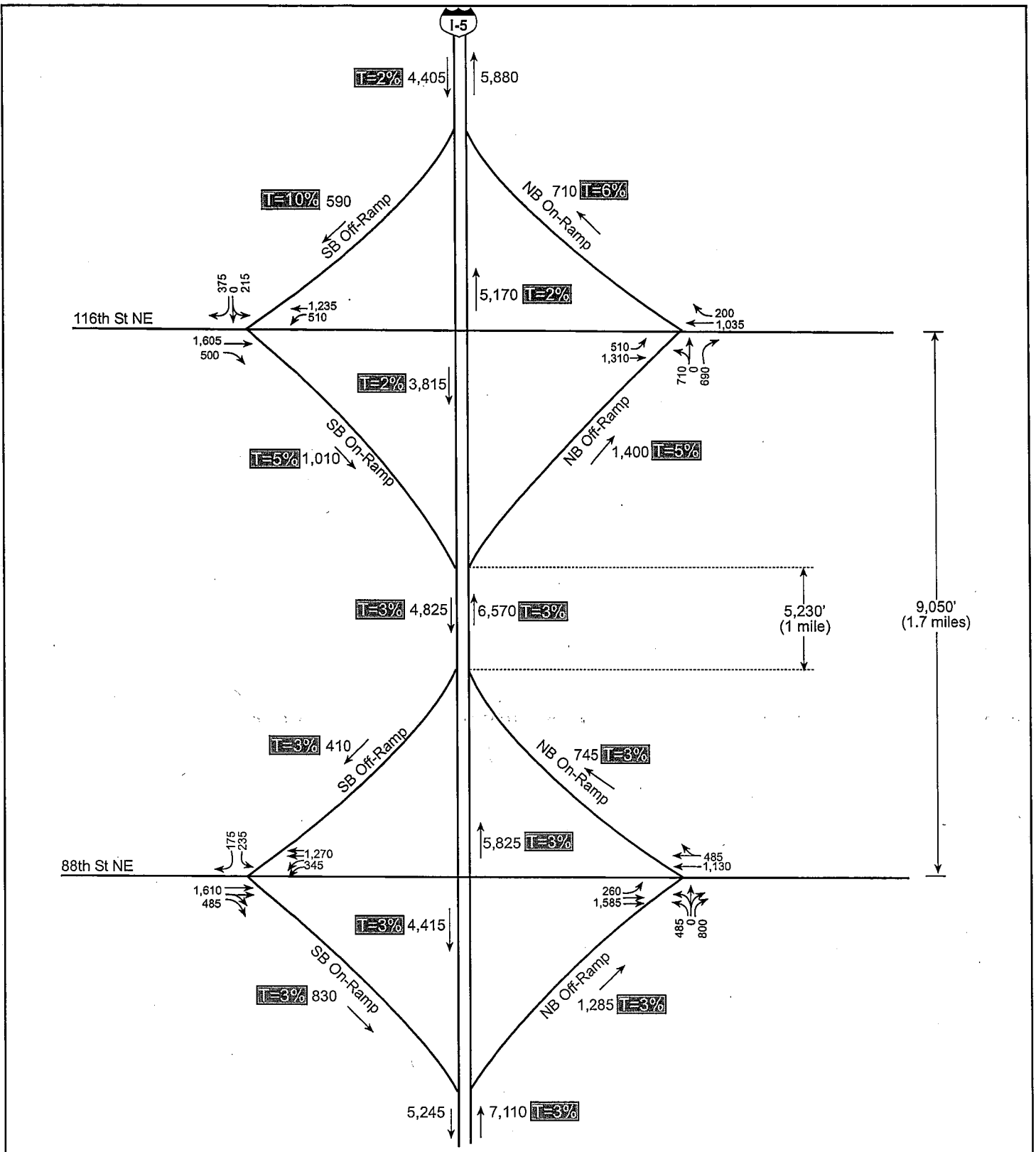


Parametrix 554-1596-017/08(103) 4/05 (B)

Note: (XX)-Year 2030 No Build Average Daily Traffic Volumes
 XX-Year 2030 Build Average Daily Traffic Volumes

Year 2030 No Build and Build daily counts were determined based on Existing Year 2003 turning movements provided by Gibson Consulting and WSDOT's average daily traffic volumes.

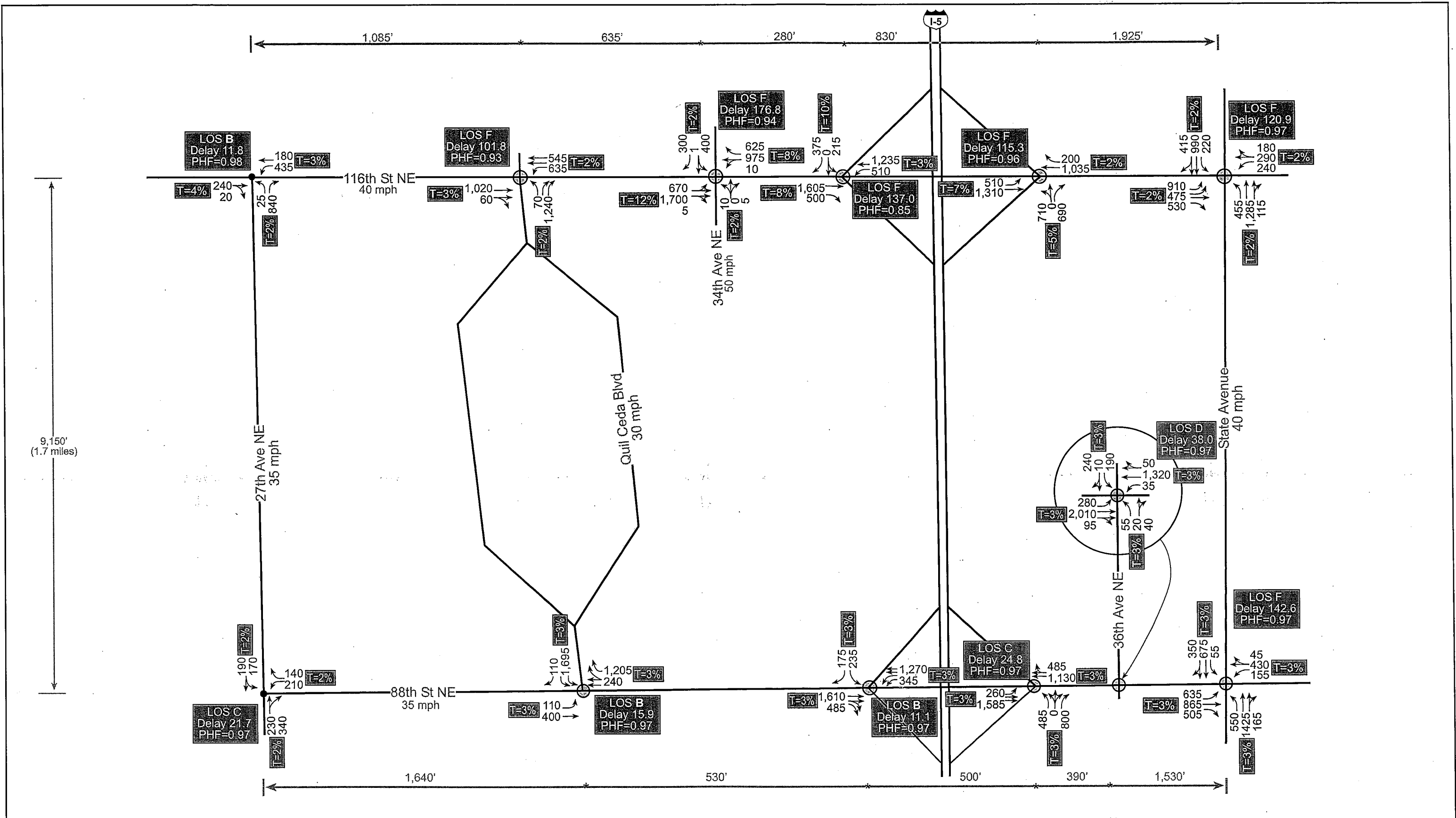
Figure 7-3
Planning Year 2030 No
Build and Build Average
Daily Traffic Volumes



Parametrix 554-1596-017/08(103) 4/05 (B)

Note: PHF = 0.98
 T = Percent Heavy Vehicles
 Speed (Ramps) = 35 mph
 Speed (Mainline) = 70 mph
 Grade is level

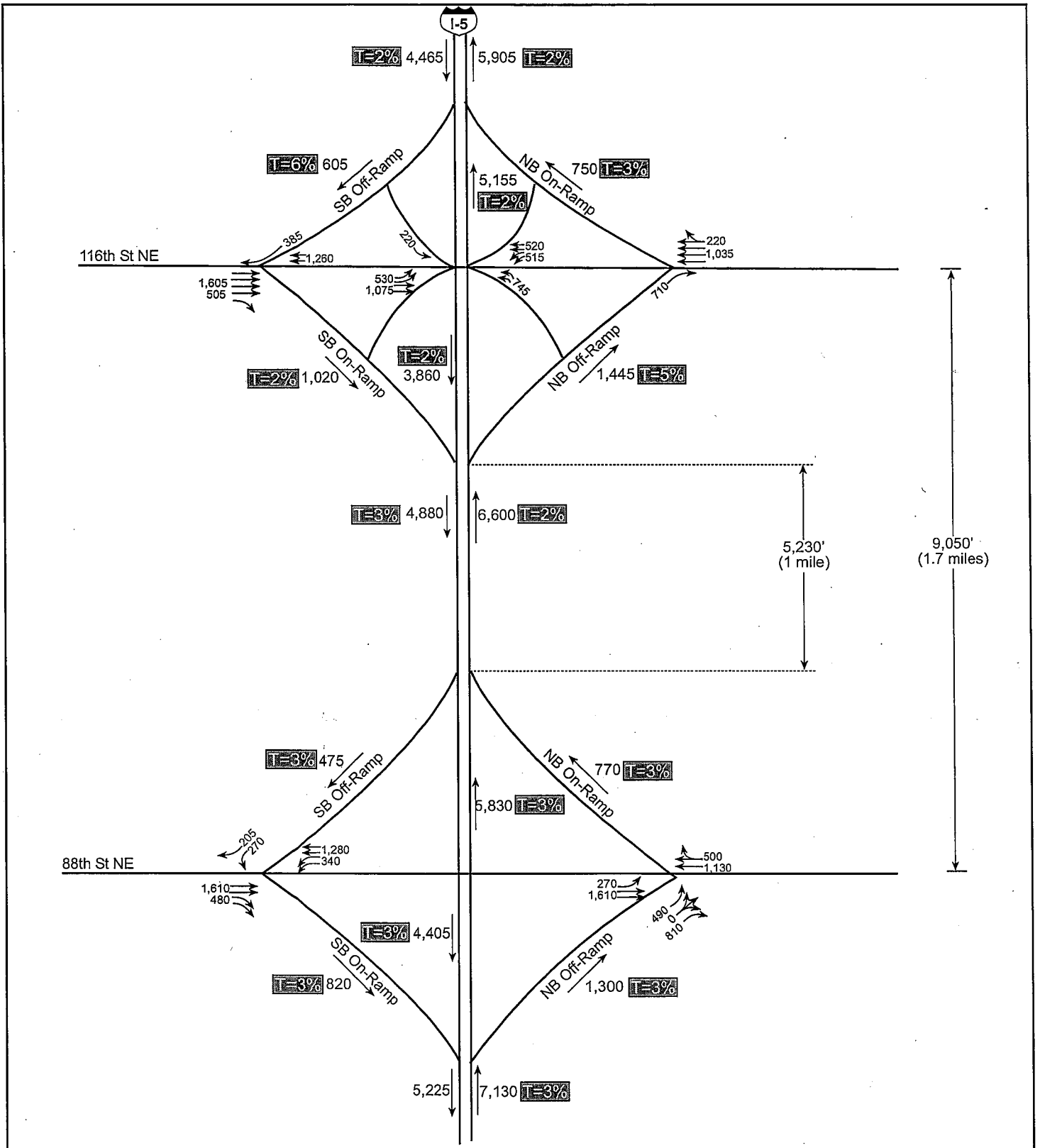
Figure 7-4
Planning Year 2030
No Build I-5
PM Peak Hour Volumes



Parametrix 554-1598-026/03(05) 4/05 (B)

Note: PHF = Peak Hour Factor
 T = Percent Heavy Vehicles
 Grade is level
 ● Unsignalized Intersection
 ⊙ Signalized Intersection

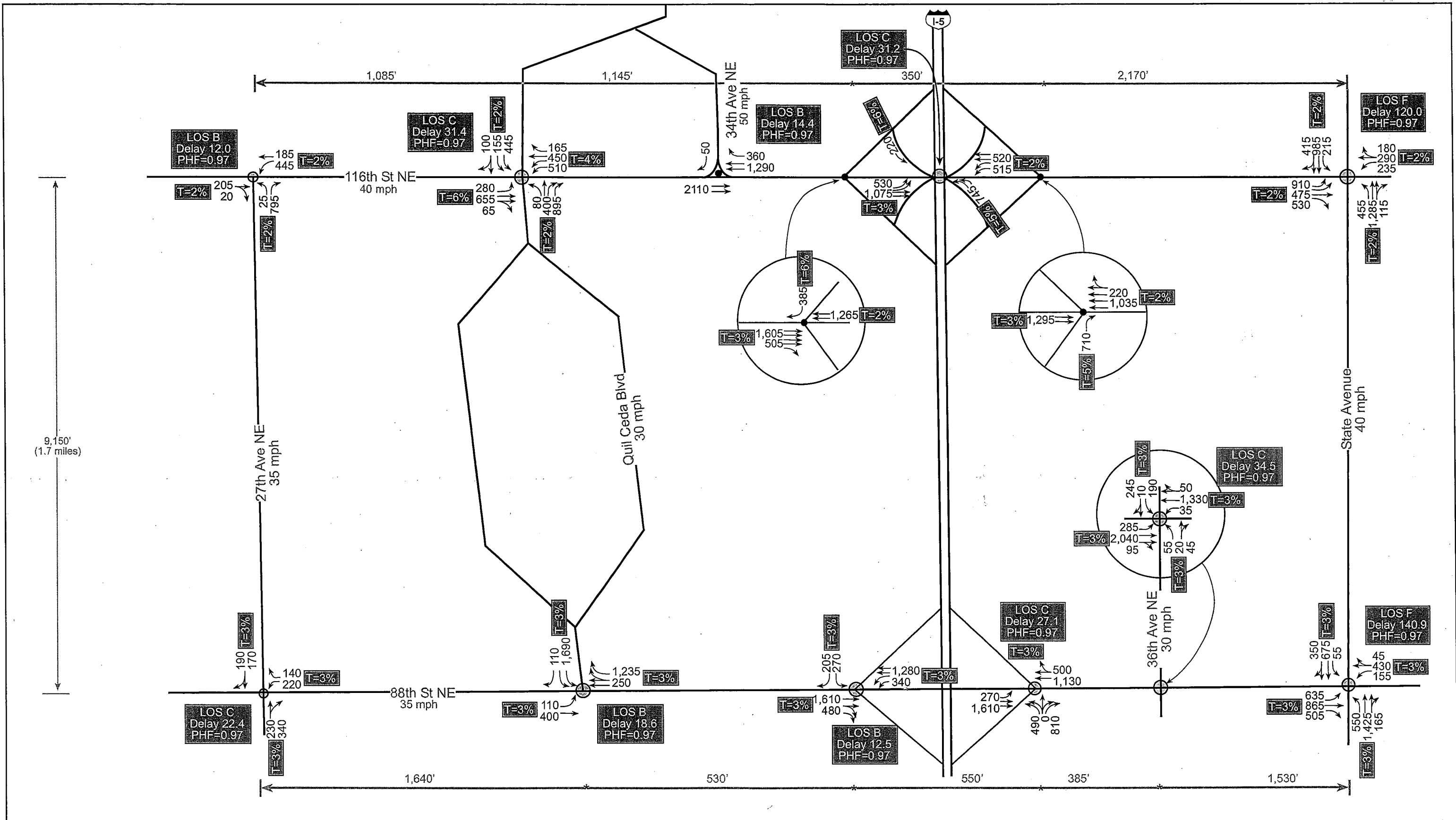
Figure 7-5
Planning Year 2030 No Build
Arterial PM Peak Hour Level of
Service and Traffic Volumes



Parametrix 554-1596-017/08(103) 4/05 (B)

Note: PHF = 0.98
 T = Percent Heavy Vehicles
 Speed (Ramps) = 35mph
 Speed (Mainline) = 70mph
 Grade is level

Figure 7-6
Planning Year 2030
Build I-5 PM Peak
Hour Volumes



Parametrix 554-1598-026/03(05) 4/05 (B)

Note: PHF = Peak Hour Factor
 T = Percent Heavy Vehicles
 Grade is level
 ● Unsignalized Intersection
 ⊙ Signalized Intersection

Figure 7-7
 Planning Year 2030 Build
 Arterial PM Peak Hour Level of
 Service and Traffic Volumes

hour traffic volumes at key points in the interchange vicinity. Figure 7-3 shows the planning year 2030 No Build and Build average annual daily traffic volumes. Year 2030 PM peak hour traffic volumes for the No Build and Build Alternatives are shown in Figures 7-4 through 7-7.

**Table 7-1. PM Peak Hour Traffic Volumes
Year of Opening (2009) and Design Year (2030) for No Build and Build Alternatives**

Location	2009	2030 No Build	2030 Build
I-5 Southbound - South of 116th Street NE I/C	3,605	4,825	4,880
I-5 Southbound - North of 116th Street NE I/C	3,155	4,405	4,465
I-5 Northbound - South of 116th Street NE I/C	4,485	6,570	6,600
I-5 Northbound - North of 116th Street NE I/C	3,990	5,880	5,905
116th Street NE/Northbound Off-ramp	1,415	1,400	1,455
116th Street NE/Northbound On-ramp	675	710	750
116th Street NE/Southbound Off-ramp	570	590	605
116th Street NE/Southbound On-ramp	915	1,010	1,020
Westbound 116th Street NE west of I-5	1,075	1,610	1,650
Westbound 116th Street NE east of I-5	895	1,235	1,255
Eastbound 116th Street NE west of I-5	1,045	2,105	2,110
Eastbound 116th Street NE east of I-5	1,260	2,000	2,005
88th Street NE/Northbound Off-ramp	1,630	1,285	1,300
88th Street NE/Northbound On-ramp	515	745	770
88th Street NE/Southbound Off-ramp	530	410	475
88th Street NE/Southbound On-ramp	1,055	830	820
Westbound 88th Street NE west of I-5	1,580	1,445	1,485
Westbound 88th Street NE east of I-5	1,055	1,615	1,630
Eastbound 88th Street NE west of I-5	1,585	2,095	2,090
Eastbound 88th Street NE east of I-5	1,650	2,385	2,420

7.2.3 Assumed Improvements

In addition to the I-5/116th Street NE interchange, 34th Avenue modification, and Quil Ceda Boulevard extension improvements identified in the preferred alternative, there are other transportation improvements that are identified in adjacent jurisdictions' road improvement plans for the year 2030. No additional improvements are assumed for the 2009 opening year analysis other than the proposed interchange improvements. For this reason, the increase in traffic volume between opening year (2009) and the year 2030 is less pronounced.

Improvements in the project area that are included in other jurisdictions' TIPs and planned improvements by the year 2030 that are included in the No Build and Build Alternatives surface street analysis are summarized in Table 7-2.

Table 7-2. Roadway Improvement Projects Assumed in the Year 2030 No Build and Build Alternatives

Intersection	Improvements
116th Street NE at 27th Avenue NE	<ul style="list-style-type: none"> • Add westbound left-turn lane • Add northbound free right-turn lane (add lane on 116th Street NE east of 27th Avenue NE)
116th Street NE at State Avenue NE ^a	<ul style="list-style-type: none"> • Add eastbound left-turn lane, shared left/through lane, and right-turn lane with east-west split phasing • Add northbound through lane • Add southbound through lane
88th Street NE at 27th Avenue NE	<ul style="list-style-type: none"> • Add southbound left-turn lane and convert to all way stop control
88th Street NE at Quil Ceda Boulevard	<ul style="list-style-type: none"> • Convert eastbound lanes to one left-turn and one through lane with protected left-turn phasing • Convert westbound lanes to one through, one shared through/right-turn, and one right-turn only lane
88th Street NE at I-5 Southbound Ramp	<ul style="list-style-type: none"> • Add southbound right-turn lane (recently constructed) • Add westbound through lane
88th Street NE at I-5 Northbound Ramp	<ul style="list-style-type: none"> • Convert northbound lanes to one left-turn, one shared left/through/right-turn, and one left-turn lane

^a Developer frontage improvements may be required in the westbound direction. These frontage improvements, which could be in place by the year 2030, were not included in the traffic analysis.

7.3 TRAFFIC OPERATIONS ANALYSIS

Detailed operational analyses for existing traffic volume conditions can be found at the end of Section 5 – Policy Point 4. Similar analyses were prepared for the opening year (2009) and design year (2030) conditions. The following summarizes these analyses.

7.3.1 Freeway Ramp Operations

Freeway operations were evaluated based on the HCM methodology using Highway Capacity Software (HCS) Version 4.1a. Basic freeway capacity analysis was performed for the sections of I-5 south of, within, and north of the interchange ramps at 116th Street NE. Merging and diverging capacities at entrance and exit ramps were also evaluated using ramp analysis procedures.

Both procedures (merging and diverging analysis) result in assigning an LOS ranging from A to F based on the traffic density at a given level of traffic flow. Specific traffic densities and a general description of operations for the different LOS ratings are shown in Table 7-3.

The interchanges adjacent to 116th Street NE are at 88th Street NE, 2.3 miles to the south, and SR 531/172nd Street NE, 3.6 miles to the north. The improvements to the 116th Street NE interchange are not projected to significantly change the traffic volumes of the adjacent interchanges or the sections of I-5 between them. The interchange improvements do not significantly alter the overall access opportunities of the transportation network in this area. Furthermore, the distances to adjacent interchanges exceed the operational influence areas of merging/diverging (1,500 feet) or weaving (2,500 feet). Because of this, the 172nd Street NE interchange was not considered in the analyses; however, because of a request by FHWA and standard procedure, the 88th Street interchange was considered. The February 25, 2002 Traffic Operations Analysis Methodology Signature Paper (see Appendix C) describes the decision to not include the 172nd Street NE interchange in the analyses.

Table 7-3. Level of Service Descriptions and Density Thresholds for Freeway Merge/Diverge Areas.

Level of Service	Density (pcpmpl)	Description
A	≤ 10	Operations or speed not dependent on volumes. Motorists free to maneuver without restrictions.
B	>10-20	Some freedom of movement affected. No reduction in speeds.
C	>20-28	Restriction of movement evident. Speed reduced and influenced by traffic flow. Travel still not objectionable.
D	>28-35	Opportunities for lane changes limited. Speed reduced and influenced by traffic flow. Temporary areas of traffic congestion appear, however, traffic flow is generally even and smooth.
E	>35	Heavy flows, significant speed reduction. However, flow is maintained. Little freedom of movement within traffic stream. Roadway operating at or near maximum capacity.
F	Demand exceeds capacity	Stop and go conditions. Traffic movement and speed erratic. Considered failure.

Source: Transportation Research Board 2000.

Year 2030 LOS was calculated at the 116th Street NE and 88th Street NE interchange ramps for the No Build and Build Alternatives using the HCS model. The results of the PM peak hour LOS analysis are summarized in Table 7-4. Refer to Appendix D for the freeway ramp operations analysis calculation sheets.

Table 7-4. Existing and Year 2030 PM Peak Hour Freeway Ramp LOS Analysis Summary

Location	Existing 2003			2030 No Build Alternative			2030 Build Alternative		
	LOS	Density (pcpmpl)	Speed (mph)	LOS	Density (pcpmpl)	Speed (mph)	LOS	Density (pcpmpl)	Speed (mph)
Northbound									
88th Street Off-Ramp	C	25.9	55	F	31.6	55	F	31.7	55
88th Street On-Ramp	C	26.1	60	E	35.8	54	E	36.0	53
116th Street Off-Ramp	D	28.5	55	E	36.3	54	D	33.7	54
116th Street On-Ramp	C	22.4	61	D	32.3	57	D	32.6	56
Southbound									
116th Street Off-Ramp	B	17.9	57	C	25.9	56	C	26.2	56
116th Street On-Ramp	C	20.6	61	D	28.3	59	C	26.9	59
88th Street Off-Ramp	C	20.5	57	C	27.6	57	C	28.0	57
88th Street On-Ramp	C	21.9	61	D	29.8	58	D	29.6	58

pcpmpl = passenger cars per mile per lane
 LOS = level of service
 mph = miles per hour

As shown in Table 7-4, all ramps to and from I-5 at the 116th Street NE and 88th Street NE interchanges currently operate at LOS D or better. By the year 2030, the 88th Street NE interchange northbound on ramp and the 116th Street NE interchange northbound off-ramp would operate at LOS E, and the 88th Street northbound off-ramp would operate at LOS F if no improvements were made. These LOS analysis results do not necessarily account for the long northbound queues that would extend from the I-5 northbound ramps/116th Street NE intersection and spill into the I-5 mainline. All southbound on- and

off-ramps at the 116th Street NE and 88th Street NE interchanges would operate at LOS D or better under the No Build Alternative in the year 2030. Under the Build Alternative, the I-5 northbound off-ramp at the 116th Street NE interchange would improve to LOS D. This is because the Build Alternative would lengthen the acceleration and deceleration lanes. These design improvements would also help alleviate congestion and queues that would occur at the northbound off-ramp with the No Build Alternative.

As shown in Table 7-5, all I-5 mainline sections between the 116th Street NE and 88th Street NE interchanges currently operate at LOS D or better.

Table 7-5. Existing and Year 2030 PM Peak Hour Freeway LOS Analysis Summary

Location	Existing 2003			2030 No Build Alternative			2030 Build Alternative		
	LOS	Density (pcpmpl)	Speed (mph)	LOS	Density (pcpmpl)	Speed (mph)	LOS	Density (pcpmpl)	Speed (mph)
Northbound									
South of 88th Street IC	D	33.1	63	F	*	*	F	*	*
Between 88th Street IC Off-Ramp and On-Ramp	C	23.5	69	E	36.3	60	E	36.3	60
Between 88th Street and 116th Street ICs	D	26.1	68	F	*	*	F	*	*
Between 116th Street IC Off-Ramp and On-Ramp	C	20	70	D	29.3	66	D	29.2	66
North of 116th Street IC	C	21.5	70	E	36.6	60.1	E	36.9	60
Southbound									
North of 116th Street IC	B	15.5	70	C	23.8	69	C	24.2	69
Between 116th Street IC Off-Ramp and On-Ramp	B	13.9	70	C	20.4	70	C	20.7	70
Between 88th Street and 116th Street ICs	B	18.0	70	D	26.8	68	D	27.2	67
Between 88th Street IC Off-Ramp and On-Ramp	B	15.6	70	C	24.0	69	C	24.0	69
South of 88th Street IC	C	19.6	70	D	30.2	65	D	30.0	66

* Results not calculated by HCS when section operates at LOS F.

pcpmpl = passenger cars per mile per lane

LOS = level of service

mph = miles per hour

By the year 2030 for the No Build and Build Alternatives, northbound I-5 operates at LOS E or F south of the 88th Street interchange to north of the 116th Street NE interchange with the exception of the section between the 116th Street off-ramp and on-ramp. I-5 southbound operates at LOS D or better for both the No Build and Build Alternatives.

7.3.2 Local Street Intersection Operations

LOS was also analyzed for intersections along the 116th Street NE and 88th Street NE corridors. Synchro 5.0 software (Build 323) was used to evaluate these intersections based on the methodologies provided in the HCM for signalized and unsignalized intersections. The intersections evaluated in the study area include:

- 116th Street NE/27th Avenue SE (unsignalized)
- 116th Street NE/Quil Ceda Boulevard

- 116th Street NE/34th Avenue NE
- 116th Street NE/SB I-5 Ramps Terminal
- 116th Street NE/NB I-5 Ramps Terminal
- 116th Street NE/State Avenue
- 88th Street NE/27th Avenue SE (unsignalized)
- 88th Street NE/Quil Ceda Boulevard.
- 88th Street NE/SB I-5 Ramps Terminal
- 88th Street NE/NB I-5 Ramps Terminal
- 88th Street NE/36th Avenue NE
- 88th Street NE/State Avenue NE

Intersection operations are also given an LOS rating based on average control delay per vehicle for all vehicles entering an intersection. Table 7-6 shows the LOS definitions and maximum average vehicle delays (seconds) that apply for each rating.

Table 7-6. Level of Service Descriptions and Delay Thresholds for Signalized and Unsignalized Intersections.

Level of Service	Delay (seconds per vehicle)		Description
	Signalized Intersections	Unsignalized Intersections	
A	≤ 10	≤ 10	No restriction
B	>10–20	>10–15	Minor restriction
C	>20–35	>15–25	Some restriction
D	>35–55	>25–35	Increasing restriction and congestion
E	>55–80	>35–50	Substantial restriction and delays
F	>80	>50	Jammed conditions, extreme delays

Source: Transportation Research Board 2000.

Table 7-7 shows the existing, year 2009 and 2030 No Build and Build Alternative intersection LOS results for the PM peak hour. Refer to Appendix D for Synchro LOS analysis calculation sheets.

As shown in Table 7-7, most intersections near the I-5/116th Street NE interchange and I-5/88th Street NE interchange currently operate at LOS D or better during the PM peak hour. The only exception is the 88th Street NE/State Avenue intersection, which currently operates at LOS E. In the year 2009, most intersections would operate similar to existing conditions, with the exception of the 116th Street NE/State Avenue intersection, which would worsen to LOS F conditions by the year 2009. By the year 2030, the 116th Street NE/State Avenue and 88th Street NE/State Avenue intersections would both operate at LOS F during the PM peak hour. In addition, increased volumes in the I-5/116th Street NE interchange area would result in LOS F conditions with the No Build Alternative at the I-5 southbound ramps/116th Street NE, I-5 northbound ramps/116th Street NE, 116th Street NE/Quil Ceda Boulevard, and 116th Street NE/34th Avenue NE, intersections. With the Build Alternative, the SPUI configuration, with increased capacity for turning movements to and from the I-5/116th Street NE northbound and southbound ramps, would operate at LOS C in the year 2030, which is considerably better than No Build conditions. In addition, the realignment of the 116th Street NE/34th Avenue NE intersection to the east would improve intersection operations at the newly combined 116th Street NE/Quil Ceda Boulevard/34th Avenue NE intersection to LOS C in the year 2030.

Table 7-7. PM Peak Hour Intersection LOS Analysis Summary

Intersection	Traffic Control	2003 Existing Conditions		2009 No Build		2009 Build		2030 No Build		2030 Build	
		LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
116th Street NE @ 27th Avenue NE	all way stop	A	7.8	A	8.7	A	8.7	B	11.8	B	12.0
116th Street NE @ Quil Ceda Boulevard	signal	A	7.9	A	5.8	B	13.1	F	101.8	C	31.4
116th Street NE @ Donna's Truckstop with RT out only	minor stop control	B	11.4	C	15.7	C	19.0	F	---	F	---
										E	41.7
116th Street NE @ 34th Avenue NE	signal	B	16.3	B	18.5	B	11.5	F	176.8	B	14.4
116th Street NE @ I-5 Southbound Ramp	signal	B	11.3	C	23.5	C	24.7	F	137.0	C	31.2
116th Street NE @ I-5 Northbound Ramp	signal	C	24.0	D	44.9			F	115.3		
116th Street NE @ State Avenue	signal	D	40.5	D	44.9	D	44.9	F	120.9	F	120.0
Quil Ceda Blvd. Ext @ 34th Avenue NE	minor stop control					C	23.4			F	66.2
(with RT add lane)										E	48.0
(with Roundabout)										B/C	.64 - .76
88th Street NE @ 27th Avenue NE	future all way stop	B	14.5	C	19.3	C	19.3	C	21.7	C	22.4
88th Street NE @ Quil Ceda Boulevard	signal	B	14.7	B	12.5	B	12.5	B	15.9	B	18.6
88th Street NE @ I-5 Southbound Ramp	signal	B	13.0	C	30.9	C	30.9	B	11.1	B	12.5
88th Street NE @ I-5 Northbound Ramp	signal	D	37.5	D	45.4	D	45.4	C	24.8	C	27.1
88th Street NE @ 36th Avenue NE	signal	B	17.4	B	13.8	B	13.8	D	38.0	C	34.5
88th Street NE @ State Avenue	signal	E	56.8	E	78.2	E	78.2	F	142.6	F	140.9

7.3.2.1 Queuing

With the existing I-5/116th Street NE interchange configuration, eastbound right-turn queues at the I-5 southbound ramps/116th Street NE intersection occasionally exceed the available storage capacity during the PM peak hour. When this occurs, northbound left-turn movements may be blocked and queues may spill onto the I-5 mainline. Additionally, the existing westbound right-turn movement queue at the 116th Street NE/34th Avenue NE intersection often exceeds the available storage capacity and extends back to the southbound ramps intersections, affecting interchange operations.

In the year 2030, if no changes are made to the existing interchange configuration, queue lengths for the following traffic movements would further exceed the available storage capacity during the PM peak hour:

- At the I-5 northbound ramps/116th Street NE intersection, the combined queue lengths for the northbound right-turn pocket and shared northbound through/left-turn lane would exceed the length of the I-5 northbound off-ramp, resulting in spillover queues onto the I-5 northbound mainline deceleration lane.
- At the I-5 southbound ramps/116th Street NE intersection, the eastbound through lane queue length would well exceed the available storage capacity, spilling back beyond the 34th Avenue NE/116th Street NE intersection to Quil Ceda Boulevard.
- The westbound queue for the 116th Street NE/34th Avenue NE intersection would exceed the available capacity and extend through the I-5 southbound and northbound ramp intersections, resulting in spillover queues on the I-5 off-ramps.

With the Build Alternative, year 2030 PM peak hour traffic volumes would be adequately accommodated by the SPUI configuration, resulting in no spillover queues.

7.4 ACCIDENT ANALYSIS

7.4.1 I-5 Mainline and Ramps Accident Analysis

Accident data for the I-5 mainline and 116th Street NE and 88th Street NE interchange ramps were obtained from WSDOT for three consecutive years. This data was used to calculate accident rates that are often used to compare the safety of transportation facilities having different traffic volumes and physical characteristics. The accident rates were calculated using the equation defined in the *Washington State Highway Accident Report* (WSDOT 1996). These values were compared to 1996 Washington State highway accident rates published in the report. WSDOT's year 2005-2007 list of high accident corridors (HACs), high accident locations (HALs), and pedestrian accident locations (PALs) was also reviewed to identify areas within the project vicinity that may be experiencing a higher than average number of severe accidents.

7.4.1.1 I-5 Mainline Evaluation

I-5 mainline accident data was obtained from WSDOT for a 3-year period between 2001 and 2003. The 2001 average daily traffic (ADT) volumes were taken from WSDOT's 2001 *Annual Traffic Report*. ADT volumes on the ramps were taken from WSDOT's *Ramps and Roadways 2002* report. Figure 7-8 shows the number of accidents that occurred on I-5 from SR 529 to SR 531 for a 3-year period between 2001 and 2003. Accident data was collected for the I-5 mainline between the following milepost locations:

- I-5 between SR 529 and SR 528 – mainline MP 198.77 to 200.04

- I-5 between SR 528 and 88th Street NE – mainline MP 200.05 to 201.98
- I-5 between 88th Street NE and 116th Street NE – mainline MP 201.99 to 203.99
- I-5 between 116th Street NE and SR 531 – mainline MP 204.00 to 206.90

Accident types and the total number of accidents are summarized in Tables 7-8 and 7-9.

Typically, an accident rate of 1.00 accident per million vehicle miles (acc/mvm) for a 3-year period is used as an industry threshold to evaluate safety along road segments. However, the 1996 Washington State Highway Accident Report (WSDOT 1996) indicates that the state average accident rate for interstates is 1.60 acc/mvm. As shown in Table 7-8, the three northernmost segments evaluated (SR 528 to 88th Street NE, 88th Street NE to 116th Street NE, and 116th Street NE to SR 531) are all substantially below the industry safety threshold and the state average. While the SR 529 to SR 528 segment exceeds the industry safety threshold, the accident rate per million vehicle miles is still below the state average for interstates.

According to the 1996 Highway Accident Reports, the state average of rear-end accidents is 36 percent. As a whole, the most common type of accident in the evaluated segments of I-5 is rear-end accidents and accounts for 45 percent of the total. The SR 529 to SR 528 segment had the highest percentage of rear-end accidents with 57 percent. A relatively high number of fixed-object accidents have also been recorded for these segments; 24 percent compared to the 17 percent state average. Table 7-8 shows that the 88th Street NE to 116th Street NE segment had the highest percentage (34) of accidents involving fixed objects.

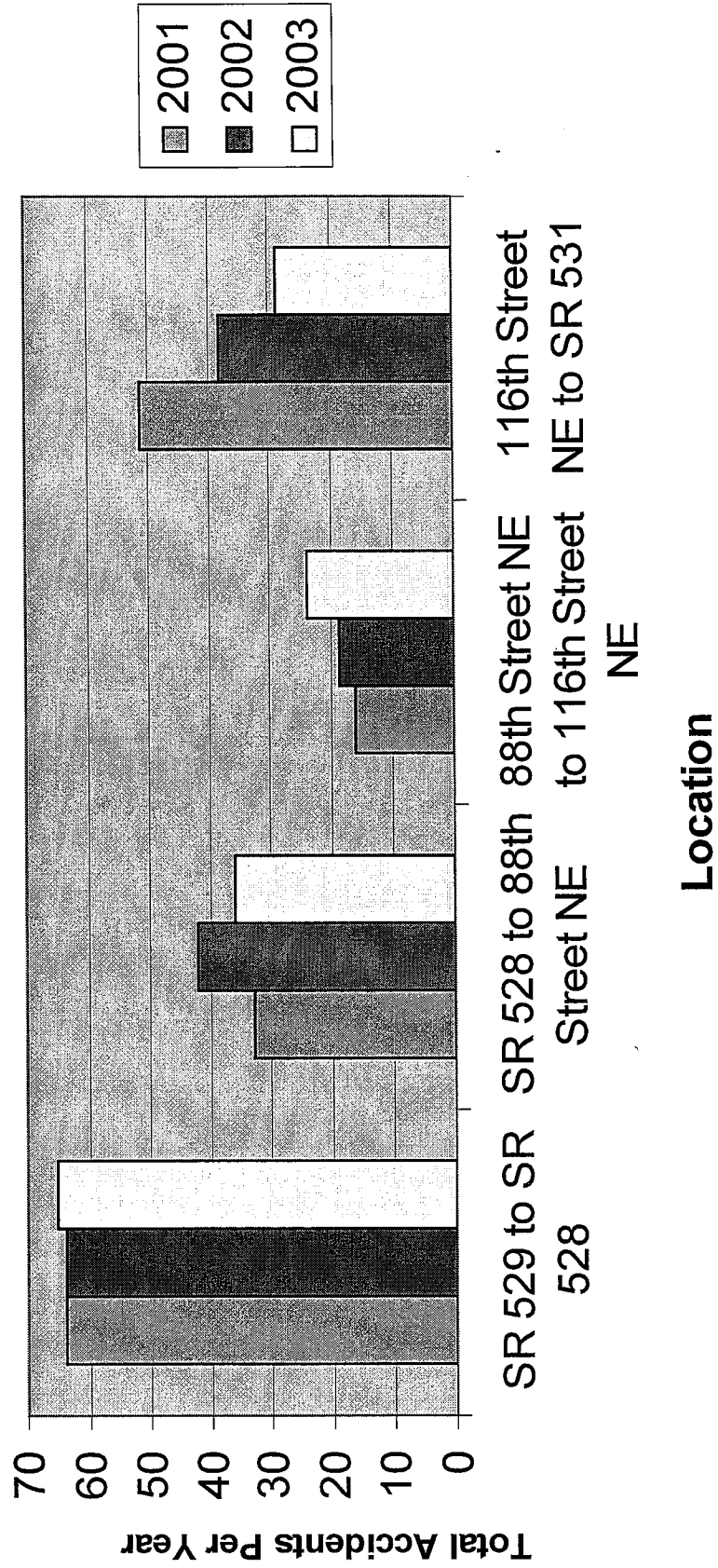
Table 7-9 provides a summary of accidents within the evaluated segments of I-5 with respect to severity, weather conditions, and lighting (day/night). For all roadway segments, there were more property-damage-only (PDO) accidents than accidents with injuries or fatalities. Between 2001 and 2003, all evaluated segments, except for SR 528 to 88th Street NE, had one accident that involved a fatality. The majority of accidents along these segments of I-5 occurred on dry roadway surface conditions (60 to 71 percent), and during daylight hours (58 to 77 percent).

The Build Alternative is not likely to result in an increase or decrease in the number of I-5 mainline accidents as compared to the No Build Alternative.

7.4.1.2 I-5/116th Street NE Interchange Ramps Evaluation

I-5/116th Street NE interchange ramp accident data was obtained from WSDOT for a 3-year period between 2001 and 2003. Accident types and the total number of accidents are summarized in Tables 7-10 and 7-11.

Figure 7-8. Year 2001 to 2003 Accident Data



Source: WSDOT

Table 7-8. I-5 Mainline Accident Rates By Type (2001 - 2003)

Segment (Interchange)	SRMP	Segment Length (mi)	ADT (veh)	Accident Type										Rate (acc/ mvm)
				Rear End	At Angle	Side Swipe	Overturn	Fixed Object	Head On	Ped/ Bicycle	Other	TOTAL		
I-5: SR 529 to SR 528	198.77 - 200.04	1.27	118,500	110	16	22	2	30	0	1	12	193	1.17	
I-5: SR 528 to 88th Street NE	200.05 - 201.98	1.93	104,900	49	11	8	7	32	1	0	7	115	0.52	
I-5: 88th Street NE to 116th Street NE	201.99 - 203.99	2.00	92,800	16	6	6	6	20	0	0	5	59	0.29	
I-5: 116th Street NE to SR 531	204.00 - 206.90	2.90	77,900	41	15	10	5	36	1	0	10	118	0.48	

Source: WSDOT

SRMP = State Route Milepost

mi = miles

ADT = Average Daily Traffic

veh = vehicles

acc/mvm = accidents per million vehicle miles

Table 7-9. I-5 Mainline Accident Totals by Severity, Conditions, and Light (2001-2003)

Segment (Interchange)	SRMP	Segment Length (mi)	ADT (veh)	Severity			Conditions						Light			Rate (acc/ mvm)		
				PDO	Injury ¹	Fatal ²	TOTAL	Dry	Wet	Ice	Snow	Other	TOTAL	Days	Nights		TOTAL	
I-5: SR 529 to SR 528	198.77 - 200.04	1.27	118,500	114	78	1	193	123	63	5	1	1	1	1	148	45	193	1.17
I-5: SR 528 to 88th Street NE	200.05 - 201.98	1.93	104,900	79	36	0	115	69	37	6	1	1	2	115	74	41	115	0.52
I-5: 88th Street NE to 116th Street NE	201.99 - 203.99	2.00	92,800	38	20	1	59	42	13	2	1	1	1	59	39	20	59	0.29
I-5: 116th Street NE to SR 531	204.00 - 206.90	2.90	77,900	74	43	1	118	78	30	5	5	0	0	118	69	49	118	0.48

Source: WSDOT

SRMP = State Route Milepost

mi = miles

ADT = Average Daily Traffic

veh = vehicles

PDO = Property Damage Only

acc/mvm = accidents per million vehicle miles¹ The number of accidents that resulted in at least one injury

² The number of accidents that resulted in at least one fatality

Table 7-10. I-5/116th Street NE Interchange Ramps - Accident Occurrence By Type (2001-2003)

Segment (Interchange)	SRMP	Segment Length (mi)	Accident Type										TOTAL
			Rear End	At Angle	Side Swipe	Overturn	Fixed Object	Head On	Ped/ Bicycle	Other			
88th Street NB On-Ramp	200.76 - 201.19	0.41	0	0	0	0	1	0	0	0	0	1	2
88th Street NB Off-Ramp	200.25 - 200.76	0.53	15	2	0	0	0	0	0	0	0	1	18
88th Street SB On-Ramp	200.18 - 200.76	0.60	1	2	1	3	4	0	0	0	0	2	13
88th Street SB Off-Ramp	200.76 - 201.07	0.30	3	0	1	0	1	0	0	0	0	0	5
116th Street NB On-Ramp	202.47 - 202.87	0.42	0	0	0	0	0	0	0	0	0	0	0
116th Street NB Off-Ramp	202.18 - 202.47	0.29	1	0	0	0	0	0	0	0	0	0	1
116th Street SB On-Ramp	202.06 - 202.47	0.42	1	0	0	1	2	0	0	0	0	0	4
116th Street SB Off-Ramp	202.47 - 202.73	0.28	0	0	0	0	1	0	0	0	0	0	1

Source: WSDOT

NB = Northbound

SB = Southbound

SRMP = State Route Milepost

mi = miles

Table 7-11. I-5/116th Street NE Interchange Ramps - Accident Totals By Severity, Conditions, and Light (2001-2003)

Segment (Interchange)	SRMP	Segment Length (mi)	Severity				Conditions							Light				
			PDO	Injury	Fatal	TOTAL	Dry	Wet	Ice	Snow	Other	TOTAL	Day	Night	TOTAL			
88th Street NB On-Ramp	200.76 - 201.19	0.41	1	1	0	2	2	0	0	0	0	0	0	0	2	2	0	2
88th Street NB Off-Ramp	200.25 - 200.76	0.53	9	9	0	18	9	9	0	0	0	0	0	0	18	15	3	18
88th Street SB On-Ramp	200.18 - 200.76	0.60	10	3	0	13	4	7	1	0	0	1	0	1	13	7	6	13
88th Street SB Off-Ramp	200.76 - 201.07	0.30	4	1	0	5	4	1	0	0	0	0	0	0	5	4	1	5
116th Street NB On-Ramp	202.47 - 202.87	0.42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116th Street NB Off-Ramp	202.18 - 202.47	0.29	0	1	0	1	1	0	0	0	0	0	0	0	1	1	0	1
116th Street SB On-Ramp	202.06 - 202.47	0.42	3	1	0	4	2	2	0	0	0	0	0	0	4	4	0	4
116th Street SB Off-Ramp	202.47 - 202.73	0.28	0	1	0	1	1	0	0	0	0	0	0	0	1	0	1	1
Total			27	17	0	44	23	19	1	0	1	0	1	0.02	44	33	11	44
Percentage			0.61	0.39	0	0.53	0.43	0.02	0.02	0	0.02	0	0.02	0.02	0.75	0.25	0.25	0.25

Source: WSDOT

NB = Northbound

SB = Southbound

SRMP = State Route Milepost

mi = miles

PDO = Property Damage Only

Similar to the mainline data, the majority of accidents that occurred on the I-5/116th Street NE interchange ramps were rear-end accidents; 48 percent compared to the state average of 36 percent. Because of the low number of total accidents at each ramp (4 of 8 ramps had fewer than two accidents over the 3-year period), it is difficult to interpolate historical accident trends per ramp. However, the 88th Street NE northbound off-ramp (18 accidents) and southbound on-ramp (13 accidents) had more accidents compared to the other on- and off-ramps (between 0 and 5 accidents) between 2001 and 2003 (see Table 7-10).

The severity, roadway surface, and lighting conditions of accidents that occurred on the 88th Street NE and 116th Street NE on- and off-ramps are summarized in Table 7-11. Of the 44 total accidents during the 3-year period, 27 (61 percent) resulted in property damage only, no fatalities, 23 (54 percent) were on dry roadway surfaces, and 33 (75 percent) occurred during daylight hours.

7.4.1.3 High Accident Locations

A list of year 2005-2007 HACs, HALs, and PALs in the study area was provided by WSDOT's Northwest Region. Each of these are defined as follows:

- **High Accident Corridor (HAC)** – a one-mile or longer section of highway that has experienced a higher than average number of severe accidents.
- **Pedestrian Accident Location (PAL)** – a section of highway with four or more pedestrian collisions with vehicles in a six-year period.
- **High Accident Location (HAL)** – a section of highway less than a mile long that experienced a higher than average number of severe accidents.

The 2005-2007 HAL, HAC, and PAL report did not list any HACs or PALs in the project area. The report did identify the SR 528/4th Street northbound off-ramp and the 88th Street NE northbound off-ramp as HALs, but these locations would not be worsened (or improved) by this project.

7.4.2 116th Street NE Accident Analysis

Snohomish County and the City of Marysville provided accident data for 116th Street NE between 27th Avenue NE and State Avenue for the years 2001 through 2003. Average accident rates were calculated at intersections along this segment using ADT volumes that were obtained by increasing corridor PM peak traffic counts by a factor of 12. This factor was derived from the combination of ADT counts and PM peak hour traffic counts in the area and the percentage of the PM peak hour traffic volumes to the ADT volumes. Intersection accident types and accident rates experienced along 116th Street NE between the years 2001 and 2003 are summarized in Table 7-12.

As shown in Table 7-12, the 116th Street NE/State Avenue intersection experienced the highest number of accidents along 116th Street NE. Most of the accidents that occurred at this intersection were rear-end accidents that were likely caused by congested conditions. Accident rates were relatively low at all other locations along the study corridor.

Table 7-12. Intersection Accident Types and Rates Along 116th Street NE

Location	Ramp Accident Type										Total Accidents	ADT	Average Accident Rate (per MEV)	
	Angle	Bicycle	Fixed Object	Head On	Other	Overturned	Railroad	Rear End	Side Swipe	T-Bone				
116th Street NE at:														
27th Ave. NE			1									1	4,400	0.21
34th Ave. NE	9		1				4					14	21,800	0.42
36th Dr. NE					2		4	1				8	15,300	0.48
38th Dr. NE							5					5	15,800	0.29
41st Dr. NE							1					1	15,800	0.06
BNRR Tracks						1						1	15,800	0.06
I-5 Overpass	3		1	1			5					10	17,900	0.51
I-5 NB Ramps				1			2					3	25,600	0.11
I-5 SB Ramps	3		3			1	4		1			11	23,900	0.42
State Ave		1			4		18	2	5	2		32	25,800	1.13
WSP ENT					2							2	4,400	0.41
TOTAL	15	1	6	2	8	1	43	3	6	3	88	--	--	--

Source: Snohomish County and the City of Marysville, January 1, 2001 to December 31, 2003
 ADT = Average Daily Traffic
 MEV = Million Entering Vehicles

7.4.3 Comparison of Build versus No Build Alternatives

A report prepared by the Virginia Transportation Research Council (1997) found no significant difference in the overall safety of a SPUI compared to a diamond interchange. However, the Build Alternative would result in a reduction in congestion at and near the I-5/116th Street NE interchange, which could decrease accident rates in the area. Rear-end accidents, which are most common in the I-5/116th Street NE interchange vicinity, are often caused by a vehicle entering a congestion location without appropriately reducing their speed. A reduction in congestion could reduce the occurrence of rear-end accidents.

7.5 SUMMARY

Overall traffic volumes at the I-5/116th Street NE interchange are projected to increase dramatically due to projected growth in the project area. As a result, future traffic operations would worsen significantly at the I-5/116th Street NE interchange and adjacent local streets without any improvements to the interchange configuration. Although no significant changes to projected travel patterns would result from the Build Alternative, the proposed SPUI configuration and intersection improvements on 116th Street NE near the interchange would provide the available capacity to accommodate the projected traffic growth in the area. The following points summarize the conclusions from the analyses presented in this chapter.

Freeway Ramp Operations

Freeway ramp operations would be similar for both the No Build and Build Alternatives at the 116th Street NE and 88th Street NE interchanges. The Build Alternative does introduce an improvement at the 116th Street NE northbound off-ramp diverge area and southbound on ramp merge area, which would operate at LOS E and LOS D, respectively, with the No Build Alternative in the year 2030. These two locations would operate at LOS D and LOS C, respectively, with the Build Alternative in the year 2030. The HCS ramp analysis does not reflect the operational improvement that would result from the reduction of queues at the ramp terminal intersections with the Build Alternative.

Local Street Intersection Operations

Ramp intersections at the I-5/116th Street NE interchange would operate dramatically better for the Build Alternative compared to the No Build Alternative during the PM peak hour. In particular, intersection LOS and average vehicle delays would improve at the SPUI compared to the existing conventional diamond interchange. In addition, long eastbound and northbound queues that would form with the conventional diamond interchange configuration would not form with the proposed SPUI configuration. With the Build Alternative, the new 116th Street NE/Quil Ceda Boulevard/34th Avenue NE intersection would operate better than the separate 116th Street NE/Quil Ceda Boulevard and 116th Street NE/34th Avenue NE intersections with the No Build Alternative. All other local street intersections evaluated as part of this APDR would operate similarly with the No Build and Build Alternatives.

Traffic Safety

Based on a review of historical accident data on I-5 and national information on the safety of SPUIs, the SPUI configuration would not necessarily improve safety in the I-5/116th Street NE interchange area. However, the overall reduction in traffic congestion resulting from all of the proposed design improvements could reduce the occurrence of accidents.

8. POLICY POINT 7: COORDINATION

Are all coordinating projects and actions programmed and funded?

The WSDOT requires that when a new or revised access is proposed, public and/or private agencies commit to:

- Coordinate comprehensive land use and transportation plans, and
- Complete non-interstate improvements necessary for the interchange to function as proposed.

This section summarizes the coordination with other agencies and the commitments by public and private agencies to construct the non-interchange transportation network necessary for the interchange to operate as proposed.

The proposal currently involves seven parties to complete the project. WSDOT, BIA, and FHWA are co-lead agencies for the project. The Tulalip Tribes and the City of Marysville are cooperating agencies. Monthly coordination meetings have been held with these agencies, as well as Snohomish County and Community Transit.

The project will be funded and constructed in phases. The first phase will be the local road improvements which include extending Quil Ceda Boulevard approximately 2,000 feet north of 116th Street NE to connect with 34th Avenue NE. The second phase is to reconstruct the interchange to a SPUI. The Tulalip Tribes have provided all funding for the planning, environmental process, right-of-way acquisition and engineering of the project. FHWA has dedicated approximately \$3 million towards the project which will be used for the first phase of construction. WSDOT has also dedicated approximately \$900,000 from the 2005 Transportation Partnership Account for use in the 2005-2007 biennium. The Tulalip Tribes and WSDOT are pursuing additional funding for the remaining \$40 million. If funding needs are met, construction of the Quil Ceda Boulevard Extension would take place March through September 2005, and construction of the 116th Street NE interchange would take place between March 2007 and September 2009.

The monthly coordinating meetings have been the forum for development and evaluation of alternatives, as well as recommendation of the preferred alternative. The following describes the commitments made by each party.

8.1 TULALIP TRIBES

The Tulalip Tribes have provided project funding for the pre-design and environmental phase of the project. They are actively pursuing federal funding for interchange construction. They will continue to lead project implementation efforts through completion of the final environmental assessment (EA) and record of decision (ROD). The Tulalip Tribes will also lead the development of project phasing and the final plans, specifications, and estimates (PS&E) for the selected alternative.

8.2 WSDOT

WSDOT is one of the co-leads for the environmental document and has been actively involved in a review capacity for the channelization plans, traffic analysis, and environmental reports. WSDOT has assigned the project to a project engineer and is expected to lead the construction effort once the project design is complete.

8.3 BIA

BIA is another of the co-leads for the environmental document and is involved with the transfer of tribal trust land for the county road realignment necessary for the interchange to operate efficiently.

8.4 FHWA

FHWA is another of the co-leads for the environmental document and has been actively involved in a review capacity for the APDR methodology and the environmental process. Once the APDR and EA are approved, FHWA will continue to be involved with design review.

8.5 CITY OF MARYSVILLE

The City of Marysville is a cooperating agency for the EA because part of the project is located within the City limits. The City has planned a separate project to improve 116th Street NE between the interchange and State Street. The City has also planned improvements to other arterials on the network, including widening State Street.

8.6 SNOHOMISH COUNTY

Snohomish County has been an active participant in the monthly coordination meetings and has provided review of plans for the Quil Ceda Boulevard extension. The extended roadway is currently planned to be on Tulalip Indian Reservation right-of-way, but will be maintained through an agreement with Snohomish County.

8.7 COMMUNITY TRANSIT

Community Transit (CT) has been an active participant in the monthly coordination meetings and attended the agency scoping meeting for the project. CT has expressed concerns about park and ride access and impacts to transit operations, both in the monthly meetings and in written comments after the scoping meeting. Separate meetings were held with CT in 2003 to attempt to resolve the issues they raised, and discussions are on-going.

9. POLICY POINT 8: PLANNING AND ENVIRONMENTAL PROCESSES

What is the status of the proposal's planning and environmental processes?

Policy Point 8 is intended to ensure that when a new or revised access is implemented, the necessary actions are taken to meet the planning requirements and the environmental processing of the proposed revision. An environmental assessment (EA) is currently being prepared to address the impacts of the proposed access modification. The EA will meet National Environmental Policy Act (NEPA) requirements. The NEPA document will subsequently be adopted under the State Environmental Policy Act (SEPA). Agency and public scoping meetings were held in June 2003. A draft EA was issued in spring 2005 and a finding of no significant impacts (FONSI) is expected to be issued by fall 2005.

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APPENDIX A

First and Second Level Screening Backup Memos and Tables

116th Street NE Interchange
Preliminary Alternatives Screening

Explanation for Ratings
12-30-02

This summary of results from the screening process for preliminary alternatives describes the reasons for the ratings given to each alternatives in each of the screening criteria. The ratings, as summarized in the graphic matrix, were arrived at by the project team at a project meeting on October 31, 2002.

For each criteria, three rating options are provided:

- Least Impacts
- Medium Impacts
- Most Impacts

The ratings are intended to indicate relative magnitude, but not to provide the means to compare additive scores for each alternative.

Purpose and Need: The alternative is consistent with the identified purpose and need: Serving future transportation needs of adopted land use plans in the Marysville/Tulalip area.

- Alternative 1-9A – All have sufficient capacity to meet future interchange capacity demands. *Least Impact*
- Alternative 10 – Widening the overpass only, without changes to existing ramps is not likely to meet future demands because of insufficient capacity due to queuing on 116th for left turns onto ramps. *Most Impact*

Geometric Feasibility: The alternative satisfies local, state and/or federal design requirements (interchange spacing, etc).

- Alternative 1 – Loop ramps in the NW and SE quadrants fully satisfies all geometric design standards. *Least Impact*
- Alternative 1A – Loop ramp in the NW with buttonhook ramps in the SE quadrant technically satisfies geometric standards. However, is deemed undesirable because of the buttonhook ramps in the SE quadrant. Encountering a buttonhook ramp along the Interstate 5 corridor is thought to produce a different driver expectations regarding freeway ramp geometrics. This can lead to confusion, poor decision-making, and ultimately, accidents. A worst-case scenario for drivers approaching the ramp from the arterial involves wrong-way movement on the ramps leading to severe hazards to both mainline traffic and the vehicle making the wrong-way approach. This would occur from a driver accidentally turning from 39th into the northbound (NB) off-ramp, having mistaken it for the entrance to the northbound on-ramp. *Medium Impacts*
- Alternative 2 – Single Point Urban Interchange (SPUI) fully satisfies all geometric design standards. *Least Impact*

- Alternative 3 – Diamond configuration with 800 foot ramp spacing technically satisfies geometric standards. However, this configuration is deemed undesirable because of the severely limited queue storage between the ramp intersections. **Medium Impacts**
- Alternative 4 – Diamond interchange with 1,200 foot ramp spacing fully satisfies all geometric design standards. **Least Impact**
- Alternative 5 & 6 – Southbound (SB) off-ramps connecting to 34th Ave with partial diamond is similar to Alternative 4. These alternatives satisfy all technical geometric standards but are deemed quite undesirable because of the buttonhook ramps in the NW quadrant. **Medium Impacts**
- Alternative 7 – Buttonhook ramps in the SE quadrant and SB off-ramps connecting to 34th Ave is similar to 1A and 6. This alternative satisfies all technical geometric standards, but is deemed quite undesirable, as it combines the undesirable buttonhook ramps common to Alternatives 1A and 9A. **Medium Impacts**
- Alternative 8 – Full diamond configuration shifted to the north satisfies all geometric design standards. **Least Impact**
- Alternative 9 – Loop ramps in NE and NW quadrants fully satisfies all geometric design standards. **Least Impact**
- Alternative 9A – Buttonhook ramp in the NE quadrant with loop in the NW is similar to 1A. This alternative satisfies all technical geometric standards, but is deemed quite undesirable because of the circulation and safety impacts of the buttonhook ramps, in the NE quadrant. **Medium Impacts**
- Alternative 10 – Widening the overpass only, without changes to existing ramps does not meet minimum geometric design standards for distance between ramp intersections. This design results in severely inadequate queue storage between ramp intersections. Not geometrically feasible. **Most Impact**

Environment: The alternative would meet applicable physical and natural environmental requirements with feasible mitigation.

Impacts of widening 116th Ave NW from the east side of the interchange to the intersection with State Street are not included in the analysis, since widening of this minor arterial is incorporated in the City of Marysville, 116th Street Planning Area, Master Plan and will proceed as a separate project.

- Alternative 1 – Realigned 34th Ave will cross Quil Ceda Creek, and possibly associated wetlands; however, a bridge may partially mitigate impacts. This may represent an improvement over the existing 34th Ave creek crossing using fill and a culvert. (The impact of the 34th Ave relocation is the same in all alternatives except Alternative 10). In the NW quadrant, additional crossings of Quil Ceda Creek are required by the SB off-ramp and loop westbound (WB) to SB on-ramp. These total width of these ramp crossings is likely to be greater than the existing stream crossing; however, impacts may be mitigated by a bridge, as compared to the existing fill and culvert. To the SE, the NB loop on-ramp will introduce an additional stream crossing, which may be mitigated with a bridge. This ramp may

also affect wetlands associated with the stream. The WB to NB loop off-ramp may encroach on the stream buffer to the SE, but will not cross the stream. **Most Impacts**

- Alternative 1A – Same impacts as realigned 34th Ave. NW quadrant same as Alternative 1. SE quadrant buttonhook ramps crossings of Quil Ceda Creek will result in greater impact because both on- and off-ramp cross the creek resulting in a wider crossing. Impacts may be partially mitigated by a bridge. **Most Impacts**
- Alternative 2 – SPUI produces the same impacts of realignment of 34th Ave. Construction of SPUI likely to be entirely within existing area of existing interchange improvements. Crossings of Quil Ceda Creek may be improved by utilizing bridges instead of the existing fill with culverts. **Least Impacts**
- Alternative 3 – Diamond configuration with 800 foot ramp spacing. Same impacts of realigned 34th Ave. SB on-ramp relocation in the SW quadrant would encroach slightly on existing Quil Ceda Creek buffer. **Medium Impacts**
- Alternative 4 — Diamond interchange with 1,200 foot ramp spacing. Same impacts of realignment of 34th Ave. Ramp relocation in the SW quadrant would encroach on existing Quil Ceda Creek more than Alternative 3 and may require re-channelling the stream. Ramp relocation in NW quadrant may displace a section of the current creek alignment.. This may be mitigated by re-aligning the creek channel. The existing channel was re-aligned in the 1970s to accommodate construction of the current interchange. Re-alignment, together with utilization of bridges for the ramp and 116th Street crossings of the stream could produce a more natural stream environment, except for the loss of mature vegetation which has been established over the past 30 years. Ramp termini to south may require widening of I-5 crossing of creek. **Medium Impacts**
- Alternative 5 & 6 – SB off-ramps connecting to 34th Ave with partial diamond has the same impacts of realignment of 34th Ave and the diamond interchange ramps as Alternative 4, except that the encroachment of the ramp on Quil Ceda Creek to the NW would be avoided. Single lane SB off-ramp to 34th Ave in NW quadrant (braided under 34th Ave in Alternative 5) would add an additional crossing of Quil Ceda Creek. **Most Impacts**
- Alternative 7 – Same impacts of realigned 34th Ave and diamond interchange as Alternative 4. Buttonhook ramps in SE quadrant has same impacts of additional Quil Ceda Creek crossing as Alternative 1A. Single lane SB off-ramp to 34th Ave in NW corner would add additional crossing of Quil Ceda Creek as in Alternatives 5 & 6. **Most Impacts**
- Alternative 8 – Full diamond configuration shifted to the north has same impacts of realignment of 34th Ave. Moving alignment north would reduce SW quadrant on-ramp encroachment on the existing Quil Ceda Creek buffer, however additional encroachment on creek may occur to NW. Ramp termini to south would be less likely to require widening of the I-5 crossing of the creek. **Medium Impacts**
- Alternative 9 – Loop ramps in NE and NW quadrants. Same impacts of realigned 34th Ave. In NW quadrant, off-ramp SB and loop to NW will have same impacts as Alternative 1 of additional Quil Ceda Creek crossings. Loop

ramp to NE will avoid stream crossing, but may be in an area with wet soils.

Medium Impacts

- Alternative 9A – Buttonhook ramps in the NE quadrant with a loop ramp in the NW has similar impacts as Alternative 9. Buttonhook ramps in NE quadrant will have slightly lower environmental impacts than the loop. **Medium Impacts**
- Alternative 10 – Widening the overpass only, without changes to existing ramps would avoid the impacts of realigning 34th Ave. Impacts of widening the overpass would be negligible on streams if retaining walls replaced the existing fill prism. **Least Impacts**

Land Use: The alternative avoids or minimizes negative land use impacts (e.g. displacement, neighborhood disruption, curtailment of land owner access due to interchange proximity, etc.)

Impacts of widening 116th Ave NW from the east side of the interchange to the intersection with State Street are not included in the analysis, since widening of this minor arterial is incorporated in the City of Marysville, 116th Street Planning Area, Master Plan and will proceed as a separate project.

- Alternative 1 – Realigned 34th Ave will cross parcel north of 116th and west of I-5 which has tribal commercial zoning. If aligned with Quil Ceda Boulevard in the Business Park, it may increase commercial visibility. It also would divide the parcel into two, which might be an advantage or disadvantage, depending on the scale of commercial development. This impact is the same for all alternatives. The loop ramp in NW quadrant would displace potentially developable commercial land, some of which is currently constrained by proximity to the stream. Interchange proximity would require relocation of access to Donna's Truck Stop in the SW quadrant to within about 300 feet of the future Quil Ceda Boulevard. Loop ramp in the SE quadrant would displace an existing mobile home park and other residences and reduce development potential in a property owned by the Tulalip Tribes south of the railroad right-of-way. **Most Impacts**
- Alternative 1A – Same impacts east of I-5 for the realigned 34th Ave, loop ramp in NW and access restriction to Donna's Truck Stop. Loop ramp in the NW quadrant same as Alternative 1. In SE quadrant buttonhook ramps would avoid existing residential neighborhoods, but likely increase noise and other proximity impacts. More displacement of potential development would occur on the tribal property south of the railroad. **Medium Impacts**
- Alternative 2 – SPUI produces the same impacts of realigned 34th Ave on property NE of interchange. There would be no impact on Donna's Truck Stop from access control. Elsewhere, negligible impacts would occur because of construction of SPUI entirely within area of existing interchange improvements. **Least Impacts**
- Alternative 3 – Diamond configuration with 800 foot ramp spacing. Same impacts of realigned 34th Ave. Ramp relocation would not result in interchange proximity access restrictions to Donna's Truck Stop., Acquisition of land, but not residences would occur to the NE and SE. Proximity of ramps would lead to

higher noise impacts to the SE, which may be mitigated by noise barriers. *Least Impacts*

- Alternative 4 – Diamond interchange with 1,200 foot ramp spacing. Same impacts of realigned 34th Ave on property to NW. Impacts on Donna's Truck Stop from access restrictions may shift the existing driveway a short distance to the east. Acquisition to the east of I-5 would displace residences and mobile homes and result in noise impacts. Due to the proximity of the NB on-ramp, access control would require the 36th Drive NE/116th Street intersection to be relocated further to the east in order to provide access for the neighborhood to the north. Closure of existing driveways near the ramp termini would require re-orientation and consolidation of driveways serving several parcels on the south side of 116th Street, including two mobile home parks. *Medium Impacts*
- Alternative 5 & 6 – SB off-ramps connecting to 34th Ave with partial diamond has same impacts of realigned 34th Ave on property to NW. There would be impacts of access restrictions on either side of the off-ramp connection to 34th Ave to future development of the vacant parcel. There would be no impacts on Donna's Truck Stop from access restrictions. Acquisition to the east of I-5 would be the same as Alternative 4 and displace residences and mobile homes and result in noise impacts. Due to the proximity of the NB on-ramp, access control would require the 36th Drive NE/116th Street intersection to be relocated further to the east in order to provide access for the neighborhood to the north. *Medium Impacts*
- Alternative 7 – Buttonhook ramps in the SE quadrant and SB off-ramps connecting to 34th Ave have the same impacts as the realigned 34th Ave on property to NW. There would be no impacts on Donna's Truck Stop from access restrictions. Buttonhook ramps to the SE would have the same impacts as Alternative 1A on development potential of undeveloped parcels and increase noise and other proximity impacts on the mobile home park. *Medium Impacts*
- Alternative 8 – Full diamond configuration shifted to the north has the same impacts as the realigned 34th Ave. Moving diamond interchange alignment north would reduce SE quadrant on-ramp encroachment on the existing mobile home park. Slight additional encroachment on undeveloped parcels would occur to the NE. The existing uses along the north side of 116th, west of approximately 39th Ave NE, would be displaced. Due to proximity to the NB on-ramp, access control would require shifting local access from 116th Street further to the east, and require a general re-orientation of access on the south side of 116th. *Medium Impacts*
- Alternative 9 – Loop ramps in NE and NW quadrants have the same impacts as the realigned 34th Ave. South of 116th Street, changes proposed for NB off-ramp and SB on-ramp will not result in any displacements, but may have some increase in noise and other proximity impacts on the mobile home park to the SE. Ramps to the NW will have the same impacts as Alternative 1 on displacement of potentially developable commercial land. Loop ramp in NE will displace about 16 single-family lots, five of which are north of the Marysville proposed Business zoning. Displaced undeveloped land with commercial zoning would total about 5 acres. *Most Impacts*

- Alternative 9A – Impacts would be the same as Alternative 9, except in the NE where the buttonhook style ramps would displace less commercially zoned land. **Medium Impacts**
- Alternative 10 – Retention of existing interchange and ramp configuration, with widening of overpass, would not displace adjacent uses. Proximity impacts from noise would remain. **Least Impacts**

Environmental Justice: The alternative avoids, minimizes, or mitigates disproportionate impacts on minority, low-income or other populations with special needs.

- Alternative 1 – Loop ramps in the SE quadrant impact the only known low-income populations in the area – the two adjacent mobile home parks in the SE quadrant of the interchange. One of these parks limits its residents to the elderly, a population with additional special needs. The WB to NB loop ramp in this alternative would displace both mobile home parks. **Most Impacts**
- Alternative 1A – In the SE quadrant, the proposed buttonhook ramps would avoid the existing mobile home parks, but likely increase noise and other proximity impacts. Noise impacts may be mitigated by noise barriers. **Least Impacts**
- Alternative 2 – Construction of SPUI entirely within area of existing interchange improvements would avoid displacement. Proximity impacts such as noise would be the same or slightly lower than the existing interchange configuration because NB off-ramp may be further to the west. **Least Impacts**
- Alternative 3 – Diamond configuration with 800 foot ramp spacing requires acquisition of land, but not residences adjacent to the mobile home park to the SE. Proximity of ramps would lead to higher noise impacts, which may be mitigated by noise barriers. **Least Impacts**
- Alternative 4 – Diamond interchange with 1,200 foot ramp spacing would lead to displacement of 8 to 10 mobile home residence and result in greater noise impacts to the remainder of homes because of closer proximity, which may be mitigated by noise barriers. Access control due to proximity to NB on-ramp would require relocation of the current mobile home park access further to the east. Shifting further to the north, as in Alternative 8, would reduce displacement impacts to mobile home residences, but would likely require greater re-orienting of the circulation system. **Medium Impacts**
- Alternative 5 & 6 – SB off-ramps connecting to 34th Ave with partial diamond have the same impacts as Alternative 4. NB off-ramp in the SE displaces mobile home units. **Medium Impacts**
- Alternative 7 – Buttonhook ramps in the SE quadrant and SB off-ramps connecting to 34th Ave would avoid displacement of units in the mobile home park and have the same proximity impact of increased noise as Alternative 1A. **Least Impacts**
- Alternative 8 – Moving the diamond interchange alignment north would reduce on-ramp encroachment on the existing the mobile home park to the SE. The preliminary plan moves the centerline about 200 feet and reduces displacement to one or two units, plus relocation of the access driveway to meet access control

requirements. Moving the interchange further north could eliminate displacement to the SE, but would require additional changes to internal circulation to parcels south of 116th. *Least Impacts*

- Alternative 9 & 9A – Loop ramp or buttonhook ramp in NE quadrant and loop ramp in NW quadrant preserves the existing off-ramp in the SE quadrant and has no impact on the mobile home park. *Least Impacts*
- Alternative 10 – Retention of existing interchange and ramp configuration, with widening of overpass, would not displace adjacent uses. Proximity impacts from noise would remain. *Least Impacts*

TRANSPORTATION

Local Mobility - Circulation: The alternative maintains or improves local traffic circulation, including construction impacts. (The greater the restriction or diversion of the local arterial system the greater the impact of the proposal. Additionally, any potential overflow due to lack of capacity or increased number of conflict points/signals for local traffic would increase the impacts of the alternative)

- Alternative 1 – Loop ramps in the NW and SE quadrants have few restrictions and diversions in local circulation system near ramps. No change to local arterial system other than those realignments that are common to all the alternatives. The alternative also provides for a standard crossing with sufficient capacity for local traffic to cross the freeway. *Least Impacts*
- Alternative 1A – Buttonhook ramps in the SE quadrant provide a more circuitous route for local access to and from the freeway and extends the restricted access area further into the properties in the SE quadrant. Increases interaction/conflict points with 39th Drive. *Medium Impacts*
- Alternative 2 – SPUI produces the least impact on local circulation system near ramps. No change to local arterial system other than those realignments that are common to all the alternatives. The alternative also provides for only one signal for traffic crossing the freeway. *Least Impacts*
- Alternative 3 – Diamond configuration with 800 foot ramp spacing produces little change to the configuration of the local circulation system near ramps. No change to local arterial system other than those realignments that are common to all the alternatives. However, the alternative only provides minimum storage/capacity for local traffic to cross the freeway and is likely to impact the local arterial system. *Medium Impacts*
- Alternative 4 – Diamond configuration with 1,200 foot ramp spacing results in little change to the configuration of the local circulation system near ramps. No change to local arterial system other than those realignments that are common to all the alternatives. Provides for a standard crossing of the freeway with sufficient capacity for local traffic to cross the freeway. *Least Impacts*
- Alternative 5 & 6 – SB off-ramps connecting to 34th Ave provides a more circuitous route for local access to and from the freeway and extends restricted access area further into the property at the NW quadrant. Additionally, increases interaction/conflict points with 34th Avenue. *Medium Impacts*

- Alternative 7 – Buttonhook ramps in the SE quadrant and SB off-ramps connecting to 34th Ave provide the most circuitous and confusing route for local access to and from the freeway, and extends restricted access area further into the properties in the NW and SE quadrants.. Additionally, the alternative increases interaction/conflict points with 34th Ave and with 39th Drive. **Most Impacts**
- Alternative 8 – Full diamond configuration shifted to the north has similar impacts on local traffic as Alternative 4. **Least Impact**
- Alternative 9 – Loop ramps in NE and NW quadrants has similar impacts on local traffic as Alternative 1. **Least Impact**
- Alternative 9A – Buttonhook ramp in the NE quadrant with loop in the NW is similar to Alternative 1A for local traffic. Increases circuitousness of access and extends limited access area. **Medium Impact**
- Alternative 10 – Widening overpass only, without changes to existing ramps would not provide sufficient capacity for access to and from the freeway and due to queues at left turns, would provide excessive delays for local traffic crossing the freeway. **Most Impact**

Local Mobility – Freeway Access: The alternative maintains or improves local accessibility to I-5. (The provision of predictable routes to the freeway on-ramps and the capacity to move local traffic onto the freeway minimizes the impact of the alternative).

- Alternative 1 – Loop ramps in the NW and SE quadrants provides an interchange configuration with sufficient capacity for local traffic to access or exit the freeway. **Least Impacts**
- Alternative 1A – Buttonhook ramps in the SE quadrant make for a slightly more unpredictable route for northbound access to and from the freeway but provide for sufficient capacity to meet the needs of access to and from the freeway. **Least Impacts**
- Alternative 2 – SPUI improves access for local traffic by reducing the number of interaction/conflict points to and from the freeway. **Least Impacts**
- Alternative 3 – The diamond configuration with 800 foot ramp spacing only provides minimum storage/capacity for local traffic to access the freeway, likely causing periods of at-capacity conditions causing potential overflows on the local system. **Medium Impacts**
- Alternative 4 – Diamond interchange with 1,200 foot ramp spacing increases storage/capacity for local traffic to access the freeway, helping to eliminate periods of at-capacity conditions. **Least Impacts**
- Alternative 5 & 6 – Provides a more circuitous route for local access from the freeway and provides additional interaction/delay points with 34th Avenue. **Medium Impacts**
- Alternative 7 – Buttonhook ramps in the SE quadrant and SB off-ramps connecting to 34th Ave provide the most circuitous and confusing route for local access to and from the freeway and extends restricted access area further into properties in the NW and SE quadrants. Additionally, the additional intersections increase delay on 34th Avenue and 39th Drive, but does still provide sufficient capacity for projected traffic volumes. **Medium Impacts**

- Alternative 8 – Full diamond configuration shifted to the north is similar to alternative 4. **Least Impact**
- Alternative 9 – Loop ramps in NE and NW quadrants has similar impacts on freeway access as Alternative 1. **Least Impact**
- Alternative 9A – Similar to 1A, increases circuitousness of access but does provide sufficient capacity to move traffic on and off the freeway. **Medium Impact**
- Alternative 10 – Widening overpass only, without changes to existing ramps would not provide sufficient capacity for access to and from the freeway. **Most Impact**

Freeway Operation: The alternative maintains or improves traffic operations on I-5. (The largest potential impact onto freeway operations would be back ups on the off-ramps which would impact mainline operations. Also, any substandard geometrics that would not allow for standard merge/diverge areas or future ramp metering would degrade freeway operations)

- Alternative 1 – Loop ramps in the NW and SE quadrants provide a standard interchange configuration with sufficient capacity for local traffic to access and exit the freeway with standard merge/diverge areas. **Least Impacts**
- Alternative 1A – Loop ramp in the NW, with buttonhook ramps in the SE provide sufficient capacity to prevent queuing back ups on I-5. **Least Impacts**
- Alternative 2 – SPUI provides sufficient capacity to prevent queuing back ups on I-5. **Least Impacts**
- Alternative 3 – Diamond interchange with 800 foot ramp spacing only provides minimum storage/capacity for the exit ramps from the freeway, likely causing periods of at-capacity conditions with some potential back ups impacting the mainline. **Medium Impacts**
- Alternative 4, 5, 6, 7, 8, 9 & 9A – Provide sufficient capacity to prevent back ups onto the mainline. **Least Impacts**
- Alternative 10 – Widening the overpass only, without changes to existing ramps, would not provide sufficient capacity for egress traffic from I-5 and would cause back ups onto the mainline. **Most Impact**

Safety: The alternative maintains or improves vehicular safety through physical or operational methods. (A combination of over capacity conditions or non-standard configurations or excessive circulation with additional conflict points would all lead to safety concerns)

- Alternative 1 – Loop ramps in the NW and SE quadrants provide the greatest increase in capacity, as they remove the critical left-turns which are most accident prone. The loop is a standard configuration that drivers can anticipate. **Least Impact**
- Alternative 1A – Loop ramp to the NW with buttonhook ramps to the SE provide a circuitous connection to 39th Drive in the SE. This could lead to confusion and increased accidents from wrong-way movement on the ramps from a driver

turning into the northbound off-ramp, having mistaken it for the entrance to the northbound on-ramp. **Medium Impact**

- Alternative 2 – SPUI provides for sufficient capacity and removes a conflict point by having only one central signal, offsetting the fact that it is presently a non-standard configuration for the Northwest region. **Least Impact**
- Alternative 3 – Diamond configuration with 800 foot ramp spacing provides standard configuration but at-capacity conditions could lead to additional conflict/rear-end accidents. **Medium Impact**
- Alternative 4 – Diamond interchange with 1,200 foot ramp spacing has sufficient capacity, standard configurations and no additional conflict points. **Least Impact**
- Alternative 5, 6 & 7 – SB off-ramps connecting to 34th Ave with partial diamond provide circuitous circulation for at least one of the major movements that could lead to confusion. Also, an additional intersection/conflict point is added to the system, increasing the likelihood of accidents. **Most Impact**
- Alternative 8 – Full diamond configuration shifted to the north has the same impacts as Alternative 4. **Least Impact**
- Alternative 9 – Loop ramps in NE and NW quadrants provide for sufficient capacity, standard configurations and no additional conflict points. **Least Impact**
- Alternative 9A – Loop ramp in the NW quadrant with buttonhook ramp in the NE quadrant provides a circuitous circulation in the NE quadrant that could lead to confusion. An additional intersection/conflict point is added to the system, which all could lead to and increase in accidents. **Most Impact**
- Alternative 10 – Widening overpass only, without changes to existing ramps involves a potential for an increase in accidents due to the lack of capacity at the ramps and on the I-5 mainline. **Most Impact**

Pedestrian Safety: The alternative maintains or improves pedestrian safety through physical or operational methods. (The safest over crossing configuration for pedestrians is one where all movements are controlled by a signal and there is sufficient capacity to minimize the need for right turn on red or impatient drivers. Typically the loop ramp configuration does add lanes for the loops, thus restricting where pedestrians cross which can cause pedestrian s to violate restriction and interact with vehicles at free movements.

- Alternative 1 – Loop ramps in the NW and SE quadrants have several free movements, which can cause drivers to neglect pedestrian right-of-way at crossings. **Medium Impact**
- Alternative 1A – The added circulation of the buttonhooks in the SE quadrant to the local road system provided more potential interaction with pedestrians. **Medium Impact**
- Alternative 2 – SPUI provides limited/restricted pedestrian movements and free movements. **Medium Impact**
- Alternative 3 – Standard diamond with signalization for every movement. **Least Impact.**
- Alternative 4 – Diamond interchange with 1,200 foot ramp spacing has same status as Alternative 3. **Least Impact**

- Alternative 5, 6 & 7 – SB off-ramps connecting to 34th Ave with partial diamond adds circulation/interaction with the local road system and provides potential increase in interaction/confusion with pedestrians. **Medium Impact**
- Alternative 8 – Full diamond configuration shifted to the north has the same status as Alternatives 3 and 4. **Least Impact**
- Alternative 9 – Loop ramps in NE and NW quadrants are similar to Alternative 1. **Medium Impact**
- Alternative 9A – Buttonhook ramp in the NE quadrant with loop in the NW produces increased interaction/conflict with pedestrians due to increase in circulation/interaction with the local road system and the free movements at the loop ramp. **Medium Impact**
- Alternative 10 – Widening overpass only, without changes to existing ramps results in a severe over capacity situation, which would negate any pedestrian benefits of the standard diamond configuration. **Most Impact.**

Capacity to Meet Demand: Provides sufficient capacity for 30-year growth projections. Does not preclude future HOV and capacity improvements to I-5.

- Alternative 1 – The loop ramp configuration in the NW and SE quadrants provided the greatest increase in capacity due to free movements onto the loop ramps and the removal of the major left-turn movements. **Least Impact**
- Alternative 1A – The combination of loops in the NE quadrant and buttonhook in the SE minimizes the critical left-turn movement and can provide sufficient storage to easily meet the traffic demands. **Least Impact**
- Alternative 2 – SPUI provides appropriate capacity based on the Synchro and Sim Traffic analysis with the preliminary traffic volume projections. **Medium Impact**
- Alternative 3, 4, 5, 6, & 8 – The standard diamonds increased capacity, but provided less capacity than other alternatives. **Medium Impact**
- Alternative 7, 9 & 9A – Buttonhook ramps in 7 and 9A and loop ramp configuration in 9 and in the NW quadrant in 9A provide the greatest increase in capacity due to free movements onto the ramps and the removal of the major left-turn movements. **Least Impact**
- Alternative 10 – Widening overpass only, without changes to existing ramps, would not provide capacity to meet 30-year demand. **Most Impact**

PUBLIC OPINION

Local Support: The alternative is likely to be supported by local jurisdictions, residents and businesses.

- Alternative 1 – The loop ramp in the SE quadrant displaces an established mobile home neighborhood, so local residents and the City of Marysville likely would not support. **Most Impacts**
- Alternative 1A – Leaves mobile home neighborhood to the SE intact, but includes proximity impacts with new buttonhook ramps. **Medium Impacts**

- Alternative 2 – SPUI has the lowest impacts on the surrounding area as it stays within existing right of way. *Least Impact*
- Alternative 3 – Tight diamond stays within existing right-of-way; standard design. *Least Impact*
- Alternative 4 – Expanded diamond displaces some of existing mobile homes in the neighborhood to the SE and access control on 116th Street to the east requires relocation of 39th Ave and access to properties to the south. *Medium Impacts*
- Alternative 5 & 6 – Variations of Alternative 4 with SB off-ramp to 34th Ave provides circuitous routing for SB on-ramp movement *Medium Impacts*.
- Alternative 7 – Buttonhook ramps in the SE quadrant and SB off-ramps connecting to 34th Ave provide circuitous circulation for at least one of the major movements that could lead to confusion. Also, an additional intersection/conflict point is added to the system, increasing the likelihood of accidents-. *Medium Impacts*
- Alternative 8 – A variation of Alternative 4, but shifted to miss mobile homes to the SE. Impacts commercial property on the north side of 116th by shifting street. *Medium Impact*
- Alternative 9 – Loop ramps in NE and NW quadrants would impact neighborhood to the NW consisting of both residential uses and undeveloped commercial sites. *Most Impacts*
- Alternative 9A – Buttonhook ramp in the NE quadrant with loop in the NW results in somewhat lower impact on the neighborhood in the NE quadrant, as compared to the loop ramp. *Medium Impacts*
- Alternative 10 – Widening overpass only, without changes to existing ramps would avoid impact to any neighborhood but would not address access needs to serve local land uses. *Medium Impact*

Regional/State Support: The alternative is likely to be supported by other regional, tribes, state and federal agencies.

- Alternative 1 – FHWA and WSDOT support for loop ramps in the NW and SE quadrants is low due to environmental justice concerns related to displacement of the mobile home parks in the SE quadrant. *Most Impacts*
- Alternative 1A – FHWA and WSDOT support low due to buttonhook ramps which increase the likelihood of accidents due to wrong way traffic on ramps. *Most Impacts*
- Alternative 2 – SPUI has lowest impact because it stays within existing right-of-way. *Least Impact*
- Alternative 3 – Diamond configuration with 800 foot ramp spacing diamond doesn't meet desirable FHWA and WSDOT standards. *Medium Impacts*
- Alternative 4 – Expanded diamond meets standards, but displaces some of existing mobile home units to the SE. *Medium Impacts*
- Alternative 5 & 6 – Variations of Alternative 4, but with undesirable elements on SB off-ramp to 34th Ave. *Most Impacts*
- Alternative 7 – Buttonhook ramps in the SE quadrant and SB off-ramps connecting to 34th Ave provide circuitous access. Buttonhook ramps with

increased likelihood of accidents due to wrong way traffic on ramps. **Most Impacts**

- Alternative 8 – A variation of the expanded diamond in Alternative 4, but shifted to miss the neighborhood to the SE. Would require acquisition of existing single family residences (planned for future commercial redevelopment) to shift 116th Street to the north. **Moderate Impact**
- Alternative 9 – Loop ramps in NE and NW quadrants primarily would impact neighborhood to the NE, which is largely undeveloped, or slated for commercial redevelopment. **Least Impacts**
- Alternative 9A – Loop ramp in NW quadrant, buttonhook ramps in NE quadrant. FHWA and WSDOT support is low due to circulation and safety issues relating to buttonhook ramps in the NE quadrant. **Most Impacts**
- Alternative 10 – Widening overpass only, without changes to existing ramps would avoid impact to any neighborhood, but would not provide capacity to serve demand without mainline impacts. **Most Impacts**

IMPLEMENTATION

Financial Viability: The alternative's cost is likely to be viable within the budget available.

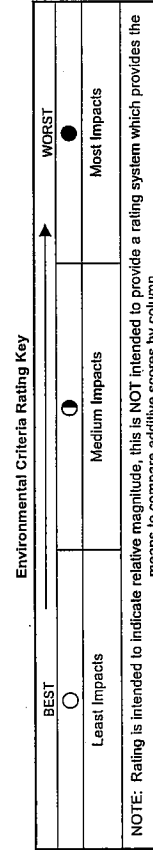
- Alternative 1 – Loop ramps in the NW and SE quadrants have the most expensive acquisition and relocation costs, due to displacement of mobile home park. **Most Impacts**
- Alternative 1A – Loop ramp in NW and buttonhook ramps in the SE result in less cost because they avoid acquisition of the mobile home park. **Medium Impacts**
- Alternative 2 – SPUI is lowest cost for right-of-way, since it's within existing improved roadway. Construction cost is greater than diamond configurations Alternatives 3 and 4. **Least Impact**
- Alternative 3 – Diamond configuration with 800 foot ramp spacing is within existing right-of-way. **Least Impacts**
- Alternatives 4 through 7 – Diamond interchanges with 1,200 foot ramp spacing, Alternatives 5 & 6 involve SB off-ramp to 34th Ave, Alternative 7 includes buttonhook ramps in the SE quadrant. All take some new right-of-way, but not as much as Alternative 1. **Medium Impacts**
- Alternative 8 – Expanded diamond interchange shifted to the north, avoids displacement of mobile homes to the SE, but requires relocation of existing houses on the north side of 116th and loss of undeveloped commercial property. **Medium Impacts**
- Alternative 9 – Loop ramps in the NW and NE quadrant has similar land acquisition as Alternative 1, but land in the NE quarter is largely undeveloped, or slated for future commercial redevelopment. **Medium Impacts**
- Alternative 9A – Loop ramp in the NW quadrant, buttonhook ramps in the NE quadrant reduced land acquisition in the NE quadrant. **Medium Impacts**
- Alternative 10 – Widening overpass only, without changes to existing ramps utilizes only existing right-of-way. **Least Impact**

Investment Phasing: The project is capable of being phased. Initial elements can be constructed to meet shorter term (5-10 year) transportation demand with additional features added for longer term (10-30 year) demand. (Not the same as construction staging, which is how the project gets built while serving existing traffic.)

- Alternative 1 – Loop ramps in the NW and SE quadrants: Could be built initially as a widened diamond. Loop ramps could be added one at a time as demand dictated. Each loop would give some benefit over existing conditions. *Least Impact*
- Alternative 1A – Loop ramp in the NW quadrant and buttonhook ramps in the SE quadrant. Same as Alternative 1. *Least Impact*
- Alternative 2 – The bridge for the SPUI would be a completely new structure. All or nothing design. *Most Impacts*
- Alternatives 3 through 8 – All diamond interchanges. Could be built a piece at a time, but each piece would have less benefit individually than the loop ramps. So feasible, but not particularly advantageous. *Medium Impacts*
- Alternatives 9 and 9A – Loops in the NW and NE quadrant with Alternative 9, buttonhook in NE quadrant in Alternative 9A, is the same concept as Alternatives 1 and 1A. *Least Impact.*
- Alternative 10 – Widening overpass only, without changes to existing ramps involves a simple widening and can be constructed in just one phase, but doesn't meet traffic demand. *Most Impacts*

Screening Design Alternatives
Tulalip Tribes/WSDOT/FHWA/Marysville (Draft 10.31.02)

Criteria	Definitions	1	1-A	2	3	4	5	6	7	8	9	9-A	10
		Loop Ramps SE & NW	Loop to SE to 38th Ave	SPUI	Diamond Minimum	New Diamond	SB Ramp to 34th A	SB Ramp to 34th B	Loop in SE	Shifted North	Loop Ramps NE & NW	Loop to NE to New Arterial	Widen Existing Overpass
Purpose And Need	The alternative is consistent with the identified purpose and need: Serving future transportation needs of adopted land use plans in the Marysville/Tulalip area	○	○	○	○	○	○	○	○	○	○	○	○
Geometric Feasibility	<i>Fatal Flaw</i> The alternative satisfies local, state and/or Federal design requirements. Interchange spacing, etc	○	○	○	○	○	○	○	○	○	○	○	○
Environment	The alternative would meet applicable physical and natural environmental requirements with feasible mitigation.	●	○	○	○	○	○	○	○	○	○	○	○
Land Use	The alternative avoids or minimizes negative land use impacts (e.g. displacement, neighborhood disruption, curtailment of land owner access due to interchange proximity etc)	●	○	○	○	○	○	○	○	○	○	○	○
Environmental Justice	The alternative avoids, minimizes, or mitigates disproportionate impacts on low-income or other populations with special needs.	●	○	○	○	○	○	○	○	○	○	○	○
Transportation													
Local Mobility – Circulation	The alternative maintains and improves local traffic circulation, and/or nonmotorized connections. Including construction impacts.	○	○	○	○	○	○	○	○	○	○	○	○
Local Mobility – Freeway Access	The alternative maintains or improves local accessibility to I-5	○	○	○	○	○	○	○	○	○	○	○	○
Freeway Operation	<i>Fatal Flaw</i> The alternative maintains or improves traffic operations on I-5	○	○	○	○	○	○	○	○	○	○	○	○
Safety	<i>Fatal Flaw</i> The alternative maintains or improves safety through physical or operational methods	○	○	○	○	○	○	○	○	○	○	○	○
Pedestrian Safety	Maintains or improves pedestrian safety	○	○	○	○	○	○	○	○	○	○	○	○
Capacity To Meet Demand	Provides sufficient capacity for 30-year growth projections. Does not preclude future HOV and capacity improvements to I-5	○	○	○	○	○	○	○	○	○	○	○	○
Public Opinion													
Local Support	The Alternative is likely to be supported by local jurisdictions, residents and businesses	●	○	○	○	○	○	○	○	○	○	○	○
Regional / State Support	The alternative is likely to be supported by other regional, tribes, state, and Federal interests.	●	○	○	○	○	○	○	○	○	○	○	○
Implementation													
Financial Viability	The alternative's cost is likely to be viable within the budget available.	○	○	○	○	○	○	○	○	○	○	○	○
Investment Phasing	The project is capable of phasing. Initial elements can be constructed with additional features added for longer demand. I (Not the same as construction staging, which is how the project gets built while serving existing traffic.)	○	○	○	○	○	○	○	○	○	○	○	○



116th Street NE Interchange
Second Level Screening

Explanation for Ratings
07-30-03

This summary of results from the second level screening process describes the reasons for the ratings given to each of the three alternatives in each of the screening criteria. The ratings, as summarized in the graphic matrix, were made during a discussion of the project coordination team on July 30, 2003.

- For each criteria, the alternatives were rated on a scale from 1 to 5 (or in some cases, 1 to 10), with a higher number representing the best performance (or least impact) and a lower number representing the worst performance (or greatest impact).

The ratings were summed to provide guidance in the selection of a preferred action alternative to consider in the Environmental Assessment.

The three alternatives under consideration were:

- Alternative 1 – Single Point Urban Interchange
- Alternative 2 – Widened Diamond Interchange
- Alternative 3 – Diamond Interchange with Loop Ramps in the Northeast and Northwest Quadrants

Purpose and Need (Maximum Points – 10): The alternative is consistent with the identified purpose and need: Serving future transportation needs of adopted land use plans in the Snohomish County/Marysville/Tulalip area.

- Alternatives 1, 2 and 3 – All have sufficient capacity to meet future interchange capacity demands, and warrant a rating of 10.

Geometric Feasibility (Maximum Points – 10): The alternative satisfies local, state and/or federal design requirements, e.g. interchange spacing, etc.

- Alternative 1 – Meets all requirements, and because of the single intersection, has the least conflict between intersections. Warrants a rating of 10.
- Alternative 2 – Meets all requirements, but with two adjacent intersections within the interchange, is slightly less desirable than Alternative 1. Warrants a rating of 9.
- Alternative 3 – Meets all requirements, but the relatively tight radii of the loop ramps make this slightly less desirable than Alternative 1.

Transportation – Freeway Operation (Maximum Points – 5): The alternative maintains or improves traffic operations on I-5

- Alternatives 1, 2 and 3 – The analysis of freeway operations has not been completed, so the rating of this criteria was deferred.

Transportation – Traffic Safety (Maximum Points – 5): The alternative maintains or improves traffic safety through physical or operation methods.

- Alternative 1 – An analysis of the recent accident history at the interchange shows that most accidents are congestion-related. This alternative would improve operations, and with only one signalized intersection, would have the least opportunity for conflicts. Warrants a rating of 5.
- Alternative 2 – The two signalized intersections would have more opportunities for rear-end accidents. Warrants a rating of 3.
- Alternative 3 – The loop ramps would reduce the number of turning movements at the intersections, relative to Alternative 2. Warrants a rating of 5.

Transportation – Capacity to Meet Demand (Maximum Points – 5): Provides sufficient capacity for 30-year growth projections. Does not preclude anticipated future HOV and capacity improvements to I-5.

- Alternatives 1, 2 and 3 – All alternatives are designed to meet growth projections and future I-5 improvements. Warrant a rating of 5.

Transportation – Local Mobility – Circulation (Maximum Points – 5): The alternative maintains and improves local traffic circulation, and /or non-motorized connections. Maintains or improves local accessibility to I-5. Minimizes construction traffic impacts.

- Alternative 1 – Has the least impact on access to adjacent properties along 116th Street NE, due to its compact design. Warrants a rating of 5.
- Alternative 2 – The two existing signalized intersections would be moved out, impacting adjacent property access. Warrants a rating of 3.
- Alternative 3 – The loop ramps would have the greatest impact on access to adjacent properties. Warrants a rating of 2.

Transportation – Transit and HOV Mobility (Maximum Points – 5): The alternative maintains or improves transit and High Occupancy Vehicle accessibility to I-5.

- Alternative 1 – Worst impacts to transit and HOV. Eliminates and does not replace existing flyer stops for transit. Features circuitous route to existing park and ride lot for both buses and carpools. Warrants a rating of 1.
- Alternative 2 – Would relocate park and ride lot, and feature circuitous route to new lot. Could incorporate flyer stops on relocated ramps. Warrants a rating of 3.
- Alternative 3 – Would relocate park and ride lot, and feature circuitous route to new lot. Could incorporate flyer stop, but there would be some circuitry of travel for transit to use them. Warrants a rating of 2.

Transportation – Non-motorized Safety (Maximum Points – 5): Maintains or improves pedestrian and bicycle safety.

- Alternative 1 – Worst impact to pedestrian and bicycle traffic, due to difficulty crossing the large intersection. Would feature bicycle lanes on 116th Street NE. Warrants a rating of 3.
- Alternative 2 – Least impact to pedestrian and bicycle traffic, due to the relative ease to cross intersections. Would feature bicycle lanes on 116th Street NE. Warrants a rating of 5.
- Alternative 3 – Medium impact to pedestrian and bicycle traffic, due to difficulty crossing loop ramps on the north side of 116th Street NE. Would feature bicycle lanes on 116th Street NE. Warrants a rating of 4.

Environment – Sensitive Areas (Maximum Points – 5): Minimizes displacement of sensitive features, wetlands, streams.

- Alternative 1 – No impacts to sensitive areas. Warrants a rating of 5.
- Alternative 2 – Severe impacts to Quilceda Creek and associated wetlands in both the northwest and southwest quadrants. Warrants a rating of 1.
- Alternative 3 – Severe impacts to Quilceda Creek and associated wetlands in the northwest quadrant of the interchange. Warrants a rating of 1.

Environment – Fisheries/Endangered Species (Maximum Points – 5): Minimizes fisheries and endangered species impacts.

- Alternative 1 – No impacts to fisheries and endangered species. Warrants a rating of 5.
- Alternative 2 – Severe impacts to Quilceda Creek, a fish-bearing stream, in both the northwest and southwest quadrants. Warrants a rating of 1.
- Alternative 3 – Severe impacts to Quilceda Creek, a fish-bearing stream, in the northwest quadrant of the interchange. Warrants a rating of 1.

Environment – Hazardous Materials (Maximum Points – 5): Minimizes hazardous materials impacts.

- Alternative 1 – No impacts to underground storage tanks or the contaminated plume south of the interchange. Warrants a rating of 5.
- Alternative 2 – Potential to encounter asbestos in homes to be acquired, but no impact to underground storage tanks or the contaminated plume. Warrants a rating of 4.
- Alternative 3 – Potential to encounter asbestos in homes to be acquired, but no impact to underground storage tanks or the contaminated plume. Warrants a rating of 4.

Environment – Proximity Impacts (Maximum Points – 5): Minimizes proximity impacts: noise and air, light and glare.

- Alternative 1 – Reduces proximity of interchange ramps to residences. Warrants a rating of 5.
- Alternative 2 – Increases proximity of interchange ramps to residences in both the southeast and northeast quadrants. Warrants a rating of 2.
- Alternative 3 – Increases proximity of interchange ramps to residences in the northeast quadrant. Warrants a rating of 3.

Land Use/Relocation/Land Use (Maximum Points – 10): Avoids displacement, neighborhood disruption, curtailment of land owner access.

- Alternative 1 – No displacements or curtailment of access. Warrants a rating of 5.
- Alternative 2 – Displacements in the southeast quadrant. Access impacts to businesses on the west side and residences on the east side of the interchange. Warrants a rating of 2.
- Alternative 3 – Displacements in the northeast quadrant. Access impacts to businesses on the west side and residences on the east side of the interchange. Warrants a rating of 2.

Public Opinion – Local and Regional Support (Maximum Points – 5): The alternative is likely to be supported by local jurisdictions, residents and businesses.

- Alternative 1 – Strongly supported by local residents, the City of Marysville and the Tulalip Tribes. Warrants a rating of 5.
- Alternative 2 – Strongly opposed by local residents, and not supported by the City of Marysville or the Tulalip Tribes. Warrants a rating of 1.
- Alternative 3 – Strongly opposed by local residents, and not supported by the City of Marysville or the Tulalip Tribes. Warrants a rating of 1.

Public Opinion – Regional/State Support (Maximum Points – 5): The alternative is likely to be supported by other regional, tribes, state and federal interests.

- Alternative 1 – Supported by WSDOT, FHWA, BIA and likely to be supported by Corps of Engineers, and NMFS due to improvements to Quilceda Creek. Warrants a rating of 5.
- Alternative 2 – Not supported by WSDOT, FHWA, BIA and likely to be opposed by Corps of Engineers, and NMFS due to severe impacts to Quilceda Creek and associated wetlands. Warrants a rating of 1.
- Alternative 3 – Not supported by WSDOT, FHWA, BIA and likely to be opposed by Corps of Engineers, and NMFS due to severe impacts to Quilceda Creek and associated wetlands. Warrants a rating of 1.

APPENDIX B
Meeting Minutes

**NE 116TH STREET INTERCHANGE
WSDOT AND FHWA COORDINATION MEETING MINUTES
JULY 25, 2002
10:00 TO 12:00**

Attendees: Pat McCormick – WSDOT
Methqal Abu-najem – WSDOT
Elizabeth Healy – FHWA
Dave Leighow – FHWA
John Klasell – Tulalip
Dave Des Voigne – HDR
John Villager – HDR
Edward Koltonowski – Gibson Traffic Consultants
Michael Ollivant – Parametrix
David Martin – Parametrix

Purpose and Need for Interchange Improvements

John Klasell (JK) gave a very brief introduction to the project. He said that the Tulalips had incorporated Quil Ceda Village as a federal city. They plan to commercially develop this area, and hired Gibson Traffic Consultants (GTC) to assess the need for transportation improvements to support the growth. GTC determined that the NE 116th Street Interchange is one facility that needs to be improved. JK emphasized that the interchange improvements are regional in nature, and will support growth in Marysville and Snohomish County, as well as from Quil Ceda Village.

Edward Koltonowski (EK) elaborated on the growth plans in the area. He said that even with the recent signalization of the interchange ramp terminals, the interchange is exhibiting operation problems. There is a short-term need for widening of NE 116th Street to at least 5 lanes over the freeway.

Potential Scope of Interchange Improvements

David Martin (DM) said that the specifics of the interchange improvements aren't determined yet, but it looks like they could be significant, potentially with loop ramps for one or more movements. Pat McCormick (PM) asked when traffic projections would be available. EK stated that we would have some numbers within a week or so, developed by overlaying Tulalip development demand over the output of the Snohomish County Arterial Network (SnoCAN) model.

Elizabeth Healy (EH) expressed concern with the use of 2020 traffic numbers for evaluating alternatives. She stated that 2030 numbers are available from PSRC and should be used. There was a discussion about some technical problems with the 2030 projections, but it was agreed that we would use the PSRC projections as the basis for analysis.

EK handed out four graphics with 2020 background traffic projections developed using the SnoCAN model. These projections only assume about 20% of the expected traffic demand for the Tulalips, so the numbers are definitely low.

There was a discussion of potentially phasing the project as needed, since the Tulalips don't have all the funding necessary for the ultimate improvements. The first stage would likely be the widening of the structure over I-5.

WSDOT and FHWA Potential Issues

EH restated that 2030 numbers would be needed for analysis. She also stated that if the project is phased, each phase needs to be analyzed in the Access Report to make sure that it works.

There was a long discussion of the threshold for an Access Report. EH stated that no Access Report would be needed for a simple widening of the overcrossing, or for turn lanes at off-ramp terminals. An Access Report would be needed for any improvement that revises ramp geometrics, with the exception that an improvement that merely brings an existing ramp up to current design guidelines would be exempt. The conclusion of the discussion was that the anticipated interchange improvements will definitely require an Access Report.

EH stated that environmental documents expire three years after approval. This means that a document prepared for the ultimate interchange will need to be redone if the construction is phased, because future phases would occur after the three years have passed. There is a risk because of the likelihood that environmental regulations will change in the meantime.

EH encouraged close coordination with FHWA and WSDOT throughout development of the Access Report and environmental documentation. It was agreed that she and a WSDOT representative should be invited to the monthly project coordination meetings.

DM asked about coordination with the City of Marysville's proposed North Marysville Interchange project. EH said that there is a very small chance that the City's proposal will be acceptable. FHWA is concerned because the freeway is already congested, and it isn't clear that all potential improvements to the local street network have been explored. PM said that there is a meeting in Marysville on August 5 to discuss the interchange, and that a representative from the NE 116th Interchange team would be welcome to attend.

Communication Channels

Future communication will be on a variety of levels. WSDOT will assign a project engineer (possibly Methqal Abu-najem). Other WSDOT contacts include Sam Schuyler, the Local Programs representative for the Tulalips, and Don Ho Chan, representing Traffic.

116TH STREET NE INTERCHANGE
MONTHLY COORDINATION MEETING MINUTES
AUGUST 29, 2002
10:00 TO 11:30

Attendees: Klara Fabry – WSDOT Asst. Regional Administrator
Pat McCormick – WSDOT Engineering Manager
Methqal Abu-najem – WSDOT Project Engineer
Ken Seguin – WSDOT NW Traffic
Tony Basha – WSDOT NW Environmental
Dean Torkko – WSDOT NW Environmental
Dick Albin – WSDOT OSC Design Office
Dave Des Voigne – HDR
Edward Koltonowski – Gibson Traffic Consultants (GTC)
David Sherrard – Parametrix
Michael Ollivant – Parametrix
David Martin – Parametrix

Introduction and Roles

After introductions of staff, David Martin (DM) gave a brief overview of the project. He said that the proposed improvements to the 116th Street NE interchange were needed due to regional development in Snohomish County, Marysville and at the Tulalip Reservation. He said that the consultant team of Parametrix, HDR and GTC were hired to perform preliminary design, environmental studies and a traffic analysis, including an 8-point access study.

Pat McCormick (PM) stated that WSDOT had met recently on the proposed North Marysville interchange. One of the potential locations of this proposed interchange is at 158th Street NE. The Marysville City Council is currently considering what next steps to take on the project.

Planning-Level Traffic Projections

Edward Koltonowski (EK) presented traffic projections to be used for preliminary development of project alternatives. The basis of the projections comes from 2020 data from the SnoCAN model. These numbers were enhanced with traffic generated by build-out land use at the business park, and then factored to 2030 numbers, using the PSRC model numbers that were recently approved. The projections were done for the AM and PM peak hour, with and without the North Marysville interchange, and assuming either full build-out or just phases 1-4 of the business park. He also presented Saturday volumes for a peak period between 1:00 and 3:00 PM.

EK emphasized that these were very conservative numbers, based as they are on an aggressive business plan.

EK requested that WSDOT provide Saturday mainline volumes for the time period 1:00 PM to 3:00 PM. Ken Seguin (KS) will take care of this request.

Development of First-Level Screening Alternatives

DM stated that the consultant team would be meeting September 3 to brainstorm potential design concepts that will accommodate the projected traffic volumes. He stated that the initial brainstorming of alternatives would not consider environmental and physical constraints, but that subsequent screening will. Methqal Abu-najem (MA) expressed his interest in attending the brainstorming session.

Potential Environmental Constraints and Screening of Alternatives

David Sherrard (DS) briefly described the known environmental constraints. These include wetlands, Quilceda Creek, groundwater, environmental justice, and an undetermined potential underground hazardous materials plume from the Boeing Test Site west of I-5.

The screening process has not been clarified yet. MA expressed his interest in providing input to both the screening criteria and the screening process.

Project Direction

KF asked what group would be guiding the project on both the technical and policy levels. There was a discussion about the need to involve a variety of agencies on some level. These agencies include Marysville, Snohomish County, and resource agencies, as well as the Tribes, WSDOT and FHWA. If the Bureau of Indian Affairs is the lead agency, they should be involved as well.

Outstanding Issues

Dean Torkko (DT) brought up a number of issues, including who the federal lead agency will be. He asked whether the BIA would be representing the Tribes at the federal level, and if so, would it be as lead agency, or as co-lead with FHWA.

There also needs to be a determination on the type of environmental document. He had not seen any traffic projections to suggest any type of document yet. Another issue is whether a combined NEPA and SEPA document should be prepared, if an EIS is needed.

DT stated that a Public Involvement Plan should be prepared soon. If the appropriate environmental document is determined to be an EIS, a Notice of Intent should be published.

KF asked about the proposed schedule. Mike Ollivant (MO) answered that the Tribes wanted a Record of Decision within 18 months, and the interchange improvements constructed within 3 years. He stated that 4 years for construction would be more realistic.

DT stated that WSDOT uses 2 years as a best-case schedule for an EIS, with a timeframe of 9 to 18 months being the goal for an EA. He also stated that he had never seen a project-level EIS where this two-year schedule was met. He advised that there were two ways to help ensure the project takes a minimum of time: don't delay making decisions, and don't change your mind later (causing backtracking and doing work over again).

**116TH STREET NE INTERCHANGE
MONTHLY COORDINATION MEETING MINUTES
SEPTEMBER 26, 2002
10:00 TO 11:30**

Attendees: Methqal Abu-najem – WSDOT Project Engineer
Ken Seguin – WSDOT NW Traffic
David Weiser – Mayor, City of Marysville
Robin Nelson – City of Marysville Public Works
Jim Owens – City of Marysville Public Works
T. Peter Mills – Business Park Manager
John McCoy – Quil Ceda Village General Manager
Mel Sheldon – Tribe Policy/Board Member
Dave Des Voigne – HDR
John Villager – HDR
Terry Gibson – Gibson Traffic Consultants (GTC)
David Sherrard – Parametrix
David Martin – Parametrix

Introductions

After introductions, T. Peter Mills (PM) gave a brief overview of the project. He emphasized the regional benefits of the proposed interchange project, and thanked the representatives from Marysville for attending. He also mentioned that the project schedule was “assertive”.

Interchange Alternatives

John Villager (JV) presented a list of eight (8) alternative interchange configurations that are being conceptually designed by HDR. He said that all the alternatives are being developed to full FHWA standards. Three of the alternative concept designs are ready now; the remaining five will be complete by October 4.

Alternative 1 – Loop Ramps

This alternative features the following major elements:

- Loop ramps in the northwest and southeast quadrants of the interchange, to accommodate the WB to SB and EB to NB left-turn movements, respectively
- Relocated NB and SB off-ramps, to accommodate the new loop ramps and to better separate the ramp terminals
- Relocated 34th Avenue NE, to accommodate the relocated SB off-ramp and to line up with the newly constructed Quil Ceda Blvd. Extension
- Widening of the overpass bridge

The proposed interchange would cross the west fork of Quilceda Creek in four places: the NB off-ramp, the SB on and off-ramps, and realigned 34th Avenue NE.

PM noted that the need to accommodate projected growth in Snohomish County north of the interchange and west of I-5. He also emphasized that the interchange needs to accommodate all foreseeable future

growth, and that we shouldn't skimp on such elements as the bridge widening. Methqal Abu-Najem (MA) noted that WSDOT long-range plans include HOV lanes as far as SR 531, which should be incorporated in design options.

PM asked if the crossings of Quilceda Creek presented a permitting problem. David Des Voigne (DD) replied that this wouldn't be a problem if we span the creek with bridges or bottomless culverts. David Sherrard (DS) said that fish biologists from Parametrix are currently planning to do a stream survey, to determine the presence of chinook and appropriate habitat. He also noted that none of the proposed stream crossings were nearly as detrimental as the existing crossing of I-5 in a culvert. He mentioned that if mitigation is necessary, one possibility is to improve the I-5 crossing.

There was a discussion of the impact of Alternative 1 on the mobile home park east of I-5. JV stated that the impact shouldn't be viewed as a fatal flaw; he mentioned the example of SR 509, which is relocating an even larger mobile home park. PM stated that perhaps there could be a relocation of the mobile home park to the south of the interchange, to a currently undeveloped parcel, in cooperation with the City of Marysville.

Robin Nelson (RN) stated that the City has a Master Plan that includes an extension of 38th Avenue NE across 116th Street NE. He suggested that a revision to Alternative 1 that moved the northbound on and off-ramp connection from 116th to 38th would have far less impact on the mobile home park, plus have the advantage of tying into the local arterial system, and probably operating with less congestion. The consultant team will incorporate this suggestion into the design.

Alternative 2 – Single-Point Urban Interchange (SPUI)

This alternative features the following major elements:

- A completely new bridge structure over I-5, containing a single intersection for vehicles turning left to and from 116th Street NE.
- Separated lanes for right turning vehicles to and from 116th Street NE
- Relocated 34th Avenue NE, identical to the realignment for Alternative 1.

The proposed interchange would create one new crossing (realigned 34th Avenue NE) of the west fork of Quilceda Creek.

JV explained that the SPUI was a relatively uncommon design for this area, but there are local examples such as the I-5/Black Lake Interchange near Olympia. The advantages of the SPUI include the ability to accommodate high traffic volumes in a relatively small area.

DM noted that an initial traffic analysis indicates that the concept would work for the projected volumes.

John McCoy mentioned his experience with the SPUI interchange near Olympia and in the Phoenix area and noted the advantage of not requiring additional right-of-way.

Alternative 5 – Full-diamond

This alternative features the following major elements:

- A ramp configuration similar to the existing interchange, but with all ramps relocated to increase

the separation between ramp termini.

- Widening of 116th Street NE, primarily east and west of the overpass bridge.
- Relocated 34th Avenue NE, identical to the realignment for Alternative 1.

The proposed interchange would create three new crossings of the west fork of Quilceda Creek: realignment 34th Avenue NE, and the southbound off and on-ramps. The proposed ramps would also impact the mobile home park and the truck stop. There was a discussion about whether the truck stop would be viable with this alternative.

PM noted that the realignment of 34th Avenue NE shown on the drawings doesn't quite line up with the extension of Quil Ceda Blvd. The design team will obtain a copy of the construction plans for Quil Ceda Blvd. and make that correction.

It was noted that this alternative could also incorporate the City's proposed extension of 38th Avenue NE.

Screening of Alternatives

A special meeting was scheduled for Thursday, October 10 from 10:00 to 12:00 at the Business Park offices, to begin screening alternatives. The agenda for the meeting will include a presentation of the remaining alternatives, and a discussion of screening criteria. The regularly scheduled monthly meeting on October 31 is planned to finalize initial screening.

DS passed out draft screening criteria and draft maps of the project area, and asked for comments and corrections. It's especially important that Marysville staff ensure that the roadway network on the base maps include all the important arterials on the east side of I-5.

MA offered comments on draft screening criteria. More comments will follow.

DS pointed out that the results of the screening process will determine the scope of alternatives, which will determine whether an EIS is required. The project budget and schedule provides resources and time for an EIS, and if that route is appropriate, it would be beneficial to start the EIS process as soon as possible to ensure the full involvement of other interested agencies, such as the Corps of Engineers and NOAA Fisheries.

RN asked if the traffic analysis would extend beyond State Street. He noted that FHWA typically questions whether the traffic projected for an interchange might be constrained by bottlenecks in the surrounding arterial network.

It was also noted that Sound Transit's long-range plans might include the extension of commuter rail as far north as the interchange area, and the project should consider that possibility.

Next Meeting

The next regularly scheduled meeting is on October 31 at 10:00, at the Tulalip Business Park offices.

**116TH STREET NE INTERCHANGE
MONTHLY COORDINATION MEETING MINUTES
OCTOBER 10, 2002
10:00 TO 12:00**

Attendees: Pat McCormick – WSDOT
Ken Seguin – WSDOT
Dick Albin – WSDOT
Dongho Chang – WSDOT
John Milton – WSDOT
Elizabeth Healy – FHWA
Robin Nelson – City of Marysville
Jim Owens – City of Marysville
Jim Bloodgood – Snohomish County
Dave Evans – Snohomish County
T. Peter Mills – Tulalip Business Park Manager
Les Parks – Tulalip Tribes Construction Manager
Debbie Bray – Tulalip Business Park Planner/Construction Management
Dave DesVoigne – HDR
John Villager – HDR
Becky Hart – HDR
Edward Koltonowski – GTC
Mike Ollivant – Parametrix
David Sherrard – Parametrix
David Martin – Parametrix

Introductions

After introductions, T. Peter Mills (PM) gave a brief overview of the project. He once again emphasized the regional nature of the proposed interchange project.

Interchange Alternatives

John Villager (JV) presented a total of ten (10) alternative interchange configurations that have been conceptually designed by HDR. He handed out a revised list of the alternatives, and then described each using CADD drawings on the aerial photograph. At the end of the meeting, JV was requested to provide the group with a narrative description of each alternative; therefore, no detailed description is included here.

JV noted that a realignment of 34th Avenue NE is common to all alternatives. The realigned 34th will connect to the recently completed Quilceda Blvd. Extension at 116th Street NE.

Alternative 1A is a revised version of Alternative 1 shown at the previous meeting. Alternative 1A includes realigned ramps in the southeast quadrant of the interchange, which came about at the suggestion of the City of Marysville. The revision would avoid significant impact to the mobile home park.

Robin Nelson (RN) showed a copy of the City's 116th Street NE subarea plan, which includes an extended arterial that would align with 38th Avenue NE.

JV noted that the ten interchanges are variations on three basic themes: an improved version of the existing diamond interchange; the addition of loop ramps to accommodate high left-turning volumes; and the Single Point Urban Interchange (SPUI).

Alternative 9 includes a flyover ramp for northbound traffic to access the arterial system within the business park near 99th Street NE. Les Parks (LP) stated that this concept was brought up some time ago, and he supports it. JV noted that at this time, the ramp would only provide access from the freeway; traffic leaving the business park would access I-5 at 116th Street NE.

In response to a question, JV stated that the alternatives have been laid out horizontally, not vertically. So questions such as potential interference with the existing railroad grade will be addressed later, after initial screening.

Traffic Projections

Edward Koltonowski (EK) was asked whether the traffic projections that the alternatives were based on would be revised in the future. EK gave a brief synopsis of how the initial projections were developed. He noted that the projections are conservative, since they are based on the North Marysville Interchange not being built, and on the Tribes' full, best-case build-out scenario. Elizabeth Healy (EH) stated that it was appropriate to assume that the North Marysville interchange would not be built. EK stated that Parametrix would be developing a traffic model, based on the SnoCAN model, to develop traffic projections for the traffic analysis.

Land Use

PM gave an overview of the planned development of the business park. In addition to the casino being built now, Phase 1 will include a theater/office/restaurant complex, along with retail development. Discussions with Chelsea Corporation about a proposed high-end outlet mall will be finalized in the next few weeks. There are also plans for a hotel. Phase 1 construction would be completed in 2004.

Further development would be part of Phase 2 and would not be completed until 2006. Phase 2 can't occur without improvements to the interchange.

EK gave an overview of other development planned in the area, including that in the Cities of Marysville and Arlington, and in Snohomish County.

Access and Traffic Issues

Dongho Chang (DC) stated that he is concerned about mainline volumes, in addition to merely focusing on ramp and intersection operations. He foresees this segment of I-5 becoming like the segment in Lynnwood, where development surrounding the interstate causes the mainline to breakdown. John

Milton (JM) noted that mainline volumes are an issue that could affect the project schedule. At a minimum, it is necessary to leave enough room to widen the mainline of I-5 in the future.

EH stated that one of the points in the access decision report is whether improvements to the local street network would relieve the need for improvements to the freeway. RN brought up the issue of ensuring that the interchange project adequately integrates with the surrounding arterial network. A third issue regarding the surrounding street network is whether the traffic demand on the interchange can actually reach the interchange, given the constraints of the arterial network.

There was a discussion about the relationship between the environmental process and the access decision process. JM stated that there are risks in combining the two processes; on the other hand, there are risks in one process getting too far ahead of the other. The project schedule needs to reflect the relationship between the two processes.

PM asked if the current scope of work included an evaluation of the arterial network. David Martin (DM) stated that he thought it did, at least as far as the requirements for the access decision report.

Screening Criteria

David Sherrard (DS) handed out the draft screening criteria, which reflects input from WSDOT. EH asked for interchange spacing to be added to the Geometric Feasibility criteria.

EK felt that the feasibility of staging construction should be part of the criteria. Ken Seguin (KS) stated that construction impacts should be part of the Local Mobility – Circulation criteria.

JM stated that the impact of the improvements on access to residents and business should be part of the Land Use criteria.

Environmental Permits

There was a discussion about the need for a 404 permit. Dave DesVoigne (DD) stated that the project may be able to proceed under a Nationwide Permit, depending on the extent of wetlands associated with the West Fork of Quilceda Creek. If we bridge the creek and wetlands, an individual permit shouldn't be needed. EH noted that if an individual permit is needed, the project would be reviewed under the merger process, and this would extend the schedule.

Next Meeting

DM asked what information would be needed for the group to screen the alternatives. The consensus was that traffic demand and operations data (available from EK); land use maps (to be provided by DS); and a cursory look at freeway operations (typical merge analysis) would be very helpful.

DM stated that the consultant team would prepare a screening matrix, and make a first attempt at filling it in for the alternatives. Then the group will comment and revise the draft matrix.

The next meeting will be held at WSDOT NW Headquarters on October 31, from 10:00 to 12:00.

**116TH STREET NE INTERCHANGE
MONTHLY COORDINATION MEETING MINUTES
OCTOBER 31, 2002
10:00 TO 12:00**

Attendees: Pat McCormick – WSDOT
Ken Seguin – WSDOT
Dan Hagglund – WSDOT
Dongho Chang – WSDOT
Klara Fabry – WSDOT
Murshed Delwar – WSDOT
Elizabeth Healy – FHWA
Robin Nelson – City of Marysville
Dave Evans – Snohomish County
John Klasell – Tulalip Tribes
Dave DesVoigne – HDR
John Villager – HDR
Becky Hart – HDR
Edward Koltonowski – GTC
David Sherrard – Parametrix
David Martin – Parametrix

Introductions

After introductions, David Martin stated that the purpose of the meeting was to go through the screening matrix for the interchange alternatives, and ideally make a selection of alternatives for further study.

Interchange Alternatives

John Villager (JV) briefly described three new alternative interchange configurations that were developed since the last meeting. Alternative 9 features a loop ramp in the northeast quadrant of the interchange, to serve the NB to WB off movement. Alternative 9A serves the same traffic, but features a ramp that ties into the local street system at 36th Drive NE. Alternative 10 is a simple widening of the existing bridge over I-5, with no ramp improvements.

Robin Nelson (RN) noted that there were drainage problems in the northeast quadrant of the interchange. He also noted that Alternative 9A lacked a connection with Smokey Point Blvd. He further noted that this alternative would be better if it tied in further south than shown on the drawing.

Screening Matrix

David Sherrard (DS) explained that the consultant team had made a first stab at rating the alternatives on the screening criteria discussed at the last meeting. Three possible ratings were assigned: best (or least impact); middle (or medium impact); and worst (or most impacts). A spreadsheet of the final ratings is attached, reflecting the input of the group.

Purpose and Need – DS stated that all alternatives except Alternative 10 met the purpose and need of the project. There was no disagreement.

Geometric Feasibility – JV explained that all alternatives were designed to meet at least minimum design standards. This item was therefore rated primarily on how well an interchange works in terms of intersection spacing, configuration, etc. The consultant team felt that Alternative 10 wouldn't work well, since there would be insufficient capacity on the ramps and traffic would back up onto the mainline. Alternative 3, with its minimum spacing between ramp termini, warranted a medium rating. All the other alternatives were rated as best.

Elizabeth Healy (EH) disagreed. She stated that alternatives with "button-hook" ramps (1A, 5, 6, 7 and 9A) would be undesirable and should be rated as medium. These alternatives don't meet driver's expectations, and could be expected to be a safety concern due to wrong-way movements (e.g. a vehicle entering an off-ramp).

Environment – DS stated that this item referred to impacts to the physical and natural environment, (e.g. crossings of Quil Ceda Creek, impacts to wetlands, and intrusion into the contaminant plume in the southwest quadrant of the interchange; plus impacts to residences). Many of the loop ramp alternatives (1, 1A, 5, 6, and 7) feature multiple crossings of Quil Ceda Creek, in addition to residential impacts, and were rated worst. Alternatives 3, 4, 8, 9, and 9A have fewer impacts and were rated medium. Alternatives 2 and 10 have the least impacts and were rated best. There was no disagreement with these ratings.

Land Use and Environmental Justice – DS explained that these two criteria are closely related. Land use refers to displacements, disruptions of neighborhoods, loss of access, etc. Environmental justice refers to disproportionate impacts to low-income or elderly populations. Alternative 1 would displace the mobile home park and was rated worst. Alternative 9 would have impacts to both a residential neighborhood and potential commercial property and was also rated worst. The larger diamond alternatives (4, 5, 6, and 8) and alternative 9A would have medium land use impacts.

RN suggested that Alternative 9A, as currently designed, should also be rated as worst. There was a discussion about moving the off-ramp further south. With this modification, the medium rating would stand.

Local Mobility – Circulation – Edward Koltonowski (EK) explained that Alternative 7 was rated worst because it introduced convoluted travel patterns. Alternative 10 was also rated worst, because local traffic wouldn't be able to move through the interchange. The alternatives with standard loops or diamonds, without button-hook designs on the ramps were all rated best. The other alternatives were rated medium. There was no disagreement with the ratings.

Local Mobility – Freeway Access – EK explained that this item referred mostly to how well access to and from the freeway would work. Alternative 10 was rated worst, since it contains no ramp improvements.

The tight diamond (Alternative 3) was rated medium, as were alternatives 5, 6, and 7, since there were some deficiencies in access relative to alternatives with loop ramps. All the other alternatives were rated best since they would improve freeway access.

Freeway Operation – Alternative 10 was again rated worst, since traffic would back up onto the freeway, affecting mainline operations. Alternative 3 was rated medium, since it too would affect mainline, but to a lesser degree than Alternative 10. All the other alternatives were rated best. Dongho Chang (DC) asked if a merge and diverge analysis had been done. EK replied that it hadn't yet, but would be as part of the Access Point Decision Report analysis. DC requested that DM send him a copy of the Synchro analysis. Murshed Delwar requested a copy of the entire package of information that was sent to most team members.

Safety – Due to the concerns with the button-hook designs mentioned earlier, the alternatives with this feature (Alternative 1A, 5, 6, 7, and 9A) were rated worst. Alternatives 3 and 10 were rated medium because there would be increased accident potential with the more congested conditions. All the other alternatives were rated best.

There was a discussion on pedestrian safety, particularly with the SPUJ. John Klasell (JK) stated that 88th Street was intended to be the main pedestrian route over I-5, and that pedestrians were discouraged from using 116th Street. RN stated that with the increase in commercial development along 116th Street, more pedestrian traffic can be anticipated. There is also an existing park-and ride lot associated with the interchange with a stop for northbound transit service at the ramp terminus. Pedestrians walk from the flyer stop to the park and ride.

It was mentioned that this park and ride lot could be expanded with the proposed realignment of 34th Street.

Capacity to Meet Demand – Alternative 10 was rated worst, because it doesn't meet future capacity demands. The diamond alternatives (3, 4, 5, 6) were rated medium, since they have relatively less capacity than the loop alternatives. The other alternatives were rated best.

Local Support – RN gave his input on the City of Marysville's support or opposition. JK mentioned that certain tribal members would be opposed to Alternatives 5 and 6 because of the impact to property. He also mentioned that the County (and the Tribes) support the realignment of 34th Street, although the specifics of the alignment still need to be determined. There was a discussion about the impacts of some of the alternatives on access to Donna's Truck Stop, which would lead to their opposition.

Based on this input, Alternative 1 was rated worst, because the displacement of the mobile home park would be expected to receive heavy opposition from residents of the community. Alternatives 1A, 5, 6, 7, 8, 9 and 9A would also be expected to have moderate opposition and were rated medium. The other alternatives were rated best.

Regional/State Support – EH stated that Alternatives 1, 1A, 5, 6, 7, 9A and 10 would be unacceptable to FHWA due to safety and environmental justice concerns. These alternatives were rated worst. There was medium support for the diamond alternatives (3, 4, and 8). The SPUI (Alternative 2) and Alternative 9 were rated best from an operational point of view. There was a discussion about Alternative 8, which would shift the alignment of 116th Street to the north. David Evans (DE) stated that the County would support this concept. JK stated that the Tribes would be opposed to introducing curves into the 116th Street alignment. DS suggested that this alternative be considered only if needed to mitigate specific impacts on streams which could be addressed by moving ramp termini to the north.

Financial Viability – This item is basically an indication of project cost. DM stated that the major difference in cost between alternatives was right of way acquisition. Therefore, Alternative 1 was rated worst, due to the large number of relocations. Alternatives 2, 3 and 10 would have little, if any right of way acquisition, and were rated best. The other alternatives were rated medium.

Phasing – DM explained that this item was an indication of whether part of the alternative could be built and still have utility. The loop ramp alternatives (1, 1A, 9 and 9A) were rated best, since construction of a single loop ramp alone would improve traffic operations. The SPUI (Alternative 2) and Alternative 10 were rated worst, since they are all-or-nothing alternatives. The other alternatives were rated medium.

Selection of Alternatives for Further Study

The 12 alternatives were reduced to three for future study:

- Alternative 2 – Single Point Urban Interchange
- Alternative 4 (with possible features from the other diamond alternatives) – New Diamond Interchange
- Alternative 9 – Interchange with NE and NW Loop Ramps

Environmental Document

There was a discussion about the appropriate environmental document. It was decided that it is premature to make this determination. Depending on the impacts of the selected alternative, an Environmental Assessment may be adequate.

Presentation to Marysville City Council

There was a discussion about the desirability of making a presentation to the Marysville City Council. RN stated that the December 9 meeting would be the only day open for the rest of this year. DM will work with Robin on setting this up.

Next Meeting

The next regularly scheduled meeting would fall on Thanksgiving, and therefore won't be held. It may be necessary to meet prior to a possible presentation to the Marysville City Council on December 9. DM will update the group should that be necessary. A meeting to discuss the Access Point Decision Report is tentatively scheduled for November 14. The time and place need to be arranged.

**116TH STREET NE INTERCHANGE
ACCESS POINT DECISION REPORT
MEETING MINUTES
NOVEMBER 14, 2002
10:00 TO 11:30**

Attendees: WSDOT:
Darlene Sharar
Shuming Yan
Methqal Abu-Najem
Ken Seguin
Dick Albin
John Milton
Tim Hostetler
FHWA:
Elizabeth Healy
Liana Liu

PMX:
David Martin
David Sherrard
Rishi Rao
Michael Horntvedt
HDR:
John Villager
GTC:
Edward Koltonowski

Purpose of Meeting and Project Background

After introductions, David Martin (DM) stated that the purpose of the meeting was to introduce the project to WSDOT and FHWA staff who will be involved in reviewing and approving the Access Point Decision Report (APDR). The other purpose is for the consultant team to begin understanding any issues that WSDOT and FHWA might have in regard to the APDR, and to ensure that our analysis address those issues.

DM stated that the project was in its early stages. Improvements to the 116th Street NE interchange are being proposed to accommodate future growth that is planned in Snohomish County, Marysville and on the Tulalip Reservation. A coordination group that includes representatives from all affected agencies has been meeting for the past several months. A total of 10 interchange alternatives have been developed, and were recently screened down to three.

Draft Purpose and Need

David Sherrard (DS) handed out a draft Purpose and Need statement and asked the group to send him comments.

Transportation Model

DS stated that the consultant team intended to use the Puget Sound Regional Council's (PSRC) 2030 land use projections as the basis for analysis. The planned development at the Quil Ceda Business Park is not included in the PSRC model, and will be added.

For the traffic analysis, the team will use the traffic network from the Snohomish County Arterial Network (SnoCAN) model. This is a model that has wide acceptance from surrounding jurisdictions. It includes programmed roadway improvements.

John Milton (JM) asked if the SnoCAN model accounted for growth. DS replied that SnoCAN includes 2020 forecasts from the PSRC 1998 projections. We will update to 2030 forecasted land use from the 2001 projections. JM noted that land use assumptions were a major issue for WSDOT on the 88th Street interchange project, since the projections for the EIS and Access Point Decision Report were different. DS stated that the land use and traffic projections would be identical for this project.

There was a discussion about the correlation between the modeling effort for this project and the PSRC 2030 model. Shuming Yan (SY) asked about the timeline for the APDR. Rishi Rao (RR) estimated that approximately 5 months would be needed to complete the modeling. The PSRC expects to have its model approved at the end of January 2003. It was noted that we may not be able to wait for the PSRC approved model before proceeding ahead.

It was suggested that there be follow-up meetings that focus on just the modeling assumptions and input. These meetings would include JM, SY, Liana Liu (LL), and someone from PSRC.

There was a discussion about the transportation network assumptions that are in the PSRC model. As an example, RR stated that the model assumes an additional general purpose lane in each direction on I-5 by 2030; it assumes a commuter rail station at 116th Street NE. The additional lanes are also included in WSDOT's System Plan for 2030. The question that needs to be answered is whether improvements like the additional lane on I-5 can be assumed for the analysis of the interchange project. JM stated that WSDOT would discuss this issue internally and make a decision about what to assume.

Approach to Report

Michael Horntvedt (MH) handed out a draft outline of the steps needed to complete the APDR (attached). He explained that the preliminary work (identifying the need for the project, and developing and screening alternatives) were already finished. We are now at the point of defining those items and issues that will require consensus from the Access Decision support team.

JM stated that just evaluating level of service (LOS) will not be sufficient. An evaluation of delay will also be necessary.

There was a discussion of what constitutes a "significant adverse impact". It was determined that the analysis should look at the No Build and the Build alternatives. If the No Build alternative would create a worse situation than the Build, then the project would not be making a significant adverse impact.

It was also stated that a mid-term analysis, looking at a year between Year of Opening and Design Year (2030) would be desirable. This analysis would help determine when the additional lane on I-5 is needed.

JM stated that it was necessary to stratify the analysis. This means to evaluate existing year, year of opening, and design year, as well as to estimate when operations would break down, assuming no improvements to I-5.

SY asked what the current LOS on the mainline was. EK stated that we hadn't analyzed that yet, but that the LOS has improved in the past two years, since signals were installed at the interchange. He went on to state that the unconstrained volume projections are a 100% increase over existing. The unconstrained volumes on the northbound mainline exceed 8,000 vehicles per hour, and would obviously not be accommodated with the current 3 lanes on I-5. It was reiterated that WSDOT needs to make a policy decision on the issue of what to assume in 2030.

MH stated that the consultant team would develop a draft description of the No Build alternative, for discussion and approval by the Decision Report Support Team. EK stated that the No Build would include funded improvements by local agencies, including those being proposed by the Tribes. He stated that the Tribes are developing their first Transportation Improvement Program (TIP) that includes a widening of the bridge at 88th Street.

JM stated that analysis of 172nd Street, 88th Street, and 4th Street/SR 528 interchanges would be required. The group discussed the criteria for the area of analysis. EH clarified that FHWA regulations required analysis of "affected" interchanges. A minimum of one on either side is required, but can be expanded. A discussion ensued on the analysis area for the report.

DS pointed out that the number of roads parallel to I-5 is very limited. The only crossings of Ebey Slough are I-5 and SR 529/State Street with the SR 9 crossing served by SR 2 a considerable distance to the east. EH indicated that FHWA would look at improvements to the local arterial system to limit local trips on I-5.

Methqal Abu-Najem (MA) asked what analysis software was planned. It was stated that Highway Capacity Software (HCS) would be needed, in conjunction with a Corsim analysis. The details of which software versions to use will be decided by the group that determines the modeling assumptions.

LL indicated that the HCS Freeway Facilities analysis methodology was questionable and she suggested that we not use that part of the HCS. She also stated that FHWA would use HCS to duplicate analysis results. The support group determined that the consultant team would develop an analysis methodology to present to the group for consensus prior to moving forward with the analysis.

Future Steps

It was agreed that it was critical to receive concurrence on methodology, assumptions, etc. prior to beginning analysis. It was further agreed that each decision should be discussed and settled separately, and documented with a technical memorandum. These technical memoranda can be used as pieces of the APDR.

It was noted that FHWA approval of the APDR will occur in the local office, not in Washington D.C.

DM will arrange a time for regular meetings of the Access Decision Support Team.

**116TH STREET NE INTERCHANGE
MONTHLY COORDINATION MEETING MINUTES
JANUARY 29, 2003
11:00 TO 12:00**

Attendees:	<u>WSDOT:</u>	<u>BIA</u>	<u>PMX:</u>
	Pat McCormick	Stan Suridge	David Martin
	Methqal Abu-Najem	Jim Hagen	Michael Horntvedt
	Dean Torkko	Jeff White	
	Tony Basha	<u>FHWA:</u>	<u>HDR:</u>
	Dongho Chang	Elizabeth Healy	Ross Fenton
	Terry Paananen		Becky Hart
	Dick Albin	<u>Tulalips</u>	
		Conrad Edwards	<u>GTC:</u>
	<u>City of Marysville</u>	T. Peter Mills	Edward Koltonowski
Jeff Massie	John Klasell		

Partner Confirmation Meeting Recap

After introductions, David Martin (DM) recapped the results of the Partner Confirmation Meeting that preceded the coordination meeting. The results included the determination that BIA, FHWA and WSDOT would be co-leads for the environmental document; that Snohomish County (and potentially some federal agencies) would be invited to be cooperating agencies; that the appropriate environmental document would be an EA (leading to either a FONSI or the need for an EIS); that coordination on resource issues needs to be initiated; and that a separate meeting with BIA, FHWA and WSDOT would clarify methodologies and formats for the environmental process.

Status of Traffic Modeling

Michael Horntvedt (MH) stated that a paper on methodology is currently being reviewed by John Milton (JM), and comments are expected shortly, after which the paper will be distributed to the Access Decision Point Report (APDR) working group. JM is also reviewing a detailed description of the No Action scenario. MH stated that it was necessary to resolve a number of issues, such as whether to include the additional HOV lane south of 4th Street that is described in the WSDOT System Plan. EK pointed out that there is a nearly insignificant difference in traffic impact between assuming a general purpose or HOV lane, and so the decision isn't expected to affect the results of the analysis at 116th Street NE.

EK also stated that the results of the modeling have been compared to the results of the City of Marysville's model, and the numbers are similar.

MH also stated that the model shows a large demand for local traffic trips to the Tulalip business park. He felt that this was a potential issue, but JM believes that it's a reasonable assumption.

Dean Torkko (DT) asked whether the traffic analysis for the APDR will include the specific data needed for the air and noise studies. He stated that the requirements are on the WSDOT website.

Jeff Massie (JM) asked if there was some background material on the alternatives considered to date, since he is new to the project. DM said he would put together a packet for Jeff.

Environmental Studies

DM stated that in addition to the traffic modeling work, the team has performed wetland delineation in the project area. The only wetlands are those associated with the west fork of Quil Ceda Creek.

The consultants have also walked the stream with Kurt Nelson of the Tulalip Tribes, and are currently evaluating whether the existing culvert crossings are fish barriers.

There is a right of entry request at WSDOT for the installation of three groundwater monitoring wells within the existing interchange.

DT mentioned that preparation of the Environmental Justice section of the EA should be coordinated with David Williams of WSDOT.

Design Refinements

DM stated that the current project schedule calls for final design to begin in early 2004, and for construction to begin in 2005. The Tulalip Tribes would like to accelerate the design so that construction could begin as much as a year earlier than planned. To meet this schedule, the design team will need to accelerate its work.

Terry Paananen (TP) pointed out that a decision to move forward with a single interchange design would preclude the potential use of federal funds for the project. John Klasell (JK) stated that no federal funds were anticipated for the project.

Elizabeth Healy (EH) emphasized that no decisions on alternative selection or on details of design will be based on budget already spent on design. There was general concurrence on this point. DM stated that the Tribes understood that they were potentially taking a risk by moving ahead with design, and that they knew that it was possible that design would need to be redone.

TP stated that whatever property is used for road right of way, either on the interchange or the realignment of 34th Avenue NE, needs to be certifiable. He also stated that property acquisition needed to follow the federal process. JK said that this would not be a problem. DT mentioned that present or advance ownership of any particular property would not influence the description or location of the Proposed Action.

There was a general discussion about how to move the process along. EH suggested a series of white

papers for the various issues surrounding the APDR. DT asked if perhaps we could focus on points 1 through 3 of the eight points in the APDR, and get approval for those first. It was agreed that the initial focus should be on traffic impacts, since this will drive the selection and refinement of an interchange configuration.

Methqal Abu-Najem suggested that a team of WSDOT reviewers be assembled to work with the consultant team throughout design in order to help with accelerating the review and approval process.

Next Meeting

DM suggested that the regular monthly meetings be held on the last Wednesday of each month at WSDOT NW Region. The next meeting will be held on February 26 at 10:30 am.

**116TH STREET NE INTERCHANGE
ACCESS POINT DECISION REPORT
MEETING MINUTES
FEBRUARY 24, 2003
1:00 TO 2:00**

Attendees:	<u>WSDOT:</u> Methqal Abu-Najem Dick Albin Ron Franzen Bruce Johnson John Milton Shuming Yan	<u>PMX:</u> David Martin David Sherrard Michael Horntvedt Sue Martin
	<u>FHWA:</u> Liana Liu	<u>HDR:</u> John Villager
		<u>GTC:</u> Edward Koltonowski

Purpose of Meeting and Project Background

After introductions, David Martin (DM) stated that the purpose of the meeting was to follow up on the November Access Point Decision discussion. The other purposes were to present the EMME/2 Model Results and traffic distribution, discuss the White Paper concept and to finalize Methodology and No Action Points.

Transportation Model

MH stated that in the traffic analysis it was noted that growth increased as you go north.

At 4th Ave 50%
70th 60%
116th Ave 70%

The SnoCAN model is more detailed than the PSRC and Marysville sent an update to this model on January 13, 2003. So the numbers that are being used for them are up-to-date.

There was a question about how the numbers for the Quil Ceda business park were counted. There may be a need to balance the model since it shows Quil Ceda as having less than 1% growth impact on the region.

The Tribe has done an economic development analysis, so we need to find the demand.

MH showed maps that represent unconstrained demand. DOT's standpoint is that the more conservative the better. They want to know the percentage increase at the 3 hour peak travel times.

MH showed that the pick point model, where you pick a starting point and all the volume numbers are shown in relation to that point, the for the 116th interchange serves a lot of local trips, not as many freeway trips.

Is this model correct? Can we do better? Do we have COT data to add in to balance this out?

Puget Sound model is what we have, and what we use. It is the standard that everyone uses. We know it has problems, but to we think the problems are big enough that we should try a different approach? We need to see what the impacts are with the growth. 88th pulls from State street.

MH handed out a memo, that detailed the format for the White Paper.

We looked at the No Action text. We would go with FHWA's plan as well as improvements from local jurisdictions.

There was discussion of the items in the table of the handout. FHWA didn't think the I-5 carpool lanes should be on the list, since there wasn't money in the budget for them.

There was a discussion about having a new baseline for opening year. To take the opening year and compare the Action and No Action.

The developer gets the benefit from the local improvements. Tribe has said it wants to contribute to the improvements in the local area.

Decisions

PMX will run the model for 2006 - No Action and 2030 - No Action

In determining the No Action items we will use the GMA criteria., which is to say that if the funding is committed, then the items are included.)

It was decided that in the Access Report there needs to be a discussion about opening year and design year. (Is 2006 the open year?)

**116TH STREET NE INTERCHANGE
MONTHLY COORDINATION MEETING MINUTES
MARCH 26, 2003
10:30 TO 12:00**

Attendees:	<u>WSDOT:</u>	<u>FHWA:</u>	<u>PMX:</u>
	Shuming Yan	Elizabeth Healy	David Martin
	Methqal Abu-Najem		Michael Horntvedt
	Dean Torkko	<u>Snohomish Co.</u>	
	Tony Basha	Dave Evans	<u>HDR:</u>
	John Milton		Ross Fenton
Ron Franzen	<u>City of Marysville</u>	Becky Hart	
	Dave Lervik	Dave DesVoigne	
		<u>GTC:</u>	
		Edward Koltonowski	

Status of Environmental Process

David Martin (DM) stated that the Agency Scoping Meeting would take place at WSDOT on April 16th. There was a Partner Confirmation meeting on January 29 that confirmed that WSDOT, FHWA and BIA would be co-leads for the environmental document, with Snohomish County as a cooperating agency. Since the footprint of the project isn't within the city limits of Marysville, the City will not be a cooperating agency.

There was a discussion about involvement of other agencies. Elizabeth Healy (EH) suggested that the team contact the Signatory Agency Committee (SAC) agencies for comment, even though as an EA project, the interchange doesn't trigger a formal SAC process.

Dean Torkko (DT) asked about the status of the discipline reports. DM stated that these will begin after the scoping meeting. The baseline work has been completed for wetlands and streams.

Status of Access Point Decision Report (APDR)

Michael Horntvedt (MH) stated that a No Build Alternative for 2030 has been developed. The traffic projections for 2030 seem reasonable. The projected volumes will be sent to John Milton (JM) for interim review. David Lervik (DL) asked for a copy to be sent to the City of Marysville for review.

There was a discussion about whether the traffic growth rate was related to the Quil Ceda Business Park development or to regional traffic. DM stated that it was a combination of both. The original PSRC model numbers didn't include the business park; these volumes were added by the consultant team.

When completed, four copies of the draft APDR will be sent to WSDOT for review.

Status of Design

John Villager (JV) stated that three alternatives are being developed for the EA, and that the designs will be substantially completed in the next month. Drawings are being prepared that detail the footprint of the improvements and the limits of clearing. These drawings will be displayed at the agency scoping meeting in April.

The team is also working on the design file for the SPUI alternative. A draft channelization plan will be delivered to WSDOT next week. JV requested an expedited review so that final design of the SPUI could proceed.

JV reviewed several decisions that have been made on outstanding design issues. The 116th Street NE bridge over I-5 will be replaced, rather than widened. It is expected to consist of two spans with a pier in the median, and to be pre-cast, pre-stressed concrete. It will include a pedestrian walkway. The visual elements of the bridge will be coordinated with the Tribes, as well as with WSDOT.

The realignment of 34th Avenue NE has been finalized. The new alignment will move the intersection with 116th Street NE several hundred feet to the west. The road will be built to Snohomish County standards, but will become a tribal road on tribal right of way. The proposed speed limit will be 50 mph. The future maintenance of the road will be worked out with the County.

The current plan is to leave the park and ride lot in its existing location. Access would be via the realigned 34th Avenue NE, since an access off 116th NE would be within the limited access area of the interchange. The size of the lot may be increased. Todd Jacobs (TJ) expressed Community Transit's objections to the more circuitous route to the park and ride lot, especially for northbound buses in the afternoon.

There was a question about potential ramp metering. Metering will not be part of the project, but the ramps will be designed and built to accommodate future ramp meters. It was noted that Smokey Point (NE 172nd Street) interchange will also be metered in the future.

JV stated that there was no right of way acquisition planned east of the interchange. DL requested that the ultimate widening of 116th Street NE all the way to State Street be included in the EA. Traffic operations analysis may influence the appropriate terminus of the project.

DT asked if there was any prime and unique farmland affected by the realignment of 34th Street NE. JV stated that there wasn't.

Next Meeting

The next regular monthly meeting will be held on April 30 at 10:30 am.

116TH STREET NE INTERCHANGE
MONTHLY COORDINATION MEETING MINUTES
APRIL 30, 2003
10:30 TO 12:00

Attendees:	<u>WSDOT:</u>	<u>FHWA:</u>	<u>PMX:</u>
	Shuming Yan	Elizabeth Healy	David Martin
	Methqal Abu-Najem		Michael Horntvedt
	Dean Torkko	<u>Snohomish Co.</u>	
	Tony Basha	Dave Evans	<u>HDR:</u>
	John Milton		Ross Fenton
Ron Franzen	<u>City of Marysville</u>	Becky Hart	
	Dave Lervik	Dave DesVoigne	
		<u>GTC:</u>	
		Edward Koltonowski	

Agency Scoping Meeting Recap

After introductions, David Martin (DM) recapped the Agency Scoping Meeting that took place on April 16th. He handed out Meeting Minutes for those interested in reading further.

Public Scoping Meeting

The Public Scoping Meeting will be scheduled for the second week in June, the 10th, 11th, or 12th, between 4:00 – 8:00 pm. There was discussion concerning the best date/time. It was concluded that the Public Scoping Meeting would be held from 5:00 – 8:00 p.m. on **Tuesday June 10th** in the Retail Business Center at Quil Ceda. Advertisement of the scoping meeting will be via a public mailing, notification in the Everett Herald, and posting on the WSDOT website.

EA Schedule

DM stated that background information for various discipline reports was being gathered but that the reports won't be prepared until after the Public Scoping Meeting and selection of a preferred alternative. Dean Torkko (DT) mentioned that the EA will include a discussion of the No Action alternative. DT advised the consultants to refer to the WSDOT web site for guidance on preparing the Air and Noise sections of the EA. He also advised to contact David Williams of WSDOT and Jody Peterson of FHWA to receive guidance on determining if there are Environmental Justice issues involved with impacts to the mobile home park.

Process for Selection of Preferred Alternative

Parametrix will prepare a draft matrix of screening criteria for selection of the preferred alternative. The criteria will be discussed and finalized at the next monthly update meeting (May 28). The alternatives will be rated and a preferred alternative selected at the following update meeting (June 25).

Project Logo

DM showed a draft project logo featuring a whale similar to that used in the Tulalip Tribes' logo. He stated that this was in lieu of including the Tulalip Tribes on the environmental document and other project materials, since they are not one of the co-lead agencies. After some discussion, it was decided that with some modifications (addition of other northwest elements), the logo was acceptable.

Status of Access Point Decision Report

The description of the 2030 No Action alternative is being reviewed by WSDOT and FHWA. The final traffic forecasts for the action alternatives are still being developed. Michael Horntvedt (MH) noted that the APDR for the 172nd Street NE interchange didn't include analysis of the 116th Street interchange; therefore, it seems logical that our APDR wouldn't analyze 172nd Street. There was general concurrence.

Interchange Channelization Design

Becky Hart (BH) stated that the proposed channelization plan was close to being finalized, and would be submitted to WSDOT for review shortly.

Alignment of 34th Avenue NE

The alignment of relocated 34th Avenue NE has been determined, based on several constraints. These include the desire to have a perpendicular crossing of Quil Ceda Creek, to minimize the amount of curvature within the Campbell property, and to not encroach on the property north of the tribal property adjacent to the Campbells'. Meeting all these constraints requires a reduction in design speed from 55 mph to 45 mph. A meeting will be held with Snohomish County to discuss the process for approval of the alignment and other design features of 34th Avenue.

Relocation of the Park and Ride Lot

DM stated that a meeting was held earlier in the morning to discuss possible relocation of the park and ride lot with Community Transit (CT) and WSDOT's NW Region Traffic. Conclusions from the meeting included:

- The park and ride lot will remain in its current location.
- A bus-only access from 116th Street NE to the park and ride lot is unacceptable.
- Access for all vehicles will be from the north, via existing 34th Avenue NE.
- CT will explore whether they will serve the park and ride lot in its existing location.

Other Design Issues

DM mentioned that the railroad bridge would need to be removed as part of the project. A pedestrian bridge is planned as a replacement structure. EH stated that the pedestrian bridge needs to be included on the Tribe's trail plan.

EH stated that the interchange bridge needs to accommodate the potential for five lanes on I-5, i.e. one additional general purpose lane, and one additional HOV lane.

Next Meeting

The next regular monthly meeting will be held on May 28 at 10:30 am.

**116TH STREET NE INTERCHANGE
MONTHLY COORDINATION MEETING MINUTES
MAY 28, 2003
10:30 TO 12:00**

Attendees:	<u>WSDOT:</u>	<u>FHWA:</u>	<u>PMX:</u>
	Ken Seguin	Elizabeth Healy	David Martin
	Dick Albin		Michael Horntvedt
	Bruce Johnson	<u>Snohomish Co.</u>	
	Tony Basha	Dave Evans	<u>HDR:</u>
	John Milton	<u>City of Marysville</u>	John Villager
	Steve Shipe	Dave Lervik	Becky Hart
			Dave DesVoigne
	<u>Tulalip Tribes</u>	<u>Community Transit</u>	<u>GTC:</u>
	Patricia Paul	Todd Jacobs	Edward Koltonowski
Reid Allison		Brad Lincoln	

Status of Access Point Decision Report

Michael Horntvedt (MH) led a discussion of the status of finalizing traffic projections to be used for design. Since the last meeting, the model was updated to include more detail on the I-5 mainline and the ramps at the 88th NE and 116th NE interchanges.

MH stated that the model shows that no new trips will be generated by the interchange construction, but that some trips would be diverted from 88th to 116th when the interchange is improved. Compared to the No Build condition, this diversion amounts to approximately 100 additional vehicles per hour on the northbound off ramp (a 4% increase), and lesser amounts on the other ramps. The increase in mainline volumes over No Build is about 1.5%. These are not significant increases over No Build.

MH recounted the difficulties in post-processing the traffic numbers, and requested a meeting with WSDOT and FHWA to review the projections. The meeting was subsequently arranged for June 11.

MH also suggested that since the SPUI alternative has the highest capacity of any build alternative, the volumes that result from modeling the SPUI be used for the other action alternatives, without rerunning the model each time. There was no objection from the group.

Status of Environmental Process/Issues

David Sherrard (DS) stated that the Public Scoping Meeting will be held June 10. It is anticipated that a preferred alternative can be selected after receipt of public comments.

DS led a discussion on the draft Second Level Screening matrix. It was decided that all references to Fatal Flaw be removed from the matrix, since the alternatives currently under consideration have all passed the fatal flaw review during first level screening.

Todd Jacobs (TJ) suggested that impacts to transit be a separate subcategory of Transportation, rather than being lumped in with Local Mobility. It was decided that at a minimum, impacts to transit will be added

to the description of both the Local Mobility - Circulation and Local Mobility - Freeway Access sections.

Status of Design/Issues

John Villager (JV) gave a brief report on the status of design. He stated that design of the realignment of 34th was proceeding, with a draft floodplain analysis to determine the length of the proposed bridge over Quil Ceda Creek. The Park and Ride Lot will remain in its current location, but with no direct access from 116th Street NE.

JV stated that if this were a WSDOT-funded project, there would be a Value Engineering study, but it may not be warranted. He will discuss the issue with the project office.

Elizabeth Healy (EH) reiterated that the interchange bridge needs to accommodate the potential for five lanes on I-5, i.e. one additional general purpose lane, and one additional HOV lane. John Milton (JM) stated that he was in discussion with NW Region on the issue, and that he needed to follow up with EH.

Next Meeting

The next regular monthly meeting will be held on June 25 at 10:30 am.

**116TH STREET NE INTERCHANGE
MONTHLY COORDINATION MEETING MINUTES
JULY 30, 2003
10:30 TO 12:30**

Attendees:	<u>WSDOT:</u> Methqal Abu-Najem Dean Torkko Tony Basha Dongho Chang Dick Albin	<u>FHWA:</u> Elizabeth Healy <u>City of Marysville</u> Dave Lervik <u>Community Transit</u> Todd Jacobs <u>Citizen:</u> Barbara Thompson-Armes	<u>PMX:</u> David Martin Becky Reininger <u>HDR:</u> John Villager <u>GTC:</u> Edward Koltonowski
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Introductions

Barbara Thompson-Armes attended the meeting, representing the residents of the mobile home park in the southeast quadrant of the interchange.

Status of Environmental Process/Issues

David Martin (DM) led a discussion of the second level screening matrix. The filled-in matrix, and an explanation of the group's ratings, is attached.

It was decided to defer rating the Freeway Operations section of the matrix, since the traffic analysis for each alternative has not been completed.

It was also decided to delete the Environmental Justice section, since the census data needed to make the determination has not been completed.

The Implementation section of the matrix was deleted.

The results of the ratings are as follows:

Single Point Urban Interchange (SPUI) – 79 points

Expanded Diamond Interchange – 50 points

Diamond Interchange with Loop Ramps in the Northeast and Northwest Quadrants – 50 points

Based on the ratings, the group selected the SPUI as the preferred alternative to evaluate in the Environmental Assessment.

Elizabeth Healy (EH) noted that it was still necessary to evaluate all three alternatives in the Access Point Decision Report. She stated that if the Traffic Analysis showed that there would be operational problems with the SPUI, the decision on a preferred alternative might need to be revisited.

Other Issues

Methqal Abu-Najem (MA-N) stated that the current plan for the park and ride lot was unacceptable. He asked the consultant team to investigate further options for the park and ride lot and flyer stops.

Next Meeting

The next regular monthly meeting will be held on September 24 at 10:30 am.

Attachments:

Screening Matrix

Explanation for Ratings

CSMPrg Data Gaps estimated future analytical costs (DRAFT 11/15/04)

Item	Target Constituents	AQI cost	No. Stat.	No. Events	Total Cost	Comments
		\$			\$	
A	SDE4 Source Tracing TSS, Turb, Cu, Zn (tot/diss)	148	12	1	1,776	This event is scheduled for the second half of Nov.
B	TSS, Turb, Cu, Zn (tot/diss)	148	12	1	1,776	The cost of this event depends upon the 3rd round of data
C	Phase II Post-BMP monitoring Data Gap locations 8A, 19N, 19S to coincide with Dec. NPDES	153	3	1	459	This has been scheduled
D	SDS3 Runway WQ/Filter Strips TSS, turb, Cu, Zn (tot/diss), pH (drop Pb)	153	16	2	4,896	Need two more events with new stations. Current suite of constituents (Don't always get samples at all stations)
E	Glycols only	130	16	3	6,240	Not scheduled yet. Port verifying need
F	Glycols + metals	258	16	3	12,384	Not scheduled yet. Port verifying need
	A+B+C				4,011	Source tracing + post-BMPs
	A+B+C+D				8,907	Source tracing + post-BMPs + runway (current)
	A+B+C+E				10,251	Source tracing + post BMPs + runway (glycols only)
	A+B+C+F				16,395	Source tracing + post BMPs + runway (glycols & metals)

TSS	15
Turbidity	5
pH	5
Metals digestion	12
Metals filtration	10
Zinc	10
copper	20
lead	20
glycols	130

APPENDIX C

Traffic Analysis and Traffic Volume Forecasting Memos



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TECHNICAL MEMORANDUM

Date: February 25, 2003
To: 116th Street APDR Support Group
From: Michael Horntvedt
Subject: Traffic Operations Analysis Methodology Signature Paper
cc:
Project Number: 554-1598-017
Project Name: 116th Street NE Interchange Access Point Decision Report

The purpose of this technical memorandum is to define the methodology for analysis for the NE 116th Street Access Point Decision Report (APDR). This memorandum is intended to provide the necessary information required to develop a group consensus on the methodology prior to analysis of the alternatives.

The first step in developing an APDR is to define the need for a project. The need for this project was identified early in the process of the project when it was determined using unconstrained traffic volume demand forecasts that the freeway (I-5) would operate with traffic volumes over capacity. In an effort to ease congestion on the freeway within the vicinity of the 116th Street NE interchange, it was proposed that a new interchange design be evaluated. As a result of this identified need, the project team developed several alternatives for interchange design that would have various effects on traffic operations and environmental impacts. The team evaluated over 12 alternatives and screened them down to three that would be carried forward into an environmental analysis and APDR process.

Analysis of the transportation impacts was conducted using the most recent unconstrained SnoCAN model results to project traffic volumes out to the year 2020. An estimated 1% per year growth was then added to the year 2020 volumes to develop preliminary year 2030 traffic volume estimates. Because the SnoCAN model did not include the Quil Ceda Business Park developments that are planned by the design year, the traffic volumes that would be generated by those additions were added into the future estimates external to the model. This level of traffic volume was considered to be a conservative estimate for the traffic that could reach the interchange facility by the year 2030. These traffic volume estimates were used to evaluate the interchange layout alternatives in terms of probable traffic demand.

The third major point of the APDR requires a description of all reasonable alternatives. It is proposed that this section include a description of the alternatives developed using the above mentioned traffic volume estimates and further detail about the alternative that has been

selected as the preferred. The 116th Street NE APDR will utilize output data from the final transportation planning model (as described below) to demonstrate how changes to the local arterial system would or would not provide an adequate option to modifications to the interchange as proposed.

The SnoCAN model is being updated to include the Puget Sound Regional Council's (PSRC) year 2030 land use data and trip tables, together with the Quil Ceda Business Park development to provide an updated forecast to the year 2030. This will assure consistency with regional growth trends in the PSRC forecasts as well as provide a more accurate focus on local growth and the local roadway network.

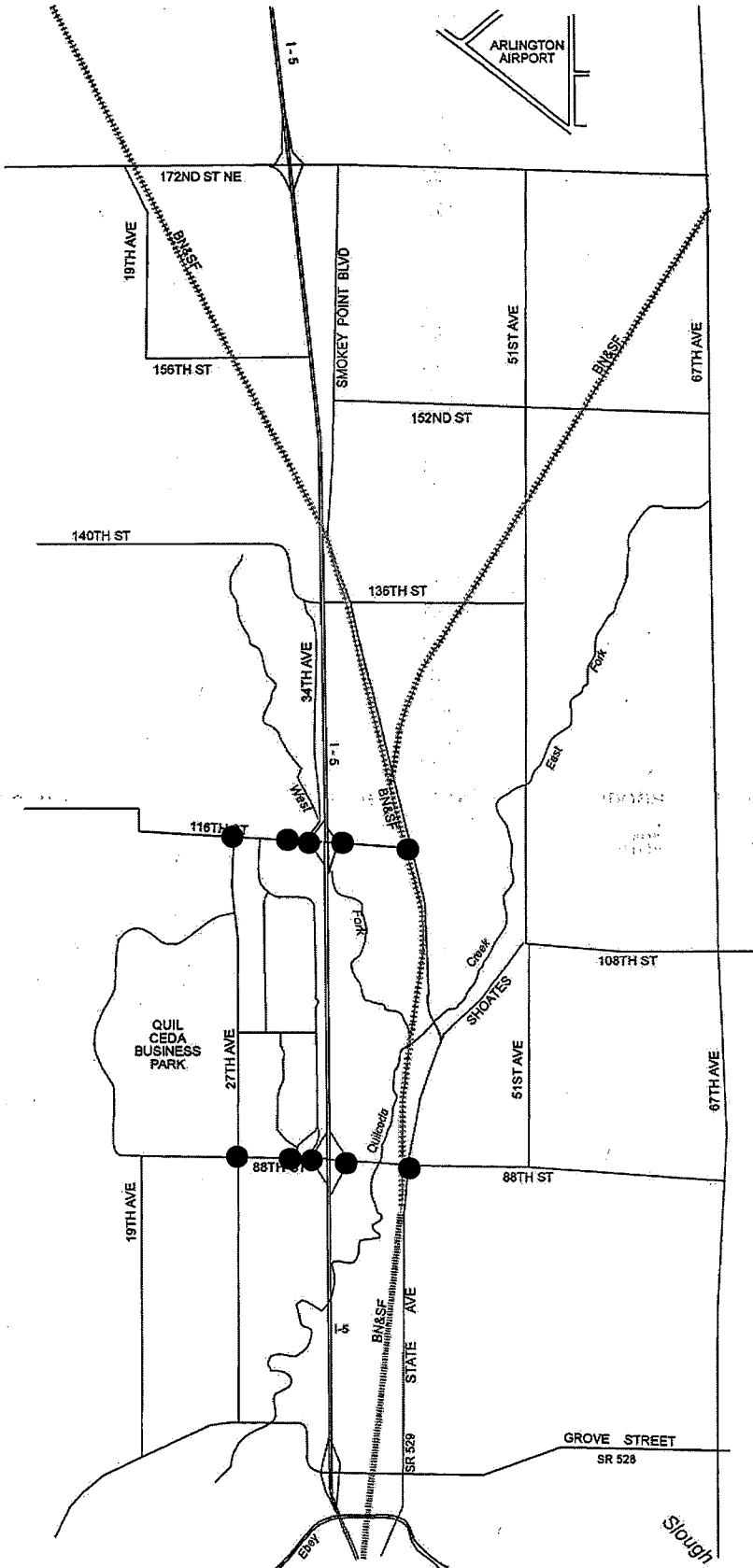
It is anticipated that the updated traffic volume forecasts will show that northbound I-5 will operate over capacity at the location where SR 529 volumes merge into I-5, which will extend two interchanges south of the proposed project area. This is anticipated because year 2000 PM peak hour traffic counts show that the freeway operated at 86% of its available capacity. This puts the current freeway at a level of operations near LOS D. Moderate traffic growth could push this level of service to a LOS F in the near term. Because of this early LOS F estimation and no identified projects to improve freeway capacity, it is necessary to plan for a constrained freeway operation by the design year.

The 116th Street NE APDR reporting limits are understood to include the 116th Street NE interchange and the 88th Street NE interchange. Because the 172nd Street interchange north of 116th Street is located over three miles to the north, it is not included in the analysis. The APDR Support Group agreed that the traffic distribution that results from a modified interchange at 116th Street would not introduce changes of any significant degree to the 172nd Street interchange. Freeway analysis will be conducted further to the south in an effort to demonstrate how the No-Action freeway capacity constrains the amount of traffic that could ultimately reach the 116th Street interchange. Figure 1 shows the locations of the local intersections to be evaluated for this APDR. Local intersections that will be evaluated in the Access Point Decision Report include the following:

- 88th Street NE/27th Ave
- 88th Street NE/Quil Ceda Boulevard
- 88th Street NE /SB ramps
- 88th Street NE /NB ramps
- 88th Street NE /State

- 116th Street NE/27th Ave
- 116th Street NE/34th Ave
- 116th Street NE /SB ramps
- 116th Street NE /NB ramps
- 116th Street NE /State

Figure 1. Access Point Decision Report Local Intersections



The methodology proposed for determination of traffic volumes to be used for final operational analysis is provided in the following list:

Transportation Planning Model

The following outlines our proposed methodology for developing traffic forecasts for the NE 116th Interchange Study:

- Use the SNOCAN EMME/2 model as the database for the travel forecasts.
- The SNOCAN model has travel forecasts for a 1998 base year and 2020 future year.
- Use the 1998 base year travel forecasts from the SNOCAN model as representative of the existing traffic activity in and around the Study area. The 1998 traffic forecasts will be validated for reasonableness using screenlines.
- Update SNOCAN's 2020 EMME/2 database to 2030 conditions.
- This update would include, growing the land use to reflect 2030 PSRC land use forecasts, as well as, updating the regional network to reflect PSRC's 2030 adopted Metropolitan Transportation Plan (*Destination 2030*).
- Since PSRC's 2030 land use forecasts does not reflect the current or proposed QuilCeda development, we will update the 2030 land use for the Tulalip traffic analysis zones (TAZs) to reflect the land use growth targets from the QuilCeda development.
- Output from the forecasting model effort will be utilized to develop reasonable traffic growth rates, trip generation, and distribution that will be applied to the existing year traffic volumes.

Traffic Operations Analysis

- Simulate the future traffic volumes in the CORSIM simulation model to identify locations where the freeway capacity constraints may limit traffic volume to the project area. Traffic volume output (volume served) from the CORSIM model will be utilized as input to the HCS freeway analysis and Synchro local traffic analysis models.
- Analyze the final freeway operations at the on- and off-ramp locations using HCS and the local operations using the SYNCHRO models. (Because there would be no change in land use between the No-Action and build alternative, the traffic volumes would only be re-distributed through the interchange area based on modifications to the interchange geometry. It is not anticipated that any change to an interchange geometry would generate or re-distribute enough trips to be outside the + or - 10% accuracy of the SnoCAN model with a 30 year horizon, thus no changes to traffic volumes would be part of this effort.)
- Summarize traffic operations results.

Because a new interchange design would not generate new trips but will merely re-distribute to some extent the trip demand, this analysis is not anticipated to generate arterial improvements other than those that would be required to route local trip demand to the interchange. Local arterial improvements will be included in the modeled network and are anticipated to accommodate local trips where both trip ends are within the local area.

The alternative to be modeled will include the following scenarios:

- Existing Conditions
- Year of Opening w/o project
- Year of Opening w/ project
- Design year w/o project
- Design year w/ project



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TECHNICAL MEMORANDUM

Date: April 21, 2003
To: Access Point Decision Report Support Group
From: Michael Horntvedt
Subject: No-Action Signature Paper
cc:
Project Number: 554-1598-017
Project Name: 116th Street NE Interchange

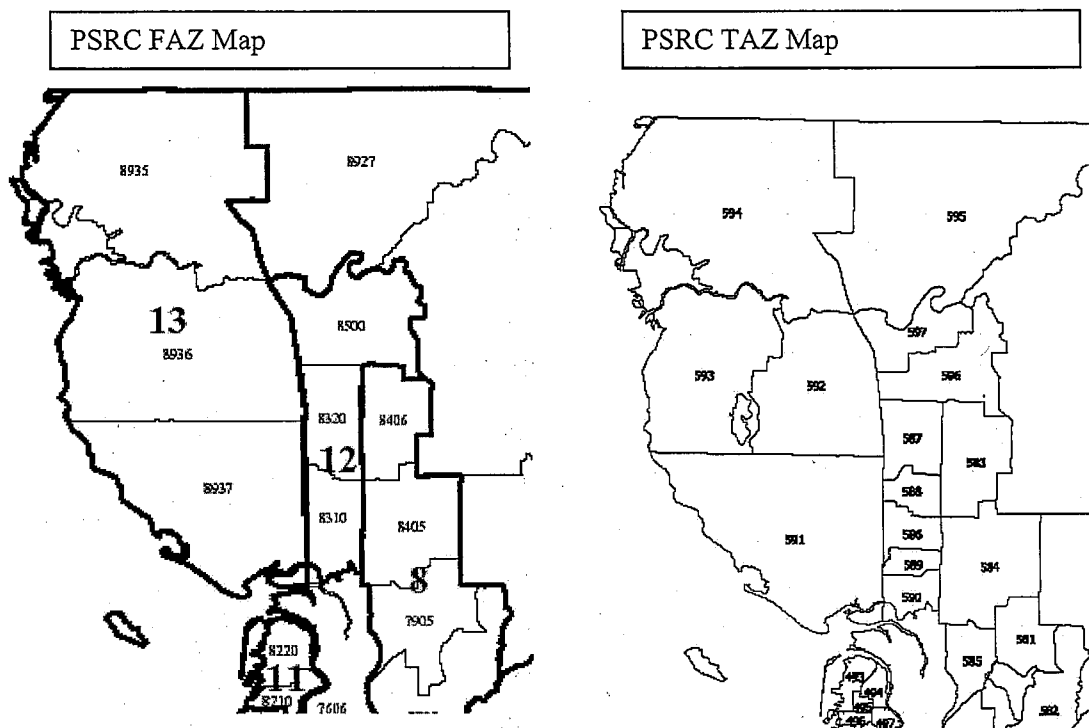
116TH STREET NE ACCESS POINT DECISION REPORT: DRAFT NO-ACTION DEFINITION

Agreeing on a definition of No-Action will provide a basis for comparison of any modifications made to the transportation network that may arise as part of the 116th Street NE Interchange project. This definition of No-Action provides an understanding of the changes between existing 2002 conditions and future land use projections (which provide the basis for transportation demand) and the future transportation network without the proposed interchange improvements. This agreement ensures that future analysis will not be required for the future No-Action condition. Any changes to the land use or roadway network in excess of the No-Action definition will be considered part of the proposed project.

Model Update

The Puget Sound Regional Council (PSRC) develops a regional planning travel forecasting model that is updated frequently to include land use and transportation network updates anticipated in the local jurisdiction's most current Comprehensive Plans and Transportation Improvement Programs (TIP). One jurisdiction in the Marysville area that did not get included in the most recent PSRC model update is the Tulalip Tribe. As a result, the most current development that is occurring on the west side of I-5 is not included in the PSRC model. The PSRC transportation planning model divides the region into various zones that represent different land use types to provide a basis for developing trip tables. Figure 1 illustrates the boundaries of the Puget Sound Regional Council (PSRC) 2001 Forecast Analysis Zones and PSRC 1998 Transportation Analysis Zones. The current PSRC Model utilizes the 1998 forecasts. Table 1 provides a breakdown by zone of each of the 1998 land use projections by TAZ that are assumed for this project and compares them with the current 2001 projections by FAZ. The table summarizes the land use by two categories: employment and Housing Units. The land use projections in the 1998 PSRC projections by TAZ are virtually identical to the 2001 projections by FAZ.

Figure 1. Land Use Zones



The major current and future economic development center on the reservation is the Quil Ceda Business Park, owned by the tribes, which is located on approximately 2,000 acres just west of the Interstate-5 corridor.

The Tribes developed a Master Plan for the property in the early 1980s and began development of the initial 460 acres in 1998. Basic infrastructure has been developed and two major national retailers, Wal-Mart and Home Depot, are operating within the business park. Tulalip Tribes is in the process of building its new 227,000 square foot Casino that is scheduled to open in June of 2003. The Tribes are currently negotiating with a large national Retail Outlet Center corporation that will locate a 170,000 square foot Outlet Mall on the north side of the Casino site. Other near future development planned includes additional retail centers a Water Theme Park and Family Center, an RV Park and Golf Course. The balance of the business park is contemplated to be a mix of retail, office and light industrial development.

The tribes have requested that PSRC revise their future land use projections to include development of the Quil Ceda Business Park. This level of update has been performed for the 116th Street NE Interchange APDR project so that the transportation forecasts provide a reasonable estimate of future conditions and transportation network needs.

The 116th Street NE Interchange APDR Methodology Signature Paper recommends that the project team utilize the SNOCAN EMME/2 model to forecast traffic for this project. Assuming that the SNOCAN model will be utilized, two transportation network modifications will be made to the transportation planning model. First, the transportation network of the year 2030 PSRC model included a commuter rail line that extended from Everett into the project area will be removed from the model that will be used for the APDR because an agreement from the APDR team deemed that project as unlikely in the timeframe considered. The other modification will remove a fourth general-purpose

lane from the Interstate-5 corridor that extends from the SR528 interchange to Arlington. The APDR Support Group deemed that this project would be unlikely to occur by the year 2030.

Year of Opening No-Action

During discussion with the APDR Support Group it was decided that a year of opening No-Action land use and transportation network planning model needed to be developed. This decision was made so that the two time periods could be reasonably represented with likely land use and transportation network improvements that could occur by that time frame. The following sections provide additional information about the decisions made for finalizing this definition.

Land Use

Because the land use changes between the opening year and existing year are neither substantial nor documented, it has been proposed that the existing year land use be assumed for the opening year model.

Transportation Network

The APDR Support Group reviewed the list of local projects currently included in local jurisdictions six year Transportation Improvement Programs (TIP) to determine which of those projects would reasonably be under construction by the year 2006. In addition to the existing roadway network, the following projects are assumed to be part of the year 2006 No-Action:

- State Avenue – Widen from two lanes to five lanes between 100th Street and 109th Street
- State Avenue – Widen from two lanes to three lanes between 116th Street and 136th Street
- State Avenue – Widen from two lanes to five lanes between 136th Street and 152nd Street
- 67th Avenue – Widen from two lanes to four lanes between 172nd Street and 211th Street
- SR531 – Widen from two to four lanes between 27th Ave and Smokey Point Blvd
- SR531 – Widen from two to four lanes between 51st Ave NE and SR9
- 64th Street – Widen from two to four lanes between 51st Ave and 83rd Ave
- 47th Ave NE – Widen from two lanes to three lanes between 5th Street and Grove Street
- 27th Ave NE – Widen from two lanes to three lanes between 88th Street and 116th Street
- Quil Ceda Boulevard – Extend current five lane roadway to 116th Street NE

Design Year 2030 No-Action

The design year No-Action alternatives will combine all of the Six Year TIP projects identified as reasonable by the APDR Support Group and it will include the full land use anticipated by the local jurisdictions and PSRC. The following sections outline the final year 2030 No-Action land use and transportation networks.

Land Use

The difference between the proposed land use and trip demand proposed to be used for this project and the PSRC projections is entirely the accounted for by the inclusion of the Quil Ceda Business Park. To place this in perspective, the projected employment of the Business Park is about 7.5% of the projected 2030 employment for Snohomish County and about 1% of the total employment for the four-county PSRC planning area. The employment projection in the Tulalip/Marysville/Arlington area, with the development of the Quil Ceda Business Park is about 2.5% of the four-county area. Figure 2 illustrates the full build out estimates for employment and population for the zones within the 116th Street NE APDR project area.

Figure 2. PROPOSED LAND USE FOR REVISED SNOCAN MODEL - VICINITY OF TULALIP RESERVATION, MARYSVILLE, ARLINGTON
 1999 & 2030 COMMERCIAL EMPLOYMENT and DWELLING UNITS

Year Projection Made	PROPOSAL															
	EMPLOYMENT			RETAIL EMPL			FIRES EMPL			WUTC & MANU EMPL			SINGLE FAMILY UNITS		MULTI FAMILY FAMILY	
	1998	2001		1999	2030		1999	2003	1999	2030	1999	2030	1999	2030	1999	2030
	PSRC	PSRC														
	TAZ	FAZ														
Tulalip Reservation			2,167	20,723	399	6,648			1,605	4,754	163	9,321	2,828	5,183	40	271
	591			24,737	399	7,919			1,605	4,748	163	12,070	2,828	5,183	40	271
Compare PSRC		8937	2,167	3,678	399	1,139			1,605	2,287	163	252	2,828	5,183	40	271
West I-5, 140th to Stillaguamish River			610	800	126	235			351	422	133	143	5,035	7,456	164	326
	592		230	307	107	156			48	79	75	72	2373	3,518	7	25
	593		380	493	19	79			303	343	58	71	2662	3,938	157	301
Compare PSRC		8936	610	800	126	235			351	422	133	143	4671	7,454	152	328
East of I-5, 172nd to Stillaguamish River			7,047	12,349	1,414	2,503			1,512	4,795	4,121	5,051	2,986	5,387	878	2,255
	596		5,434	8,918	581	1,090			919	3,020	3,934	4,808	2,028	3,741	473	1,207
	597		1,613	3,431	833	1,413			593	1,775	187	243	959	1,646	405	1,048
Compare PSRC		8500	7,047	11,381	1,414	2,037			1,512	4,243	4,121	5,101	2,986	4,734	878	1,979
East of I-5 172nd to 116th/108th			3,388	5,000	942	1,498			521	1,106	1,925	2,396	6,166	13,347	372	1,129
	583		216	385	1	27			13	55	202	303	578	1,160	1	47
Compare PSRC		8406	251	41	1	14			102	15	148	12	571	1,160	12	47
	584		183	435	54	224			80	137	49	74	2519	5,924	91	501
Compare PSRC		8405	154	320	25	179			80	134	49	7	2399	5,924	29	500
	587		2,724	3,683	759	1,102			395	743	1570	1,838	1284	3,049	194	457
	588		265	497	128	145			33	171	104	181	1785	3,214	86	124
Compare PSRC		8320	2,989	3,956	887	1,082			428	914	1674	1,960	3069	5,809	280	578
Compare PSRC		all	3,394	4,317	913	1,275			610	1,063	1,871	1,979	6,039	12,893	321	1,125
East of I-5 116th/108th to Ebey Sl./Jones Cr			5,713	7,804	2,645	3,575			2,179	2,730	889	1,499	8,137	12,044	2,346	6,090
	586		1,237	1,716	887	980			310	575	40	161	2850	4,237	239	784
	589		1,499	2,312	450	1,055			682	717	367	540	1959	2,278	1088	2,685
	590		2,977	3,776	1308	1,540			1187	1,438	482	798	3328	5,529	1018	2,621
Compare PSRC		8310	5,713	7,227	2645	3,070			2179	2,730	889	1,427	8137	10,687	5,831	5,836

PROPOSED EMPL. AND HOUSING UNITS
 PSRC Projection by FAZ (2001 estimate)

18,925 46,676 3,800 10,071
 18,931 27,403 7,221 9,539

Transportation Network

A full list of projects that are anticipated to be part of the year 2030 No-Action transportation network includes all projects identified for the opening year. New projects that will be under construction by the year 2030 are identified in bold text.

- State Avenue – Widen from two lanes to five lanes between 100th Street and 109th Street
- State Avenue – Widen from two lanes to three lanes between 116th Street and 136th Street
- State Avenue – Widen from two lanes to five lanes between 136th Street and 152nd Street
- 67th Avenue – Widen from two lanes to four lanes between 172nd Street and 211th Street
- SR531 – Widen from two to four lanes between 27th Ave and Smokey Point Blvd
- SR531 – Widen from two to four lanes between 51st Ave NE and SR9
- 64th Street – Widen from two to four lanes between 51st Ave and 83rd Ave
- 47th Ave NE – Widen from two lanes to three lanes between 5th Street and Grove Street
- 27th Ave NE – Widen from two lanes to three lanes between 88th Street and 116th Street
- Quil Ceda Boulevard – Extend current five lane roadway to 116th Street NE
- **116th Street NE – Widen from two lanes to five lanes between I-5 and State Avenue**
- **88th Street NE – Widen from two lanes to three lanes from State Avenue to 51st Avenue**
- **88th Street NE – Extend a three lane roadway from 67th Avenue to SR9**
- **51st Street NE – Extend a two lane roadway from 84th Street to 88th Street**
- SR9 – Widen by one lane in each direction between Everett and Arlington
- **I-5 – Add one HOV lane that terminates/originates to the south at SR528**

TECHNICAL MEMORANDUM (CONTINUED)

Signature Sheet

The signatures on this sheet indicate that the persons signing below have read the No-Action Signature Paper and are in agreement with the proposed definition.

John Milton, WSDOT

Elizabeth Healy, FHWA

TECHNICAL MEMORANDUM

Date: **May 2, 2003**
To: **John Milton**
From: **Michael Horntvedt**
Subject: **Forecasting Model**
cc: **Methqal Abu-Najem, David Martin, Elizabeth Healy, File**
Project Number: **554-1598-017**
Project Name: **116th Street NE Interchange**

During the project status meeting on April 30th, a question about the need to model all future interchange alternatives in the EMME/2 model was posed. The point of modeling alternatives is to assess possible diversion of traffic from other parts of the roadway network within the project area. Discussion followed that resulted in a request for a documented proposal for methodology that would be endorsed by WSDOT. Please review this technical memorandum and provide the project team with your comments/requirements or your concurrence.

The current EMME/2 model that is utilized by PSRC and Snohomish County is set up to represent roadways with a single bi-directional line that is coded with the available roadway capacity for each direction of travel. Interchanges and intersections are coded as a node. There are no ramp alignments coded in the model. Because the interchanges are coded as a node, there is no possible way to modify the model to represent changes in ramp capacity as proposed by future designs.

If the model is broken into double lines for the freeway and arterials, then the interchange configurations can be coded into the model and each ramp can be coded with its available capacity and speed. A result of this type of model change could be a re-assignment of trips within the model to minimize the travel time.

Of the alternatives remaining to be evaluated and screened for the project EA and the Access Point Decision Report, the Single Point Urban Interchange (SPUI) provides the highest capacity for traffic at the 116th Street NE interchange. Analysis of the SPUI would therefore maximize the number of trips diverted from other parts of the network. Any other alternative that would be modeled would be modified geometrically to match the capacity provided by the SPUI. Because all alternatives would ultimately be designed to serve the same traffic demand, there would be no benefit in running each of the alternatives in the EMME/2 model. The SPUI EMME/2 model would provide the maximum trip diversion between interchanges as well as the maximum utilization of the 116th Street NE interchange. If a traffic analysis were required for all alternatives, then the turning movements calculated for the SPUI would be re-distributed through the other alternatives geometric alignments for the analysis.

The following work plan is proposed to capture the future traffic volume forecast and estimate the trip diversions between interchanges:

1. Update the 1998 travel forecasting model to include details of the interchange configurations at 88th Street NE and 116th Street NE.

2. Calibrate the updated model to the screenline level
3. Run no-action trip distribution in the year 2030 travel forecasting model with the updated roadway network
4. Code the year 2030 travel forecasting model roadway network with the proposed SPUI interchange at 116th Street NE
5. Run trip distribution in the year 2030 travel forecasting model with the SPUI alignment included
6. Develop a select link plot for the 116th Street NE on- and off-ramps for both the No-Action and SPUI models. Summarize traffic volumes that constitute diverted trips between the interchanges. Summarize the amount of traffic at the interchange that is regional.

It is proposed that the 116th Street NE project would not need to run the EMME/2 travel forecasting model to develop volumes for other alternatives because their designs would be modified to serve the demand forecast for the SPUI design.

Again, your review of this proposed methodology and your concurrence are requested. You can provide your concurrence via e-mail or by signing below and returning this memorandum via mail to:

Paramatrix, Inc.
C/o Michael Horntvedt
5808 Lake Washington Blvd NE Suite 200
Kirkland, WA 98033-7350

I, John Milton, do concur with the above travel forecasting methodology for the 116th Street NE Interchange project.

John Milton, P.E.
WSDOT Assistant Design Engineer

	in	out
model (peak period)	55696	55696
model (hourly)	18565	18565
forecast (hourly)	18565	18565
Difference	0	0

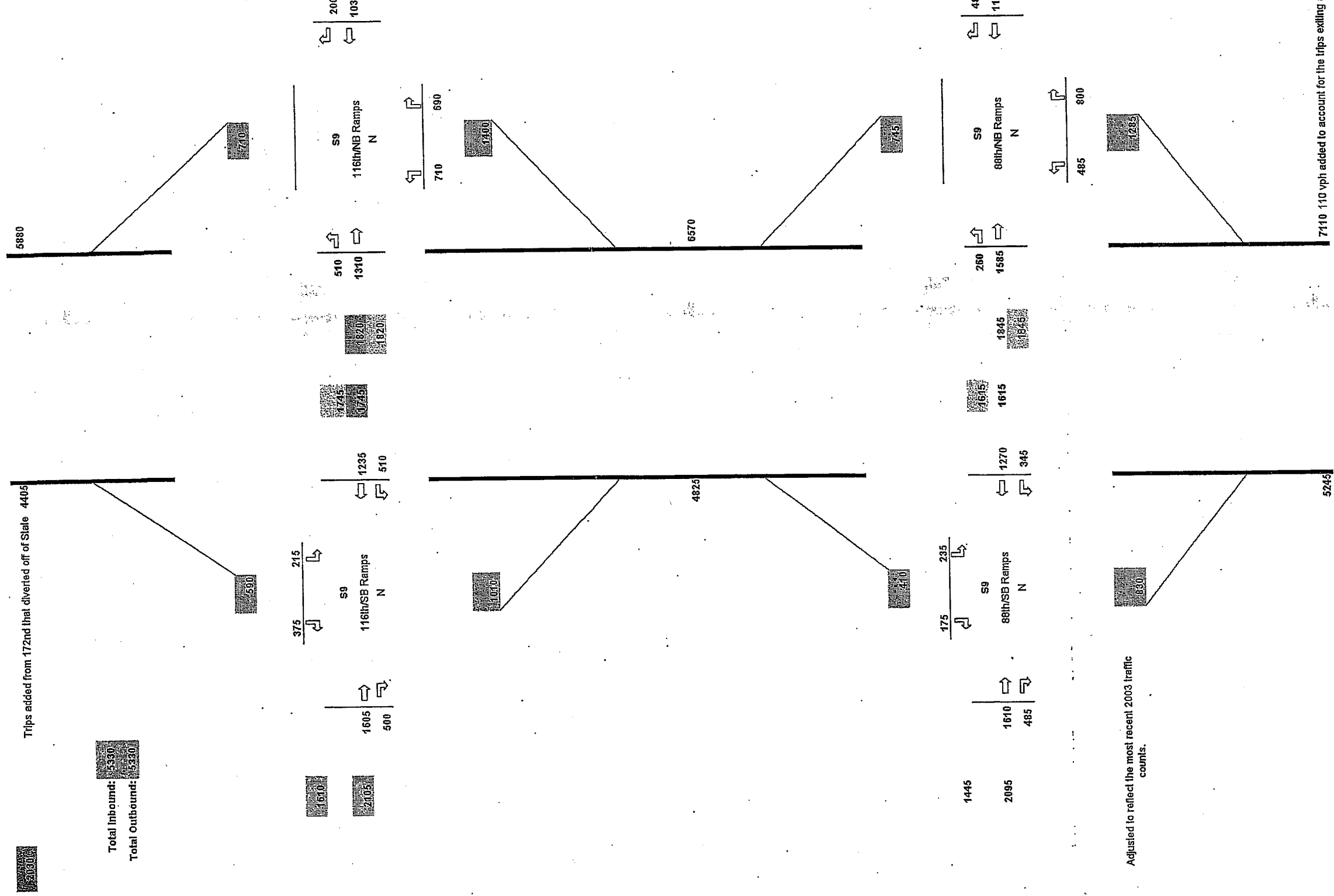


Figure 2. Year 2030 No-Action Traffic Volumes

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 KIRKLAND, WASHINGTON 98033-7350
 T. 425. 822. 8880 F. 425. 889. 8808
 www.parametrix.com

Figure 3. I-5 PM Peak Volume History (south of 116th Street NE)

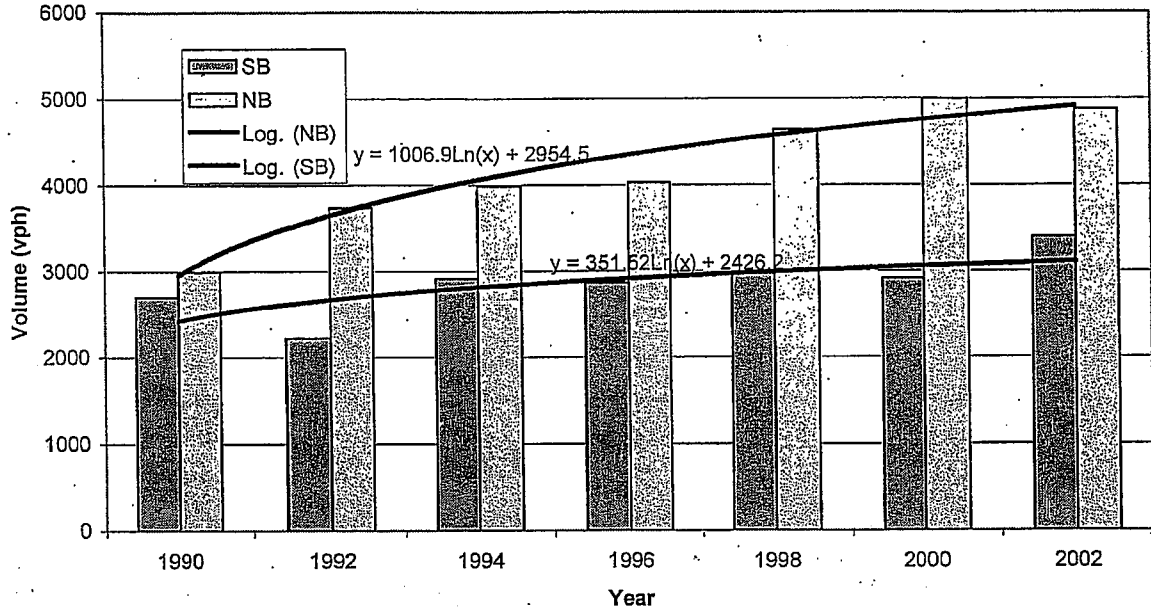
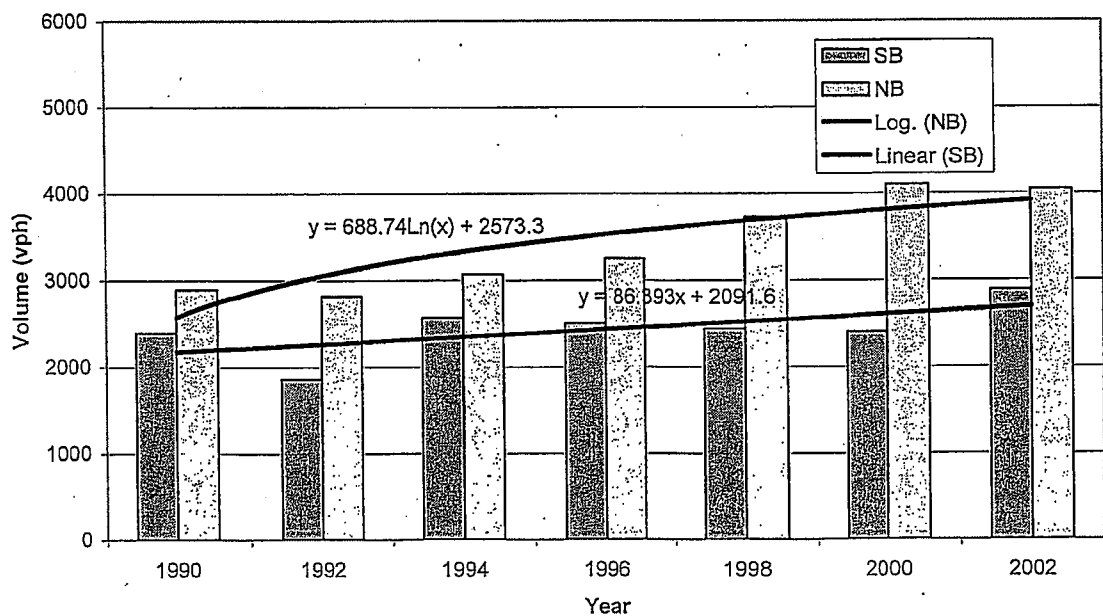


Figure 4. I-5 PM Peak Volume History (north of 116th Street NE)



Local Traffic

Traffic volume forecasts for the local intersections adjacent to the interchanges will be accomplished using the interchange volumes as a control volume. Existing turning movement ratios and the EMME/2 link approach volumes will be used in conjunction with the control volume to develop the future turning movement volumes.

Opening Year (2006) Traffic Forecast

Due to the current status of land use and funding within the project area, and due to the close time frame for the opening year of the proposed interchange (2006), the following process for developing the opening year traffic volumes is proposed:

- Determine the levels of new development expected by 2006 within the project area (in the City of Marysville and in the Quil Ceda development)
- Estimate the number of trips generated as a result of the new development using the ITE Trip Generation Manual
- Assume a 1% annual background growth
- Assign the new trips associated with planned development to the local network using hand assignment based on current traffic distribution

This methodology would provide an accurate level of traffic forecast over the next three years based on direct input from the local agencies that would be impacted/benefited from the project.

Action Alternative Year 2030 Traffic Forecast

The year 2030 traffic volumes for the action alternatives will be developed by:

1. comparing the EMME/2 model differences between the action alternative and the No-Action alternative;
2. determining the percentage difference between action and No-Action on the freeway and the ramps; and
3. applying the percentage difference at those locations to increase/decrease traffic volumes for the build alternatives using the No-Action alternative as a basis for the adjustments.

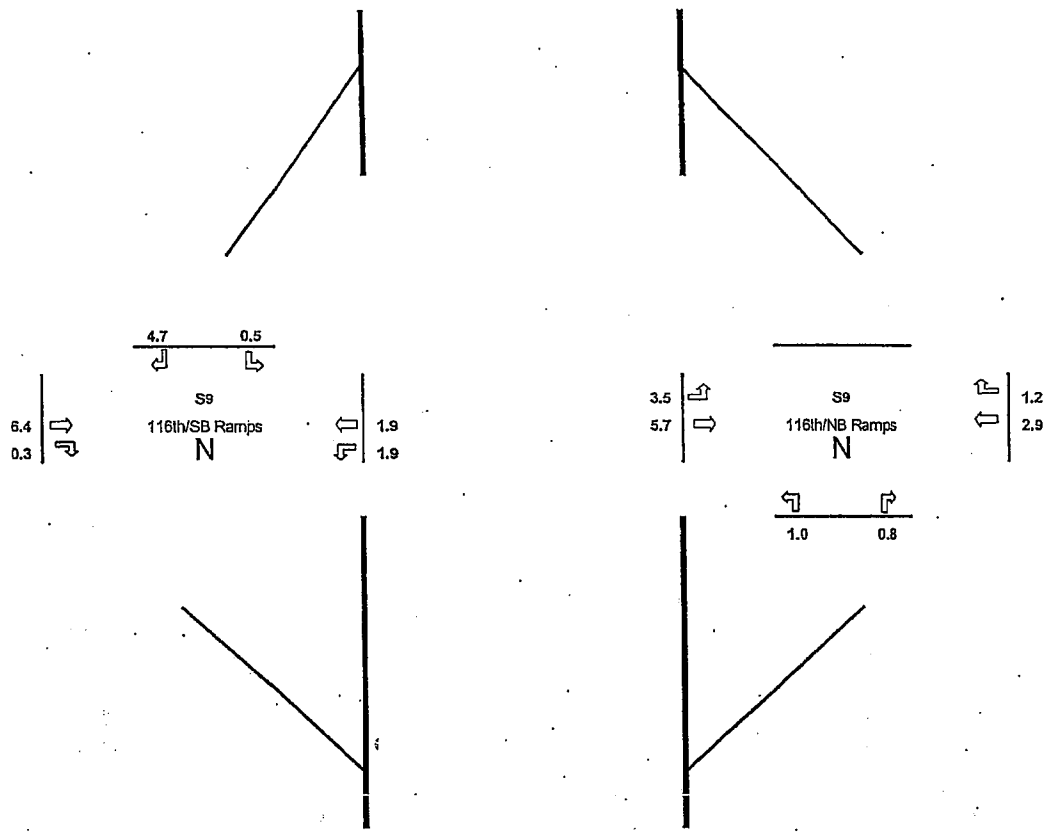


Figure 1. 116th Street NE Growth Values

TECHNICAL MEMORANDUM

Date: **July 1, 2003**
To: **Methqal Abu-Najem**
From: **Michael Horntvedt**
Subject: **Traffic Volume Forecast Summary**
cc:

Project Number: **554-1598-017**
Project Name: **116th Street NE Interchange**

The following is the methodology that the consultant team used to forecast Year 2030 traffic volumes for the No Action alternative, and to estimate Opening Year 2006 volumes.

Year 2030 No-Action Volume Forecast

1. It was assumed that the total EMME/2 future (2030) network traffic volumes projected for the 88th Street and 116th Street roadway networks is correct, but some trip re-distribution is necessary to balance traffic between the two interchanges and utilize available capacity.
2. It was assumed that the 88th Street NE interchange is near capacity under existing conditions (2003).
3. Count data was gathered to verify 2003 volumes at the 88th Street interchange.
4. The growth at the 88th Street NE ramps between the year 1998 and 2002 was calculated. The growth rates were used as guidance to set 2030 goal volumes for the 116th Street NE ramps.
 - 88th NB Off-Ramp – 137% ⇒ Set 116th NB Off-Ramp Goal = 1605 vph
 - 88th NB On-Ramp – 136% ⇒ Set 116th NB On-Ramp Goal = 355 vph
 - 88th SB Off-Ramp – 138% ⇒ Set 116th SB Off-Ramp Goal = 290 vph
 - 88th SB On-Ramp – 188% ⇒ Set 116th SB On-Ramp Goal = 1395 vph
5. A second method was used to forecast local trips at the 116th Street NE interchange. This method combined the target ramp volumes and the model output data to achieve the local volumes. Using select link data from the EMME/2 model, modifications were made to trip distribution in an effort to balance local and freeway traffic between the 88th Street NE and 116th Street NE interchanges.
 - Model trips that were taking the NB 116th Street NE off-ramp to access the Smokey Point Blvd area were re-distributed back to the freeway to access the 172nd Street NE interchange. Trips diverted total 205 vph during the PM peak hour.
 - Model trips that were crossing from the west to the east on 116th Street NE to then drive up State Ave to access the Smokey Point Blvd area were redistributed to the NB 116th Street NE on-ramp or north on 34th Ave and then across 136th Street NE. Trips that utilize the freeway were calculated to be nearly 350 vph while the trips diverted onto 34th Ave was nearly 95 vph.

- Conversely, model trips that originated in the Smokey Point area and used State Ave. to access 116th Street NE to reach the west side of I-5 were redistributed to utilize I-5 and 34th Ave NE. Nearly 305 vph were diverted from State Avenue to utilize the freeway.
 - Some model trips using the 116th Street NE interchange to access SB I-5 were re-distributed to the 88th Street NE interchange. The trip diversion was 350 vph to utilize 88th Street.
6. Upon completion of the redistribution, four checks were completed to ensure the final volumes were reasonable:
- a. 2030 traffic volumes were compared to existing 2003 volumes to ensure that the compounded growth rates of individual turning movements match the future land use and traffic patterns outlined in the EMME/2 model (see Figure 1). The EMME/2 model shows a predominance of traffic crossing over I-5 using 116th Street NE and a small amount of traffic growth at the ramps. Figure 2 illustrates that the final volumes retain that property of the EMME/2 model.
 - b. The total forecast volumes into the network of the 88th Street NE and 116th Street NE interchanges match the model volumes. Figure 2 shows in the upper right corner the model estimated volumes and the final volumes with a net difference of zero.
 - c. A balance of traffic volumes between the 116th Street NE and 88th Street NE interchanges occurred with similar directionality. Figure 2 also illustrates that the traffic on 88th Street NE and 116th Street NE is very similar in directionality and in total volume.
 - d. The freeway growth was within reason compared to actual data projected out 30 years. Figures 3 and 4 illustrate the volume history along I-5 over the past twelve years (1990 – 2002). A best fit line was included with the data and was used to estimate future traffic volumes on I-5 north and south of the 116th Street NE interchange. The following table shows the final forecast volumes from the model and the forecast volumes using trend data.

Table 1. I-5 Volume Check

Method	North of 116th Street NE		South of 116th Street NE	
	NB	SB	NB	SB
Volume Trend	4670	2865	6020	3495
Model Forecast	5880	4405	6570	4825

As the table shows, the model forecast provides a more conservative approach to estimating the future traffic volumes along the I-5 corridor.

7. The attached figures illustrate the four checks and the final traffic volumes proposed for the No-Action alternative as part of the 116th Street NE Access Point Decision Report.

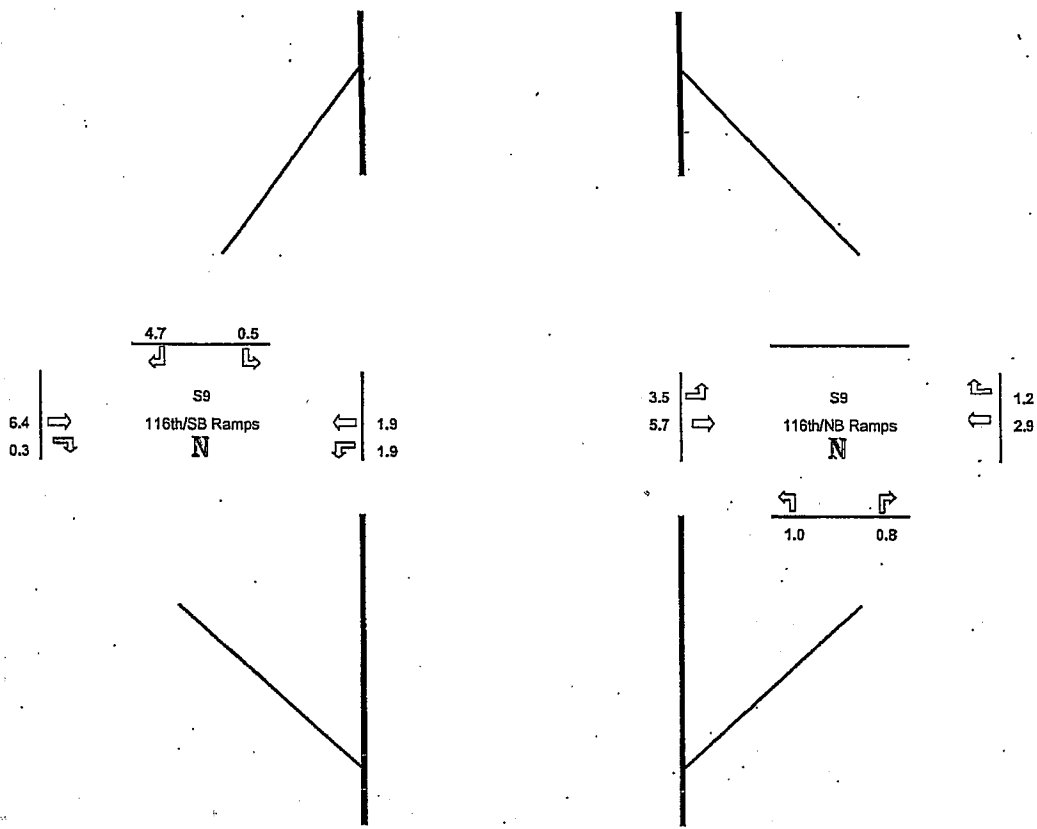


Figure 1. 116th Street NE Growth Values

	in	out
model (peak period)	55696	55696
model (hourly)	18565	18565
forecast (hourly)	18565	18565
Difference	0	0

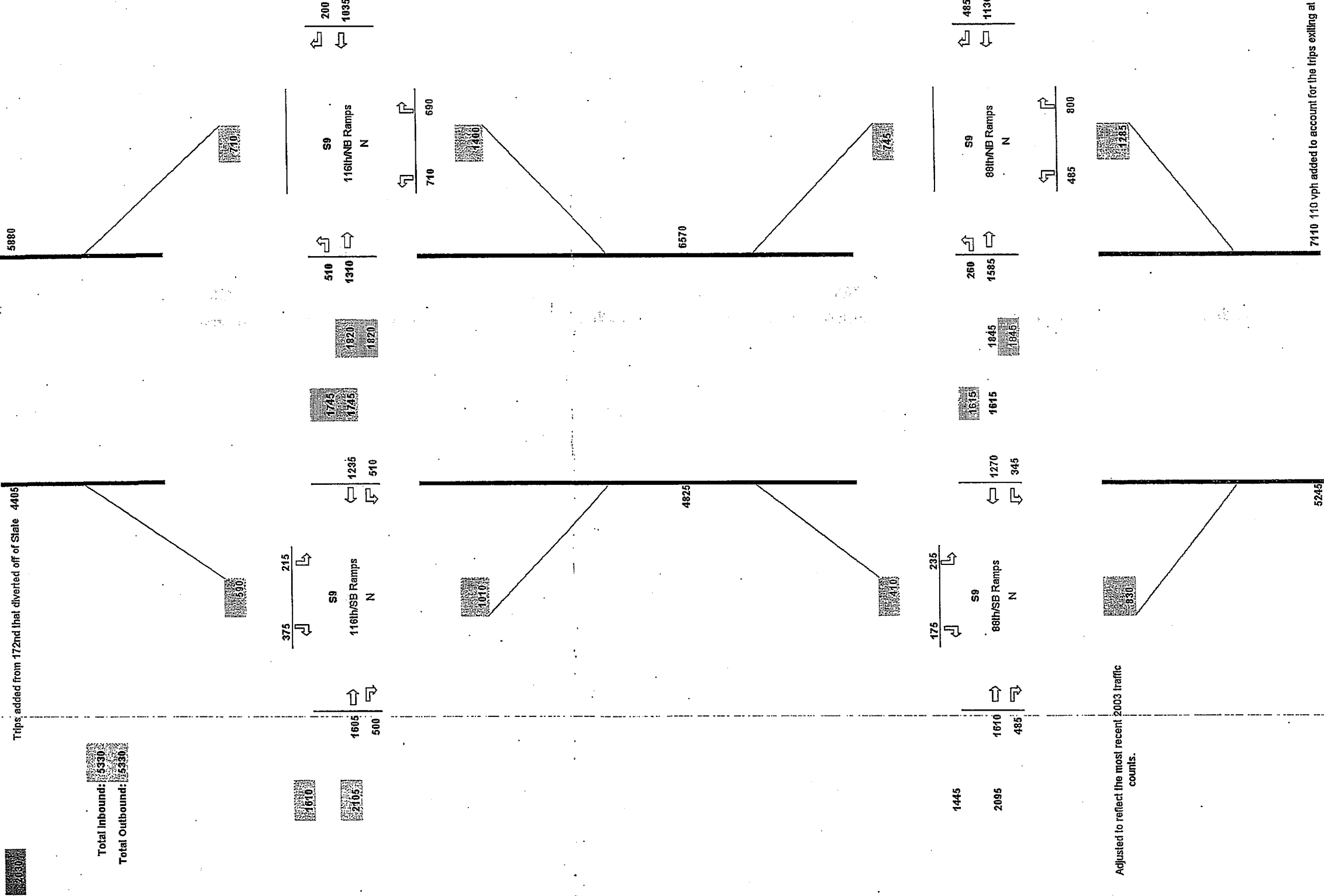


Figure 2. Year 2030 No-Action Traffic Volumes

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Figure 3. I-5 PM Peak Volume History (south of 116th Street NE)

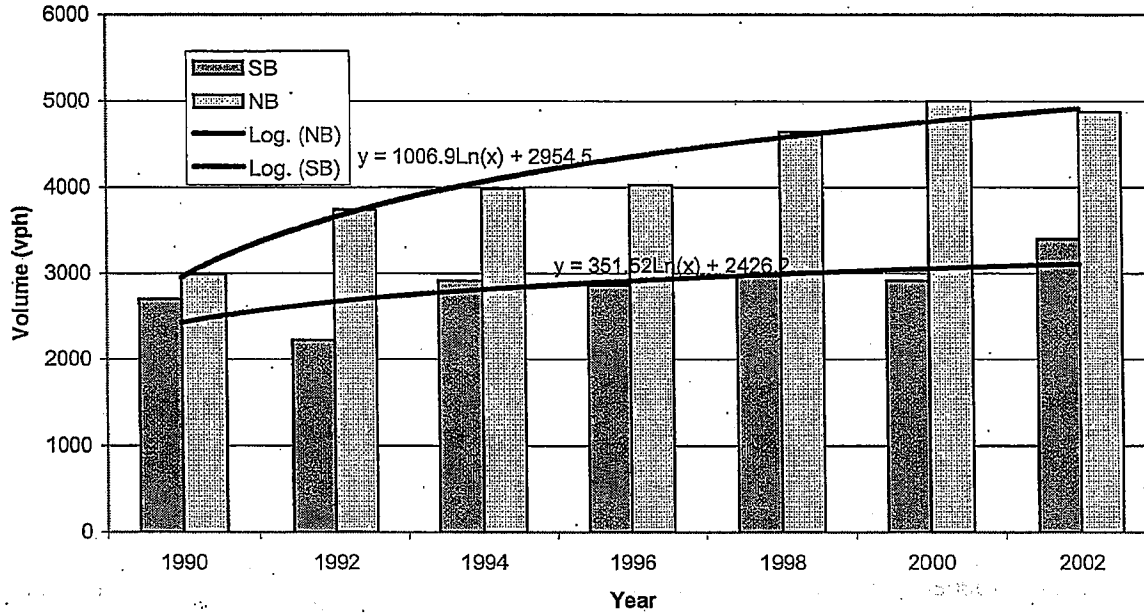
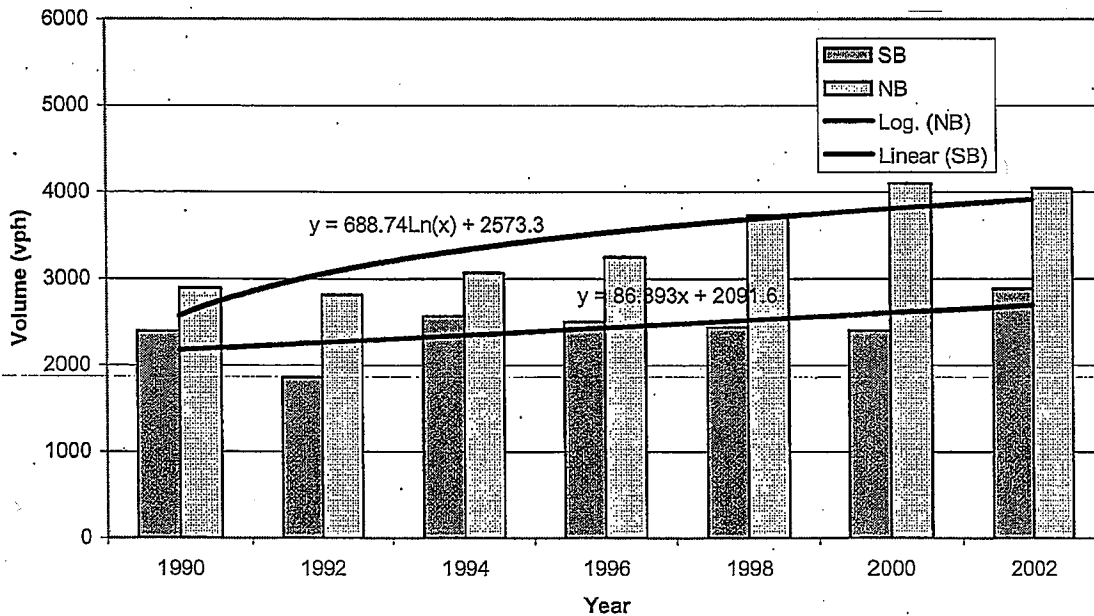


Figure 4. I-5 PM Peak Volume History (north of 116th Street NE)



Local Traffic

Traffic volume forecasts for the local intersections adjacent to the interchanges will be accomplished using the interchange volumes as a control volume. Existing turning movement ratios and the EMME/2 link approach volumes will be used in conjunction with the control volume to develop the future turning movement volumes.

Opening Year (2006) Traffic Forecast

Due to the current status of land use and funding within the project area, and due to the close time frame for the opening year of the proposed interchange (2006), the following process for developing the opening year traffic volumes is proposed:

- Determine the levels of new development expected by 2006 within the project area (in the City of Marysville and in the Quil Ceda development)
- Estimate the number of trips generated as a result of the new development using the ITE Trip Generation Manual
- Assume a 1% annual background growth
- Assign the new trips associated with planned development to the local network using hand assignment based on current traffic distribution

This methodology would provide an accurate level of traffic forecast over the next three years based on direct input from the local agencies that would be impacted/benefited from the project.

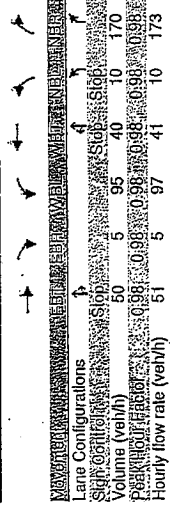
Action Alternative Year 2030 Traffic Forecast

The year 2030 traffic volumes for the action alternatives will be developed by:

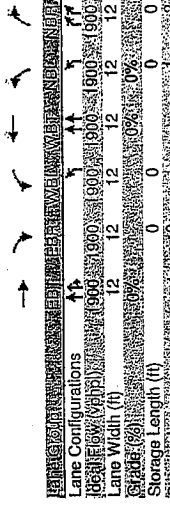
1. comparing the EMME/2 model differences between the action alternative and the No-Action alternative;
2. determining the percentage difference between action and No-Action on the freeway and the ramps; and
3. applying the percentage difference at those locations to increase/decrease traffic volumes for the build alternatives using the No-Action alternative as a basis for the adjustments.

APPENDIX D

**Intersection Level of Service Calculation Sheets
(Synchro 5.0 Software)**

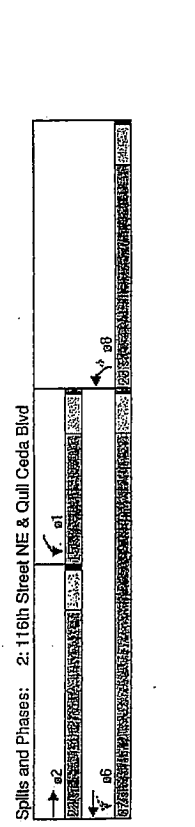


Lane Configurations	↑↑	↑↑	↑↑	↑↑	↑↑
Right Turn (RTOR)	100	0	100	100	100
Heavy Vehicle (%)	3%	2%	2%	2%	2%
Parking (#/hr)	0	0	0	0	0
Lane Group Flow (vph)	225	0	167	145	5
Protected Phases	2	1	6	8	8
Detector Phases	2	1	6	8	8
Minimum Split (s)	20.0	12.0	20.0	20.0	20.0
Total Split (%)	37%	0%	25%	62%	38%
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5
Lead-Lag Optimize?	Yes				
Recall Mode	None	None	None	None	None
Act Effect Green (s)	9.5	19.8	9.6	9.6	9.6
Act Effect Yellow (s)	3.0	3.0	3.0	3.0	3.0
Act Effect Red (s)	3.0	3.0	3.0	3.0	3.0
W/C Ratio	0.27	0.28	0.08	0.01	0.28

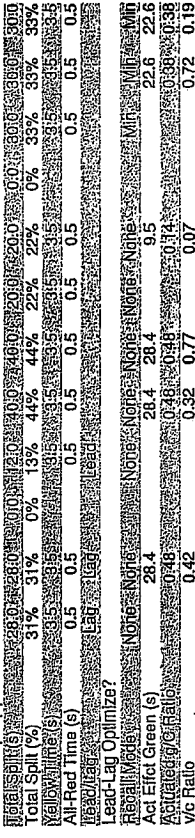


Lane Configurations	↑↑	↑↑	↑↑	↑↑	↑↑
Right Turn (RTOR)	100	0	100	100	100
Heavy Vehicle (%)	3%	2%	2%	2%	2%
Parking (#/hr)	0	0	0	0	0
Lane Group Flow (vph)	225	0	167	145	5
Protected Phases	2	1	6	8	8
Detector Phases	2	1	6	8	8
Minimum Split (s)	20.0	12.0	20.0	20.0	20.0
Total Split (%)	37%	0%	25%	62%	38%
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5
Lead-Lag Optimize?	Yes				
Recall Mode	None	None	None	None	None
Act Effect Green (s)	9.5	19.8	9.6	9.6	9.6
Act Effect Yellow (s)	3.0	3.0	3.0	3.0	3.0
Act Effect Red (s)	3.0	3.0	3.0	3.0	3.0
W/C Ratio	0.27	0.28	0.08	0.01	0.28

Control Type	Actuated-Uncoordinated
Intersection Signal Delay	7.9
Intersection LOS	A
Maximum V/C Ratio	0.28
Intersection Capacity Utilization	35.6%
90th %ile Actuated Cycle	40
70th %ile Actuated Cycle	37
50th %ile Actuated Cycle	36.6
30th %ile Actuated Cycle	36
10th %ile Actuated Cycle	35.6



Control Type	Actuated-Uncoordinated
Intersection Signal Delay	7.9
Intersection LOS	A
Maximum V/C Ratio	0.28
Intersection Capacity Utilization	35.6%
90th %ile Actuated Cycle	40
70th %ile Actuated Cycle	37
50th %ile Actuated Cycle	36.6
30th %ile Actuated Cycle	36
10th %ile Actuated Cycle	35.6





Link Length (ft)	196	119	139	51	36	22	36	4
Delay	10.7	13.6	1.6	2.4	37.7	36.4		
LOS	B	B	E	A	A	A	D	D
Approach Delay	12.5			2.2			36.9	
Approach LOS	B			D			D	
90th %ile Green (s)	54.1	54.1	11.9	70.0	22.0	22.0	22.0	22.0
30th %ile Green (s)	55.7	55.7	10.9	70.6	21.4	21.4	21.4	21.4
70th %ile Green (s)	55.7	55.7	10.9	70.6	21.4	21.4	21.4	21.4
50th %ile Green (s)	59.7	59.7	10.1	73.6	18.2	18.2	18.2	18.2
90th %ile Green (s)	62.7	62.7	9.7	76.4	15.6	15.6	15.6	15.6
30th %ile Green (s)	62.7	62.7	9.7	76.4	15.6	15.6	15.6	15.6
70th %ile Green (s)	67.7	67.7	8.7	80.4	11.6	11.6	11.6	11.6
50th %ile Green (s)	102	193	10	21	135	73		
Queue Length 50th (ft)	167	210	58	58	183	73		
Internal Link Dist (ft)	202		75		483			
95th Up Block Time (%)	4%							
95th Up Block Time (%)	20%							
90th Bay Block Time %					2%			
95th Bay Block Time %					2%			
Queueing Penalty (veh)					64			

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0.00
 Natural Cycle: 65
 Maximum v/c Ratio: 0.73
 Intersection Capacity Utilization: 75.4%
 ICU Level of Service: C

Spillover and Phases: 4: 116th Street NE & SB On-Ramp

01	02	03	04	05	06

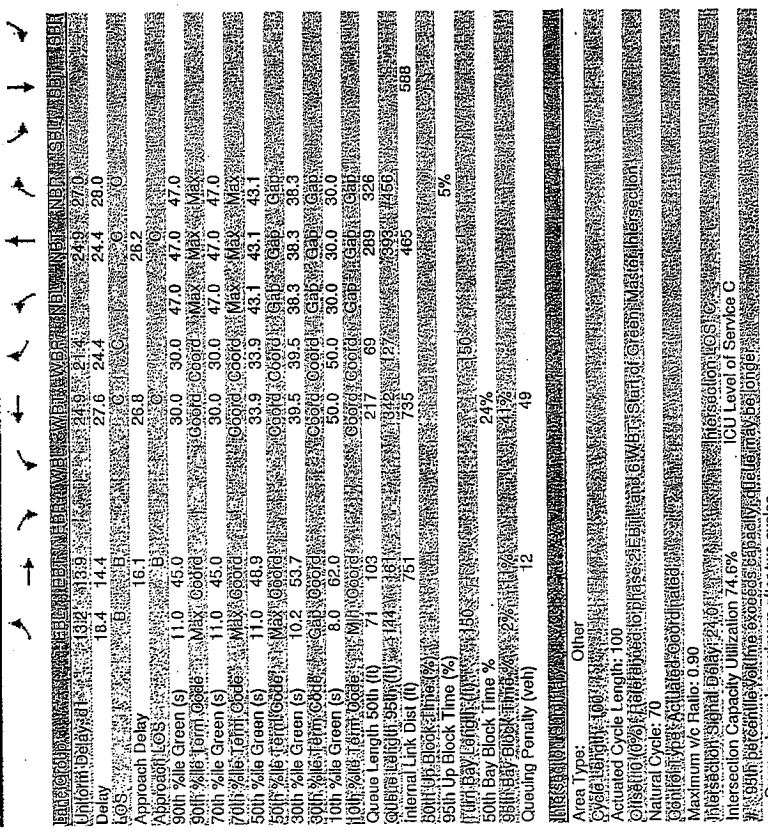


Link Length (ft)	150	0	0	150	0	0	0	0
Delay								
LOS								
Approach Delay								
Approach LOS								
90th %ile Green (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
30th %ile Green (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
70th %ile Green (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
50th %ile Green (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
90th %ile Green (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
30th %ile Green (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
70th %ile Green (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
50th %ile Green (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
90th %ile Green (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Queue Length 50th (ft)								
Internal Link Dist (ft)								
95th Up Block Time (%)								
95th Up Block Time (%)								
90th Bay Block Time %								
95th Bay Block Time %								
Queueing Penalty (veh)								

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0.00
 Natural Cycle: 65
 Maximum v/c Ratio: 0.73
 Intersection Capacity Utilization: 75.4%
 ICU Level of Service: C

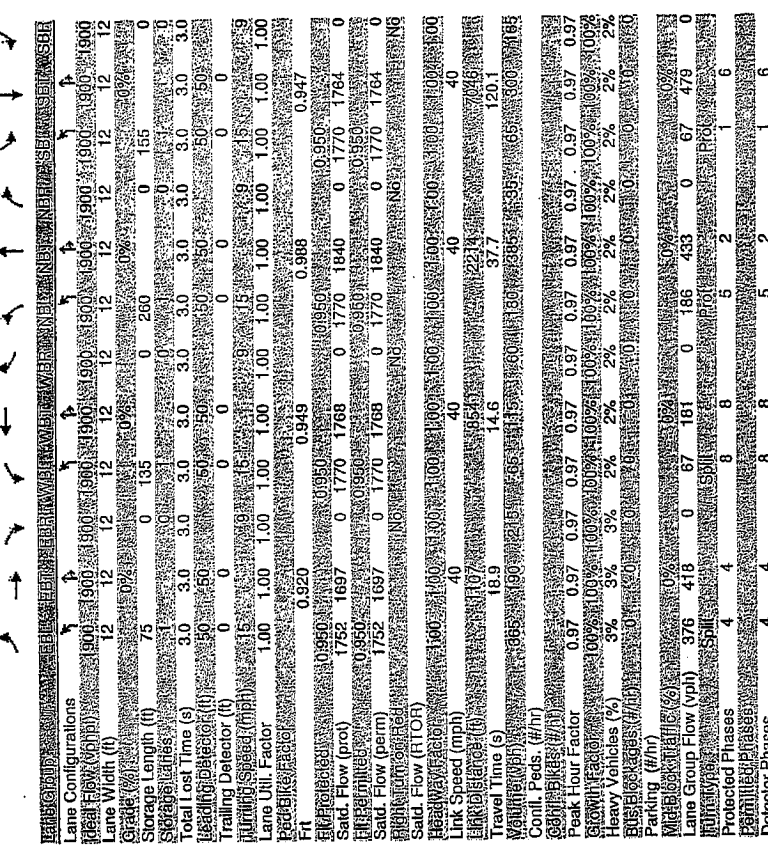
Spillover and Phases: 5: 116th Street NE & NB On-Ramp

01	02	03	04	05	06



Spills and Phases: 5: 116th Street NE & NB On-Ramp
 5th St
 116th St
 NB On-Ramp

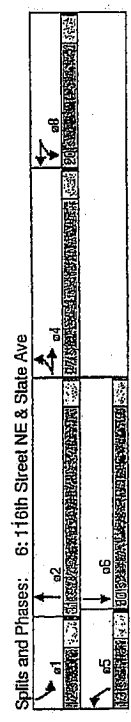
Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Green Time (s): 33.9
 Yellow Time (s): 3.9
 All-Red Time (s): 3.9
 Maximum v/c Ratio: 0.90
 Intersection Capacity Utilization: 74.6%
 ICL Level of Service: C
 Queue shown is maximum after two cycles.



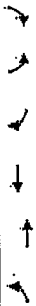
Spills and Phases: 6: 116th Street NE & State Ave
 116th St
 State Ave
 NB On-Ramp

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Green Time (s): 33.9
 Yellow Time (s): 3.9
 All-Red Time (s): 3.9
 Maximum v/c Ratio: 0.90
 Intersection Capacity Utilization: 74.6%
 ICL Level of Service: C
 Queue shown is maximum after two cycles.

Approach	Northbound	Southbound	Eastbound	Westbound
Volume (veh)	39.1	30.3	31.1	39.8
Peak Hour Factor	0.93	0.93	0.93	0.93
Queue Length (ft)	35.2	47.1	31.6	33.9
Queue Length (veh)	7.6	28.3	7.6	28.3
Delay (s)	38.1	41.2	38.1	41.2
LOS	B	D	C	D
Approach Delay	41.5	41.5	41.9	40.8
90th %ile Green (s)	23.0	23.0	16.0	16.0
90th %ile Term Code	Max	Max	Max	Max
70th %ile Green (s)	23.0	23.0	16.0	16.0
70th %ile Term Code	Max	Max	Max	Max
50th %ile Green (s)	23.0	23.0	14.2	14.2
50th %ile Term Code	Max	Max	Max	Max
30th %ile Green (s)	23.0	23.0	11.8	11.8
30th %ile Term Code	Max	Max	Max	Max
10th %ile Green (s)	17.9	17.9	8.0	8.0
10th %ile Term Code	Max	Max	Max	Max
Queue Length 50th (ft)	194	224	32	94
Queue Length 50th (veh)	44.2	51.1	7.7	21.4
Internal Link Dist (ft)	1027	1027	774	6966
90th %ile Actuated Cycle	86.2	86.2	85.8	85.8
70th %ile Actuated Cycle	69.4	69.4	69.4	69.4
50th %ile Actuated Cycle	62.0	62.0	62.0	62.0
30th %ile Actuated Cycle	48.0	48.0	48.0	48.0
10th %ile Actuated Cycle	35.0	35.0	35.0	35.0
Queueing Penalty (veh)	223	213	6	20

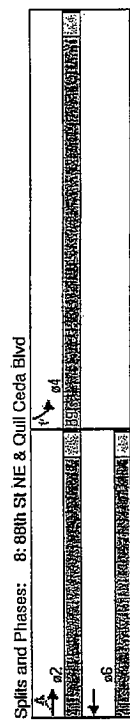


Approach	Northbound	Southbound	Eastbound	Westbound
Volume (veh)	135	180	145	150
Peak Hour Factor	0.93	0.93	0.93	0.93
Queue Length (ft)	145	97	156	81
Queue Length (veh)	35	24	39	20
Delay (s)	59.7	27.2	67.8	34.9
LOS	D	C	D	B
Approach Delay	59.7	27.2	67.8	34.9
90th %ile Green (s)	145	145	145	145
90th %ile Term Code	Max	Max	Max	Max
70th %ile Green (s)	145	145	145	145
70th %ile Term Code	Max	Max	Max	Max
50th %ile Green (s)	145	145	145	145
50th %ile Term Code	Max	Max	Max	Max
30th %ile Green (s)	145	145	145	145
30th %ile Term Code	Max	Max	Max	Max
10th %ile Green (s)	145	145	145	145
10th %ile Term Code	Max	Max	Max	Max
Queue Length 50th (ft)	145	145	145	145
Queue Length 50th (veh)	35	35	35	35
Internal Link Dist (ft)	594	272	349	349
90th %ile Actuated Cycle	145	145	145	145
70th %ile Actuated Cycle	145	145	145	145
50th %ile Actuated Cycle	145	145	145	145
30th %ile Actuated Cycle	145	145	145	145
10th %ile Actuated Cycle	145	145	145	145
Queueing Penalty (veh)	67	87	93	109

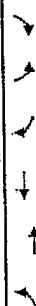


Approach Delay	8.2	6.3	0.0	32.7	23.8
Approach Delay	8.2	6.3	0.0	32.7	23.8
Approach Delay	8.2	6.3	0.0	32.7	23.8
90th %ile Green (s)	54.8	54.8	37.2	37.2	37.2
70th %ile Green (s)	59.6	59.6	32.4	32.4	32.4
50th %ile Green (s)	63.1	63.1	28.9	28.9	28.9
30th %ile Green (s)	66.6	66.6	25.4	25.4	25.4
10th %ile Green (s)	70.3	70.3	21.7	21.7	21.7
Queue Length 50th (ft)	32	20	0	267	36
Internal Link Dist (ft)	1562	449			291
95th Up Block Time (%)					6%
50th Bay Block Time %					40%
Queueing Penalty (veh)					86

Area Type: Other
 Actuated Cycle Length: 100
 Green Time: 37.2
 Natural Cycle: 40
 Maximum v/c Ratio: 0.84
 Intersection Capacity Utilization: 49.1%
 ICU Level of Service A

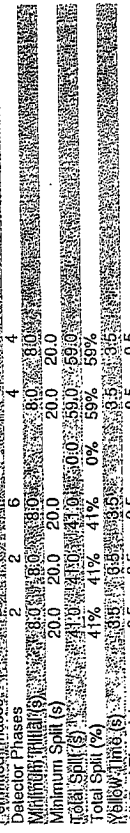


Splits and Phases: 8: 88th St NE & Quil Ceda Blvd

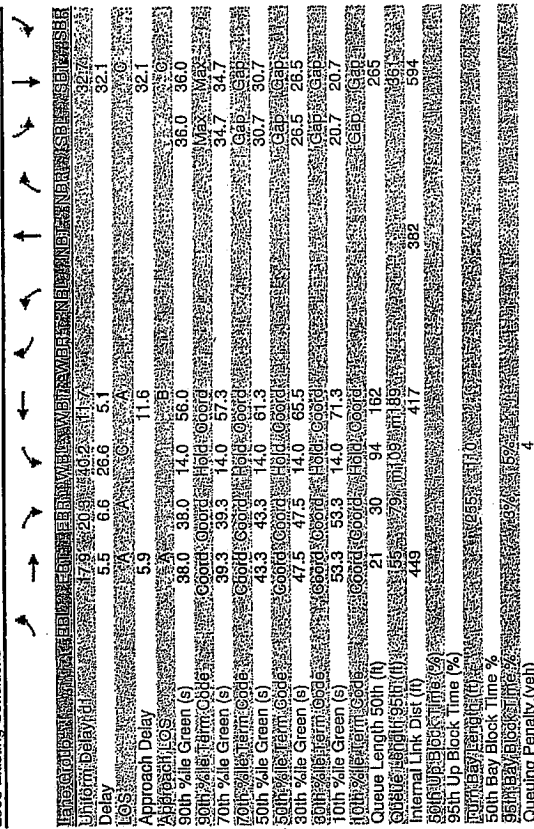


Lane Configurations	4T	4T	4T	4T
Right Turn (veh)	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12
Grade (%)	0%	0%	0%	0%
Storage Length (ft)	0	175	120	0
Total Lost Time (s)	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50
Trailing Detector (ft)	0	0	0	0
Initial Speed (mph)	15	15	15	15
Lane Util. Factor	0.95	0.95	1.00	0.97
Peak Bikes per Hour				0.850
Peak Bikes per Hour				0.850
Satd. Flow (prot)	0	3497	3539	1583
Satd. Flow (perm)	0	2891	3539	1583
Right Turn Satd. Flow (RTOR)				100
Highway Capacity	100	100	100	100
Link Speed (mph)	35	35	30	30
Link Distance (ft)	182	1559	871	871
Travel Time (s)	32.0	10.3	8.4	8.4
Vol. Flow (veh)	180	1900	1800	1800
Confl. Peds. (Min)				
Confl. Bikes (Min)				
Peak Hour Factor	0.92	0.92	0.92	0.92
Lighting	0%	0%	0%	0%
Heavy Vehicles (%)	2%	2%	2%	2%
Bus Blockage (Min)	0	0	0	0
Parking (Min)	0	0	0	0
Max. Block Traffic (%)	0%	0%	0%	0%
Lane Group Flow (veh)	0	272	174	864
Turn Type	2	6	4	4
Protected Phases	2	2	6	4
Detector Phases	2	2	6	4
Minimum Spill (s)	20.0	20.0	20.0	20.0
Total Spill (s)	41.0	41.0	41.0	41.0
Total Spill (%)	41%	41%	41%	41%
Yellow Time (s)	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5
Lead/Lag				
Lead-Lag Optimize?				
Act Effect Green (s)	63.9	63.9	100.0	30.1
Actuated P/G Ratio	0.84	0.84	1.00	0.90
v/c Ratio	0.14	0.08	0.55	0.84

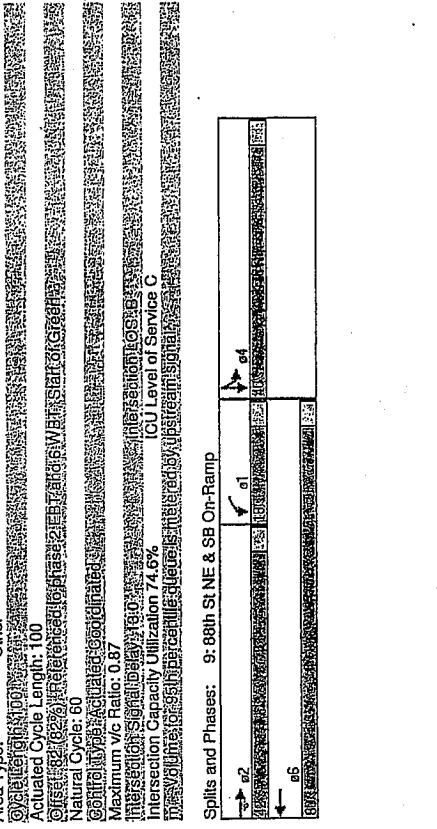
Area Type: Other
 Actuated Cycle Length: 100
 Green Time: 37.2
 Natural Cycle: 40
 Maximum v/c Ratio: 0.84
 Intersection Capacity Utilization: 49.1%
 ICU Level of Service A



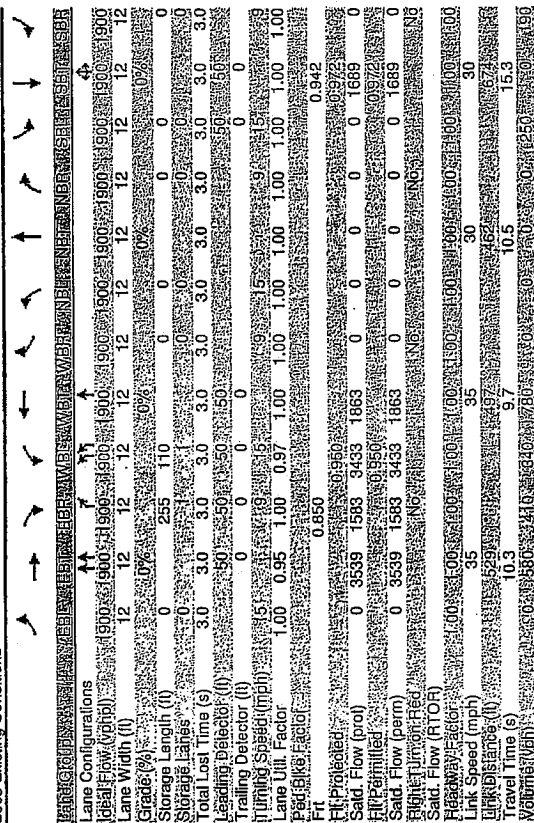
Splits and Phases: 8: 88th St NE & Quil Ceda Blvd



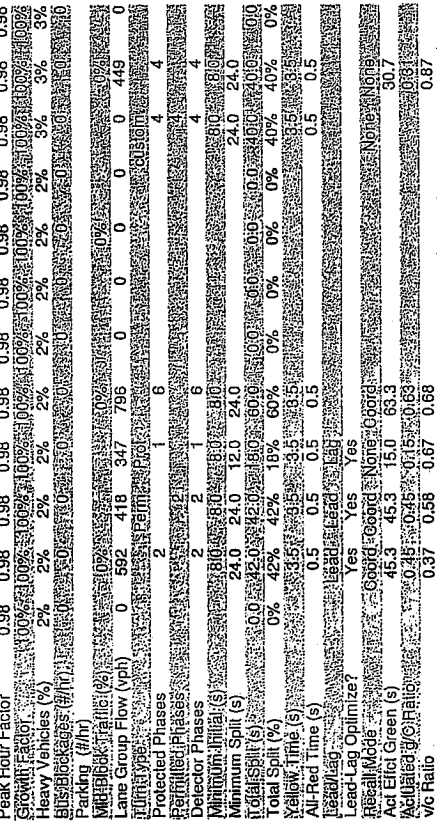
Area Type:	Other
Vehicle Length (ft):	100
Accumulated Cycle Length:	100
Natural Cycle:	60
Maximum v/c Ratio:	0.87
Intersection Capacity Utilization:	74.6%
Volume to Capacity Ratio:	0.87
Spillover:	0
Queueing Penalty (veh):	4



Area Type:	Other
Vehicle Length (ft):	100
Accumulated Cycle Length:	100
Natural Cycle:	60
Maximum v/c Ratio:	0.87
Intersection Capacity Utilization:	74.6%
Volume to Capacity Ratio:	0.87
Spillover:	0
Queueing Penalty (veh):	4



Area Type:	Other
Vehicle Length (ft):	100
Accumulated Cycle Length:	100
Natural Cycle:	60
Maximum v/c Ratio:	0.87
Intersection Capacity Utilization:	74.6%
Volume to Capacity Ratio:	0.87
Spillover:	0
Queueing Penalty (veh):	4



Area Type:	Other
Vehicle Length (ft):	100
Accumulated Cycle Length:	100
Natural Cycle:	60
Maximum v/c Ratio:	0.87
Intersection Capacity Utilization:	74.6%
Volume to Capacity Ratio:	0.87
Spillover:	0
Queueing Penalty (veh):	4



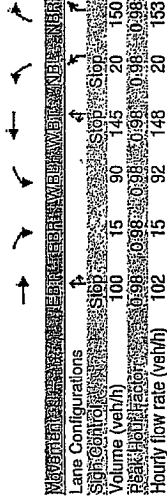
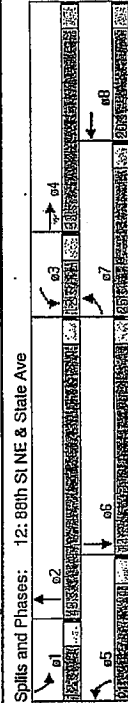
Approach	Phase	Green (s)	Yellow (s)	Red (s)	Queue Length (ft)	Delay (s)	Queue Length (ft)	Delay (s)
North	EB	15	3	10	15	15	15	15
	WB	15	3	10	15	15	15	15
South	EB	15	3	10	15	15	15	15
	WB	15	3	10	15	15	15	15
East	EB	15	3	10	15	15	15	15
	WB	15	3	10	15	15	15	15
West	EB	15	3	10	15	15	15	15
	WB	15	3	10	15	15	15	15

Area Type	Other	Actuated Cycle Length (s)	Queue Length (ft)	Delay (s)
North	Other	100	15	15
South	Other	100	15	15
East	Other	100	15	15
West	Other	100	15	15

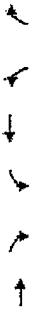


Area Type	Other	Actuated Cycle Length (s)	Queue Length (ft)	Delay (s)
North	Other	100	15	15
South	Other	100	15	15
East	Other	100	15	15
West	Other	100	15	15

Area Type	Other	Actuated Cycle Length (s)	Queue Length (ft)	Delay (s)
North	Other	100	15	15
South	Other	100	15	15
East	Other	100	15	15
West	Other	100	15	15

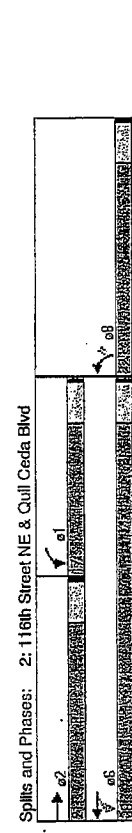


Volume Total (vph)	117	240	20	153
Volume Right (vph)	0	92	20	70
Volume Left (vph)	15	0	0	153
Peak (s)	0.0	0.1	0.2	0.16
Departure Headway (s)	4.6	4.6	5.5	4.7
Capacity (veh/h)	756	757	616	716
Approach Delay (s)	8.4	9.6	7.7	
HCM Level of Service	A			



Uniform Delay (s)	12.8	15.9	9.6	10.8	9.0
Delay	12.7	6.5	3.6	12.6	2.0
Approach Delay	12.7	5.5	2.6		
Approach LOS	B	A	B	A	A
90th %ile Green (s)	11.1	13.0	28.1	12.3	12.3
90th %ile Term Code	9.2	12.2	25.4	8.3	8.3
70th %ile Green (s)	8.0	3.8	20.3	8.0	8.0
50th %ile Green (s)	8.0	12.9	24.9	8.0	8.0
30th %ile Green (s)	0.0	8.0	8.0	8.0	8.0
10th %ile Green (s)	0.0	8.0	8.0	8.0	8.0
Queue Length 50th (ft)	21	38	7	5	0
Internal Link Dist (ft)	422	343	1129		
95th Up Block Time (%)					
50th Bay Block Time %					
Queuing Penalty (veh)					

Area Type: Other
 Actuated Cycle Length: 38.4
 Control Type: Actuated-Uncoordinated
 Intersection Signal Delay: 5.8
 Intersection LOS: A
 90th %ile Actuated Cycle: 48.4
 50th %ile Actuated Cycle: 36.8
 10th %ile Actuated Cycle: 24



Lane Configurations	↑↑	↑↑	↑↑	↑↑	↑↑
Max Flow (Vphpl)	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12
Grades (%)	0%	0%	0%	0%	0%
Storage Length (ft)	0	0	0	0	0
Storage Bikes	0	0	0	0	0
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0
Leading Detektor (ft)	50	50	50	50	50
Trailing Detektor (ft)	0	0	0	0	0
Trailing Spread (mph)	15	15	15	15	15
Lane Util. Factor	0.95	1.00	0.95	1.00	0.88
Peak Hour Factor	0.988				0.850
Flt Protected	0	0	0	0	0
Satd. Flow (vph)	3463	0	1770	3539	1770
Flt Protected	0	0	0	0	0
Satd. Flow (vph)	3463	0	1062	3539	1770
Right Turn (vph)	0	0	0	0	0
Satd. Flow (RTOR)	16				505
Link Speed (mph)	40				30
Link Delay (s)	6.02				20.9
Travel Time (s)	8.6				7.2
Confl. Reads (fl/hr)	280				30
Confl. Reads (vph)	0.93				0.93
Peak Hour Factor	0.93				0.93
Slow Start Factor	1.00%				1.00%
Heavy Vehicles (%)	3%				2%
Bus Stoppage (vph)	0				0
Parking (fl/hr)	0				0
Max B/C Ratio (%)	0%				0%
Lane Group Flow (vph)	269				505
Unit: vph	2				8
Protected Phases	2				8
Permitted Phases	2				8
Detector Phases	2				8
Minimum Split (s)	20.0				20.0
Total Split (%)	35%				37%
Yellow Time (s)	3.5				3.5
All-Red Time (s)	0.5				0.5
Lead-Lag Optimizer?	Yes				None
Recall Middle:	None				None
Act Effct Green (s)	9.9				10.3
Actuated B/C Ratio	0.24				0.27
v/c Ratio	0.32				0.07

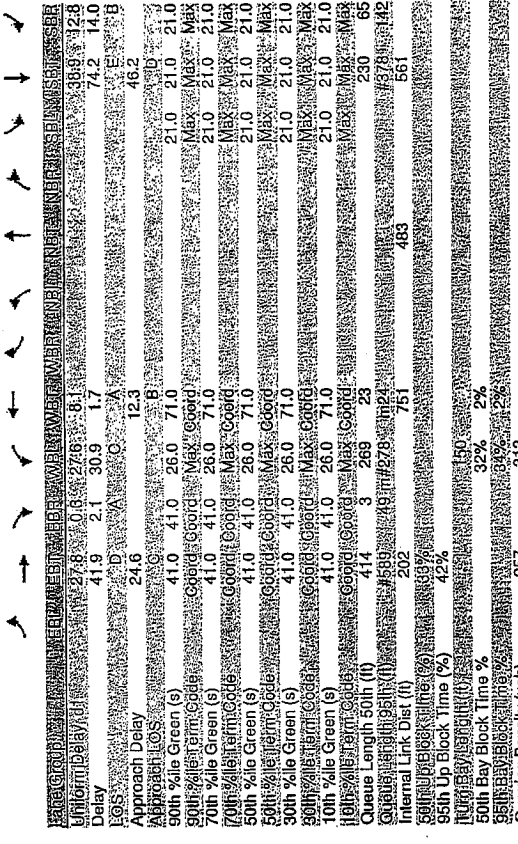
Area Type: Other
 Actuated Cycle Length: 38.4
 Control Type: Actuated-Uncoordinated
 Intersection Signal Delay: 5.8
 Intersection LOS: A
 90th %ile Actuated Cycle: 48.4
 50th %ile Actuated Cycle: 36.8
 10th %ile Actuated Cycle: 24



Area Type:	Other	
Actuated Cycle Length:	92.6	
Queue Length (ft):	120	
Control Type:	Actuated-Uncoordinated	
Maximum Yellow Clearance (s):	3.0	
Intersection LOS:	B	
90th % Actuated Cycle:	105.7	
50th % Actuated Cycle:	88	
10th % Actuated Cycle:	82.2	
Queue shown is maximum after two cycles.		
Spills and Phases: 3: 116th Street NE & 34th Ave NE		
Phase	g1	g2
Phase	g3	g4
Phase	g5	g6



Lane Configurations:	4T	
Initial Flow (veh/h):	1900	1900
Lane Width (ft):	12	12
Grade (%):	0	0
Storage Length (ft):	0	0
Storage Lanes:	0	0
Total Lost Time (s):	3.0	3.0
Leading Detector (ft):	50	50
Trailing Detector (ft):	0	0
Turning Speed (mph):	15	15
Lane Util. Factor:	0.95	0.95
Peak Hour Factor:	0.999	0.958
Flt Protected:	0.998	0.967
Satd. Flow (prot):	0.3181	0.1728
Flt Protected:	0.999	0.967
Satd. Flow (perm):	0.1945	0.1728
Flt Protected:	0.999	0.967
Satd. Flow (RTOR):	1	5
Link Speed (mph):	40	50
Link Distance (ft):	209	162
Travel Time (s):	3.6	4.8
Volume (veh/h):	200	510
Confl. Pct. (ft/h):	0.998	0.967
Peak Hour Factor:	0.94	0.94
Green Time (s):	100%	100%
Heavy Vehicles (%):	12%	8%
Parking (ft/h):	0	0
Min Block Length (ft):	16	16
Lane Group Flow (veh):	0	601
Protected Phases:	2	6
Detector Phases:	2	6
Minimum Split (s):	20.0	20.0
Total Split (s):	50.0	50.0
All-Red Time (s):	0.5	0.5
Lead-Lag Optimize?	None	None
Act Ert Green (s):	51.4	51.4
Actuated G/C Ratio:	0.58	0.62
v/c Ratio:	0.80	0.85

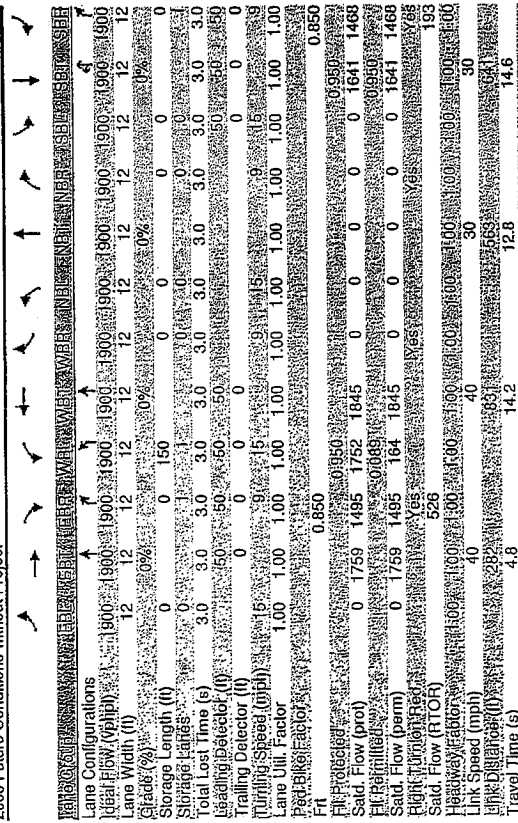


Approach Delay	24.6	12.3	46.2
90th %ile Green (s)	41.0	41.0	25.0
70th %ile Green (s)	41.0	41.0	26.0
50th %ile Green (s)	41.0	41.0	26.0
30th %ile Green (s)	41.0	41.0	26.0
10th %ile Green (s)	41.0	41.0	26.0
Queue Length 50th (ft)	414	3	289
Internal Link Dist (ft)	202	483	561
95th Up Block Time (%)	42%		
50th Bay Block Time %	32%	2%	
Queueing Penalty (veh)	287	313	

Area Type: Other
 Signal Type: Other
 Acuated Cycle Length: 100
 Natural Cycle: 90
 Maximum Vc Ratio: 0.99
 Intersection Capacity Utilization: 96.4%
 Queue shown is maximum after two cycles.



Splits and Phases: 4: 116th Street NE & SB On-Ramp
 116th Street EA
 Gibson Traffic Consultants (02-079 BJJ)
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Peak Hour Factor	0.85	0.85	0.85
Green Time (s)	30.0	30.0	30.0
Yellow Time (s)	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5
Lead-Lag Optimize?	Yes	Yes	Yes
Act Eff Green (s)	42.0	42.0	72.0
v/c Ratio	0.94	0.57	0.72

Area Type: Other
 Signal Type: Other
 Acuated Cycle Length: 100
 Natural Cycle: 90
 Maximum Vc Ratio: 0.99
 Intersection Capacity Utilization: 96.4%
 Queue shown is maximum after two cycles.



Splits and Phases: 4: 116th Street NE & SB On-Ramp
 116th Street EA
 Gibson Traffic Consultants (02-079 BJJ)
 PARAMELV1.3-FF51

6: 116th Street NE & State Ave
 2009 Future Conditions without Project
 PM Peak Hour
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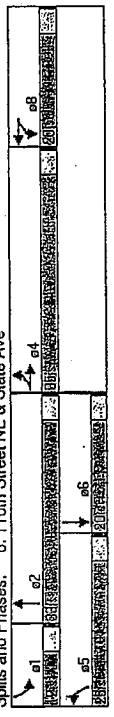
Lane Configurations	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Ideal Flow (veh/h)	12	12	12	12	12	12	12	12	12	12	12	12
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Storage Length (ft)	75	0	135	0	260	0	155	0	155	0	155	0
Storage Lanes	1	0	1	0	1	0	1	0	1	0	1	0
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15	15	15	15	15	15	15	15	15	15	15	15
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.95	1.00	0.95	0.95
Ped. Bikes Factor	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900
Flt. Protected	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950
Satd. Flow (prot)	1752	1660	0	1770	1768	0	1770	3493	0	1770	3281	0
Flt. Permitted	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950
Satd. Flow (norm)	1752	1660	0	1770	1768	0	1770	3493	0	1770	3281	0
Right Turn on Red	106	106	23	106	106	10	209	106	106	106	106	106
Satd. Flow (RTOR)	106	106	23	106	106	10	209	106	106	106	106	106
Highway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	40	40	40	40	40	40	40	40	40	40	40	40
Link Distance (ft)	18.9	18.9	14.6	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9
Travel Time (s)	445	445	370	445	445	370	445	445	445	445	445	445
Wall Time (Veh)	18.9	18.9	14.6	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9
Conf. Peds. (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Conf. Bikes (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Growth Rate	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Bike Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Mid-Block Traffic (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lane Group Flow (vph)	500	618	0	72	196	0	397	417	0	72	583	0
Left Turn	4	4	8	8	8	5	2	1	6	1	6	6
Permitted Phases	4	4	8	8	8	5	2	1	6	1	6	6
Detector Phases	4	4	8	8	8	5	2	1	6	1	6	6
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Initial Split (s)	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Total Split (%)	35%	35%	0%	20%	20%	0%	25%	33%	0%	12%	20%	0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead-Lag Optimizer?	None	None	None	None	None	None	None	None	None	None	None	None
Recall Mode	32.1	32.1	14.4	14.4	14.4	22.1	31.3	9.0	15.8	9.0	15.8	9.0
Act. Elct. Green (s)	0.83	0.93	0.15	0.15	0.15	0.23	0.33	0.09	0.15	0.09	0.15	0.09
Actuated %/C-Ratio	0.85	0.99	0.27	0.69	0.69	0.88	0.37	0.44	0.83	0.44	0.83	0.44
v/c Ratio	0.85	0.99	0.27	0.69	0.69	0.88	0.37	0.44	0.83	0.44	0.83	0.44

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6: 116th Street NE & State Ave
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Lane Configurations	304	268	367	364	373	247	382	244
Ideal Flow (veh/h)	41.3	61.2	36.7	34.6	77.2	25.0	43.4	27.0
Lane Width (ft)	12	12	12	12	12	12	12	12
Grade (%)	0%	0%	0%	0%	0%	0%	0%	0%
Storage Length (ft)	52.3	52.3	52.3	52.3	52.3	52.3	52.3	52.3
Storage Lanes	1	1	1	1	1	1	1	1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0
Turning Speed (mph)	15	15	15	15	15	15	15	15
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped. Bikes Factor	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900
Flt. Protected	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950
Satd. Flow (prot)	1752	1660	0	1770	1768	0	1770	3281
Flt. Permitted	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950
Satd. Flow (norm)	1752	1660	0	1770	1768	0	1770	3281
Right Turn on Red	106	106	23	106	106	10	209	106
Satd. Flow (RTOR)	106	106	23	106	106	10	209	106
Highway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	40	40	40	40	40	40	40	40
Link Distance (ft)	18.9	18.9	14.6	18.9	18.9	18.9	18.9	18.9
Travel Time (s)	445	445	370	445	445	370	445	445
Wall Time (Veh)	18.9	18.9	14.6	18.9	18.9	18.9	18.9	18.9
Conf. Peds. (#/hr)	0	0	0	0	0	0	0	0
Conf. Bikes (#/hr)	0	0	0	0	0	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Growth Rate	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%
Bike Blockages (#/hr)	0	0	0	0	0	0	0	0
Parking (#/hr)	0	0	0	0	0	0	0	0
Mid-Block Traffic (%)	0%	0%	0%	0%	0%	0%	0%	0%
Lane Group Flow (vph)	500	618	0	72	196	0	397	417
Left Turn	4	4	8	8	8	5	2	1
Permitted Phases	4	4	8	8	8	5	2	1
Detector Phases	4	4	8	8	8	5	2	1
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Initial Split (s)	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Total Split (%)	35%	35%	0%	20%	20%	0%	25%	33%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead-Lag Optimizer?	None	None	None	None	None	None	None	None
Recall Mode	32.1	32.1	14.4	14.4	14.4	22.1	31.3	9.0
Act. Elct. Green (s)	0.83	0.93	0.15	0.15	0.15	0.23	0.33	0.09
Actuated %/C-Ratio	0.85	0.99	0.27	0.69	0.69	0.88	0.37	0.44
v/c Ratio	0.85	0.99	0.27	0.69	0.69	0.88	0.37	0.44

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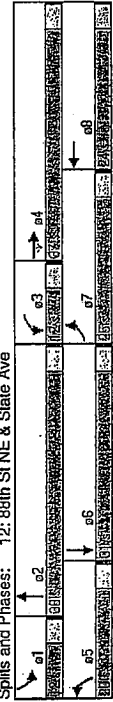
Lane Configurations	0%	0%	0%	0%
Volume (veh/h)	160	210	200	96
Peak Hour Factor	0.93	0.93	0.93	0.93
High Occupancy Vehicle (HOV) 3+ Volume	72	91	22	215
Pedestrians				
Walking Speed (ft/s)				
Right turn lane (veh)				
Median storage (veh)				
Upstream signal (ft)				
Platoon unblocked				
VC1, stage 1 cont vol	720	333		441
VC1, unblocked vol				
VC2, stage 1 cont vol				
VC2, unblocked vol				
IC, 2 stage (s)	52	87		91
pl queue free %				
Volume Right	172	0	0	97
Volume Left				
Volume Thru	360	708	1700	1119
Volume Right				
Volume Left				
Volume Thru				
Queue Length (ft)	62	11	0	7
Approach Delay (s)	C	B	B	A
Lane LOS	C	B	B	A
Approach LOS	C	B	B	A
Average Delay				6.1
Intersection Capacity Utilization				60%

Approach Delay	22.2	17.6	2.5	19.4	1.4
LOS	D	D	A	B	A
Approach Delay	22.2	3.9		17.9	
Approach LOS	D	A		B	
90th % Green (s)	29.5	29.5	29.5	62.5	62.5
90th % Green (s)	34.1	34.1	34.1	57.9	57.9
90th % Green (s)	36.1	36.1	36.1	52.9	52.9
90th % Green (s)	44.3	44.3	44.3	47.7	47.7
10th % Green (s)	51.4	51.4	51.4	40.6	40.6
Queue Length 50th (ft)	70	25	1	407	0
Internal Link Dist (ft)	1562	449		291	
55th Up Block Time (%)	17%			13%	
50th Bay Block Time %	175%			34%	
50th Bay Block Time	312			312	
Queuing Penalty (veh)					
Area Type:	Other				
Advanced Cycle Length	100				
Effective Cycle Length	100				
Natural Cycle	55				
Maximum v/c Ratio	0.85				
Intersection Capacity Utilization	69.9%				
ICU Level of Service B					
Spills and Phases:	8: 88th St NE & Quil Ceda Blvd				

Lane Configurations	4↑	4↑	4↑	4↑	4↑
Ideal Flow (vphpl)	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12
Grade (%)	0%	0%	0%	0%	0%
Storage Length (ft)	0	175	120	0	0
Storage Lanes	0	1	2	1	1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0
Trailing Speed (mph)	15	9	15	9	9
Lane Util. Factor	0.95	0.95	1.00	0.97	1.00
Red Bike Factor					0.850
Flt. Pct. (per cent)	0.00	0.00	0.00	0.00	0.00
Satd. Flow (prot)	0	3459	3539	1583	3483
Flt. Permitted	0	0	0	0	0
Satd. Flow (perm)	0	2700	3539	1583	3483
Satd. Flow (TOT)					336
Link Speed (mph)	35	35		30	
Travel Time (s)	32.0	10.3		8.4	
Conf. Peds. (#/hr)					
Conf. Bikes (#/hr)					
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	2%	2%
Bus Blockage (#/hr)	0	0	0	0	0
Parking (#/hr)	0	0	0	0	0
Min. Block (ft)	0	130	1272	1554	136
Lane Group Flow (vph)	0	315	130	1272	1554
Perm. Phases	2	6	4	4	4
Protected Phases	2	2	2	2	2
Detector Phases	2	2	2	2	2
Minimum Spill (s)	20.0	20.0	20.0	20.0	20.0
Total Spill (s)	30.0	30.0	30.0	30.0	30.0
Total Spill (%)	30%	30%	30%	30%	30%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5
Lead-Lag					
Lead-Lag Optimize?					
Act Eff. Green (s)	40.7	40.7	100.0	53.3	53.3
Actuated g/C-Ratio	0.41	0.41	1.00	0.53	0.53
v/c Ratio	0.29	0.09	0.80	0.85	0.15

Area Type	Other	90th % Actuated Cycle	100th % Actuated Cycle	90th % Actuated Cycle	100th % Actuated Cycle	90th % Actuated Cycle	100th % Actuated Cycle
Actuated Cycle Length: 100	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Control Type: Actuated-Uncoordinated	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Intersection Signal Delay: 78.2	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Intersection LOS: E	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
90th % Actuated Cycle: 100	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
100th % Actuated Cycle: 100	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Queue shown is maximum after two cycles.	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Queue shown is maximum after two cycles.	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100

Area Type	Other	90th % Actuated Cycle	100th % Actuated Cycle	90th % Actuated Cycle	100th % Actuated Cycle	90th % Actuated Cycle	100th % Actuated Cycle
Area Type: Other	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Actuated Cycle Length: 100	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Control Type: Actuated-Uncoordinated	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Intersection Signal Delay: 78.2	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Intersection LOS: E	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
90th % Actuated Cycle: 100	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
100th % Actuated Cycle: 100	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Queue shown is maximum after two cycles.	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100
Queue shown is maximum after two cycles.	Other	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100	90th % Actuated Cycle: 100	100th % Actuated Cycle: 100



Volume (veh/h)	100	15	90	145	20	150
Hourly flow rate (veh/h)	102	15	92	148	20	153
Volume Total (vph)	117	240	20	153		
Volume Left (vph)	15	0	0	153		
Volume Right (vph)	0	0	0	0	0	0
Departure Headway (s)	4.6	4.6	5.5	4.7		
Capacity (veh/h)	756	757	616	716		
Approach Delay (s)	8.4	9.6	7.7			
Approach LOS	A	A	A			
Level of Service	A	A	A			

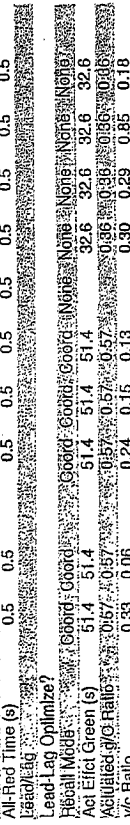
2: 116th Street NE & OCB Extension
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2009 Future Conditions with Project

Uniform Delay (s)	10.2	6.1	9.0	9.0	0.0	20.6	0.0	28.4	12.2
Delay	12.7	8.4	7.4	7.2	1.2	19.4	1.7	25.5	10.8
LOS	B	B	A	A	A	B	A	C	B
Approach Delay	11.3		6.1			10.6			23.0
Approach LOS	B		A			B			C
90th %ile Green (s)	40.0	40.0	40.0	40.0	42.0	42.0	42.0	42.0	42.0
90th %ile Term Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord
70th %ile Green (s)	45.1	46.1	46.1	46.1	35.9	35.9	35.9	35.9	35.9
70th %ile Term Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord
50th %ile Green (s)	50.2	50.2	50.2	50.2	31.8	31.8	31.8	31.8	31.8
50th %ile Term Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord
30th %ile Green (s)	55.1	55.1	55.1	55.1	26.9	26.9	26.9	26.9	26.9
30th %ile Term Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord
10th %ile Green (s)	60.7	60.7	60.7	60.7	21.3	21.3	21.3	21.3	21.3
10th %ile Term Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord	Coord
Queue Length 50th (ft)	60	10	28	25	0	74	0	149	28
Queue Length 95th (ft)	1003		343			1129			672
Internal Link Dist (ft)									
95th Up Block Time (s)									
95th Up Block Time (%)									
50th Bay Block Time %									
90th Bay Block Time %									
Queuing Penalty (veh)									

2: 116th Street NE & OCB Extension
2009 Future Conditions with Project

Lane Configurations	1	1	1	1	1	1	1	1	1
Ideal Flow (Veh/h)	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12
Grade (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%
Storage Length (ft)	250	0	330	0	250	295	0	0	0
Storage Lanes	3	0	3	0	2	2	0	0	0
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15	9	15	9	15	15	15	15	15
Lane Util. Factor	1.00	0.95	0.97	1.00	0.95	0.95	0.88	0.97	1.00
Ped. Walk Factor	0.362		0.850		0.950		0.945		
Flt. Probability	0.0950		0.0994		0.360		0.360		
Satd. Flow (prot)	1752	3372	0	3433	1863	1583	0	3518	2787
Flt. Probability	0.0926		0.0994		0.360		0.360		
Satd. Flow (perm)	1155	3372	0	2472	1863	1583	0	3224	2787
Right Turnon Ped.	27		129		355		43		
Left Turnon Ped.	40		40		30		30		
Link Distance (ft)	18.5		7.2		27.9		17.1		
Volume (Veh/h)	200	225	320	50	20	20	380	65	40
Confl. Peds. (Veh/h)									
90th %ile Delay (Veh/h)	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Stop/Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%	2%	2%	2%
Bus Blockage (Veh/h)	0	0	0	0	0	0	0	0	0
Parking (Veh/h)	0	0	0	0	0	0	0	0	0
Min. Block Traffic (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lane Group Flow (vph)	215	108	0	344	161	129	0	355	565
Number of Phases	2	2	6	6	6	6	8	8	4
Permitted Phases	2	2	6	6	6	6	8	8	4
Detector Phases	2	2	6	6	6	6	8	8	4
Minimum Spill (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Spill (s)	44.9	44.0	44.0	44.0	44.0	46.0	46.0	46.0	46.0
Total Spill (%)	49%	49%	0%	49%	49%	51%	51%	51%	51%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead-Lag									
Lead-Lag Optimize?									
Headway (ft)	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4
Acc. Eff. Green (s)	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
Accumulated Delay (veh)	0.33	0.06	0.24	0.15	0.13	0.30	0.29	0.85	0.18
v/c Ratio									



Approach Delay	21.8	27.2	23.9	25.4
90th %ile Green (s)	17.0	17.0	19.0	19.0
70th %ile Green (s)	17.0	17.0	19.0	19.0
50th %ile Green (s)	17.0	17.2	19.0	19.2
30th %ile Green (s)	15.9	20.4	19.0	23.5
10th %ile Green (s)	13.0	24.7	19.0	30.7
Queue Length 50th (ft)	127	54	138	37
Queue Length 95th (ft)	175	95	195	231
Internal Link Dist (ft)	95	95	150	150
95th Up Block Time (%)	22%	22%	36%	26%
50th Bay Block Time %				
Queuing Penalty (veh)	77	150	55	145
Area Type:	Other			
Actuated Cycle Length: 90				
Natural Cycle: 65				
Maximum Vc Ratio: 0.69				
Intersection Capacity Utilization: 51.9%				
ICU Level of Service A				

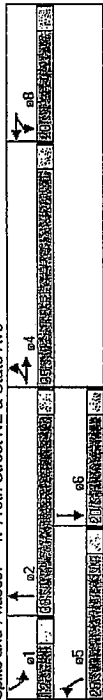
Splits and Phases: 3: 116th Street NE & NB Ramps

Phase	1	2	3	4	5	6	7	8
Split (%)	0	0	0	0	0	0	0	0
Split (veh)	0	0	0	0	0	0	0	0
Phase	1	2	3	4	5	6	7	8
Split (%)	0	0	0	0	0	0	0	0
Split (veh)	0	0	0	0	0	0	0	0

116th Street EA
 Gibson Traffic Consultants (02-079 B.J.L.)
 PARAMELV13-FF51

Lane Configurations	TT	TT	TT	TT
Design Flow (Vp/Pl)	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12
Grade (%)	0%	0%	0%	0%
Storage Length (ft)	0	0	0	0
Storage Lanes	2	2	2	2
Total Lost Time (s)	3.0	3.0	3.0	3.0
Leaving Delay (ft)	50	50	50	50
Trailing Detector (ft)	0	0	0	0
Turning Speed (mi/h)	15	15	15	15
Lane Util. Factor	0.90	0.95	1.00	1.00
RT Protected	0.950	0.950	0.950	0.950
Satd. Flow (prot)	3008	3343	3154	3505
RT Permitted	0.950	0.950	0.950	0.950
Satd. Flow (perm)	3008	3343	3154	3505
RT Left on Red	0	0	0	0
Satd. Flow (RTOR)	100	100	100	100
Headway Factor	35	35	30	30
Link Speed (mph)	75	75	75	75
Travel Time (s)	3.4	3.4	5.2	5.2
Volume (vph)	390	200	150	160
Conf. Peds. (#/hr)	0	0	0	0
Peak Hour Factor	0.90	0.90	0.90	0.90
Growth Factor	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	8%	6%	3%	2%
Trucks (%)	0%	0%	0%	0%
Heavy Trucks (%)	0%	0%	0%	0%
Trucks (veh)	0	0	0	0
Heavy Trucks (veh)	0	0	0	0
Min. Block Length (%)	0%	0%	0%	0%
Lane Group Flow (vph)	433	222	511	167
Turn Type	5	2	1	6
Protected Phases	5	2	1	6
Permitted Phases	5	2	1	6
Detector Phases	5	2	1	6
Minimum Initial (s)	4.0	4.0	4.0	4.0
Minimum Split (s)	13.0	25.0	13.0	25.0
Total Split (s)	26.0	26.0	26.0	26.0
Total Split (%)	29%	31%	31%	40%
Yellow Time (s)	4.0	4.0	4.0	4.0
All-Red Time (s)	5.0	5.0	5.0	5.0
Lead/Lag	Yes	Yes	Yes	Yes
Lead/Lag Optimizer?	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None
Act Elct Green (s)	22.0	25.3	25.0	30.7
Actual Red Ratio	0.24	0.28	0.33	0.34
V/c Ratio	0.59	0.24	0.58	0.55

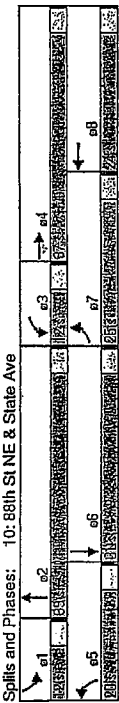
116th Street EA
 Gibson Traffic Consultants (02-079 B.J.L.)
 PARAMELV13-FF51



Lane Configurations	1P	1P	4
Signal Control	0%	0%	0%
Grade	0%	0%	0%
Volume (veh/h)	160	85	200
Peak Hour Factor	0.93	0.93	0.93
Hourly Flow Rate (veh/h)	172	228	215
Pedestrians			
Lane Width (ft)			
Walking Speed (ft/s)			
Percent Bicycles			
Fight turn flare (veh)			
Median storage (veh)			
Upstream signal (ft)			
px, platoon unblocked			
Volume (veh/h)	720	333	441
vCu, unblocked vol			
IC, 2 stage (s)			
IC, 1 stage (s)			
pl queue area %	52	87	91
pl capacity (veh/h)	960	708	1119
Volume Left	172	0	0
Volume Right			
Volume Thru			
GSH	360	708	1119
Queue Length (ft)	62	11	7
Lane LOS	C	B	A
Approach Delay (s)			
Approach LOS	C		
Average Delay		6.1	

Lane Configurations	1900	1900	1900	1900	1900	1900	1900
Ideal Flow (veh/h)	12	12	12	12	12	12	12
Lane Width (ft)	0	0	0	0	0	0	0
Grade (%)	0	0	0	0	0	0	0
Storage Length (ft)	0	175	120	0	0	0	0
Storage Lanes	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	50	50	50	50	50	50	50
Leading Detector (ft)	0	0	0	0	0	0	0
Trailing Detector (ft)	15	15	15	15	15	15	15
Turning Spaced (m/ft)	0.95	0.95	1.00	0.97	1.00	0.95	1.00
Lane Util. Factor	0.97	0.97	0.95	0.95	0.95	0.95	0.95
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Satd. Flow (prot)	0	3458	3539	1583	3433	1583	3433
Flow (perm)	0	2700	3539	1583	3433	1583	3433
Right Turn on Red	0	0	0	0	0	0	0
Satd. Flow (RTOR)	0	0	0	0	0	0	0
Link Speed (mph)	35	35	35	35	35	35	35
Travel Time (s)	32.0	10.3	8.4	8.4	8.4	8.4	8.4
Confl. Pctds. (f/ft)	165	126	120	130	125	125	136
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Lane Group Flow (vph)	0	315	130	1272	1554	136	136
Projected Phases	2	2	6	4	4	4	4
Detector Phases	2	2	6	4	4	4	4
Minimum Spill (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Spill (s)	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead-Lag Optimize?							
Act Effct Green (s)	40.7	40.7	100.0	53.3	53.3	53.3	53.3
Act Effct Red (s)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
v/c Ratio	0.29	0.09	0.80	0.85	0.15	0.85	0.15

Approach Delay	22.2	3.9	17.9	17.9
90th %ile Green (s)	28.5	29.5	29.5	29.5
70th %ile Green (s)	34.1	34.1	34.1	34.1
50th %ile Green (s)	39.1	39.1	39.1	39.1
30th %ile Green (s)	44.3	44.3	44.3	44.3
10th %ile Green (s)	51.4	51.4	51.4	51.4
Queue Length 50th (ft)	70	25	7	407
Internal Link Dist (ft)	1562	449	281	281
95th Up Block Time (%)	13%			
50th Bay Block Time %	34%			
Queueing Penalty (veh)	312			
Area Type:	Other			
Actuated Cycle Length: 100				
Natural Cycle: 55				
Maximum v/c Ratio: 0.85				
Intersection Capacity Utilization: 69.9%				
ICU Level of Service: B				
Spills and Phases:	6: 88th St NE & Quill Ceda Blvd			



Volume Total (vph)	265	444	184	26
Volume Left (vph)	20	444	0	0
Volume Right (vph)	20	0	0	0
Delay (s)	4.7	5.0	4.8	5.9
Operational Highway (s)	0.34	0.62	0.25	0.07
Capacity (veh/h)	780	711	738	559
Approach Delay (s)	10.1	12.7	9.2	11.8
Level of Service	B			

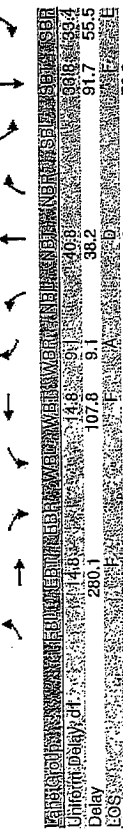
2: 116th Street NE & Quill Ceda Blvd
2030 Future Conditions without Project

Delay	22.5	21.6	7.7	14.1	12.0
95th %ile Delay	66.5	189.4	7.9	14.5	144.2
Approach Delay	66.5			94.8	137.3
90th %ile Green (s)	19.0	12.0	35.0	22.0	22.0
70th %ile Green (s)	19.0	12.0	35.0	22.0	22.0
50th %ile Green (s)	19.0	12.0	35.0	22.0	22.0
30th %ile Green (s)	19.0	12.0	35.0	22.0	22.0
10th %ile Green (s)	19.0	12.0	35.0	22.0	22.0
Queue Length 50th (ft)	-280	-335	58	20	-404
Queue Length 95th (ft)	422	827	45	53	1129
Internal Link Dist (ft)				343	
95th Up Block Time (%)				63%	
50th Bay Block Time %					
Queueing Penalty (veh)					236

Area Type: Other
 Cycle Length: 65
 Actuated Cycle Length: 65
 Control Type: Actuated-Uncoordinated
 Intersection Signal Delay: 101.8
 Intersection LOS: F
 90th %ile Actuated Cycle: 65
 70th %ile Actuated Cycle: 65
 50th %ile Actuated Cycle: 65
 10th %ile Actuated Cycle: 65
 Queue shown is maximum after two cycles.
 Queue shown is maximum after two cycles.

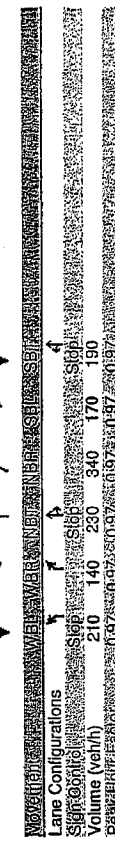
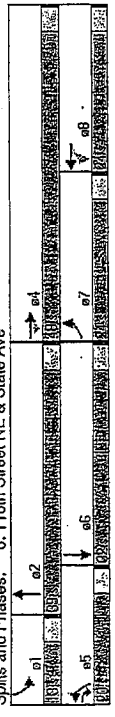
2: 116th Street NE & Quill Ceda Blvd
2030 Future Conditions without Project

Lane Configurations	12	12	12	12	12
Design Flow (veh/h)	1600	1800	1900	1900	1900
Lane Width (ft)	12	12	12	12	12
Grade (%)	0	0	0	0	0
Storage Length (ft)	0	0	0	0	0
Storage Lanes	0	0	0	0	0
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	60	60	60	60	60
Trailing Detector (ft)	0	0	0	0	0
Trailing Detector (ft)	0	0	0	0	0
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00
Reaction Factor	0.92				0.950
Reduction Factor	0.92				0.950
Satd. Flow (prot)	3477	0	1770	3539	1770
Satd. Flow (perm)	3477	0	324	3539	1770
Satd. Flow (RTOR)	100	0	100	100	100
Link Speed (mph)	40			40	30
Travel Time (s)	8.6			7.2	27.5
Confl. Peds. (#/hr)	0			0	0
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	3%	2%	2%	2%	2%
Parking (#/hr)	0			0	0
Max Block Signal (%)	0%			0%	0%
Lane Group Flow (vph)	1162	0	683	586	75
Protected Phases	2			6	5
Detector Phases	2			6	8
Minimum Spill (s)	20.0			20.0	20.0
Total Spill (%)	35%	0%	25%	60%	40%
All-Red Time (s)	0.5			0.5	0.5
Lead-Lag Optimizer?	Yes			None	None
Act Effort Green (s)	36.0			36.0	23.0
Act Effort Green (s)	36.0			36.0	23.0
v/c Ratio	1.09			1.46	0.30



Approach Delay	280.1	69.5	38.2	76.2
Approach LOS	E	F	D	E
90th %ile Green (s)	55.0	55.0	8.0	17.0
90th %ile Term Code	Hold	Hold	Hold	Hold
90th %ile Green (s)	55.0	55.0	0.0	17.0
90th %ile Term Code	Hold	Hold	Hold	Hold
50th %ile Green (s)	55.0	55.0	0.0	17.0
50th %ile Term Code	Hold	Hold	Hold	Hold
30th %ile Green (s)	55.0	55.0	0.0	17.0
30th %ile Term Code	Hold	Hold	Hold	Hold
10th %ile Green (s)	55.0	55.0	0.0	17.0
10th %ile Term Code	Hold	Hold	Hold	Hold
Queue Length 60th (ft)	-1059	-643	150	-240
Internal Link Dist (ft)	122	202	53	33
95th Up Block Time (%)	59%	46%	22%	77%
50th Bay Block Time %	29%	10%	54%	42%
Queueing Penalty (veh)	1222	635	277	201

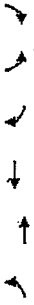
Area Type: Other
 Actuated Cycle Length: 62.4
 Control Type: Actuated-Uncoordinated
 Maximum Yellow: 4.0
 Intersection Signal Delay: 176.8
 Intersection LOS: F
 90th %ile Actuated Cycle: 92
 70th %ile Actuated Cycle: 80
 50th %ile Actuated Cycle: 80
 10th %ile Actuated Cycle: 80
 Queue shown is maximum after two cycles.
 Queue shown is maximum after two cycles.



Volume Total (vph)	216	144	588	371
Volume Left (vph)	216	0	0	175
Volume Right (vph)	0	144	351	0
Departure Headway (s)	7.0	6.2	5.2	5.9
Capacity (veh/h)	486	544	663	586
Approach Delay (s)	12.3	30.1	17.5	
Delay (s)	21.7			
HCIM Level of Service	C			

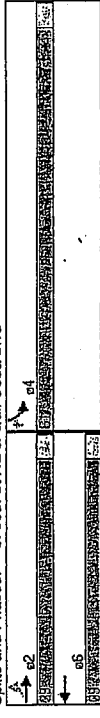


Lane Configurations	1900	1900	1900	1900	1900	1900	1900	1900	1900
Peak Flow (Veh/h)	12	12	12	12	12	12	12	12	12
Lane Width (ft)	12	12	12	12	12	12	12	12	12
Grade (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%
Storage Length (ft)	0	175	120	0	0	0	0	0	0
Storage Lane(s)	1	1	1	1	1	1	1	1	1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0
Turning Speed (ft/h)	15	0	0	15	15	15	15	15	15
Lane Util. Factor	1.00	1.00	0.91	0.91	0.97	1.00	1.00	1.00	1.00
Pd/Bkpt Factor	0.999	0.850							
Flt	0.850								
Satd. Flow (prot)	1752	1845	3018	1427	3400	1588			
Flt Permitted	0.93				0.950				
Satd. Flow (perm)	356	1845	3018	1427	3400	1588			
Height/Width Ratio	1.65				1.65				
Satd. Flow (RTOP)	611	761			113				
Headway (ft)	100	100	100	100	100	100	100	100	100
Link Speed (mph)	35	35	30		30				
Link Distance (ft)	1642	629	1171	1371	371				
Travel Time (s)	32.0	10.3	8.4		8.4				
Volume (veh/h)	113	412	758	761	1747	113			
Cont. Peds. (#/hr)									
Cont. Bikes (#/hr)									
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97			
Green Time (s)	100%	100%	100%	100%	100%	100%			
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%			
Bus Stoppage (#/hr)	0	0	0	0	0	0			
Parking (#/hr)									
Mid-Block (ft)									
Lane Group Flow (veh)	113	412	758	761	1747	113			
Unit Type	Perm	Perm	Perm	Perm	Perm	Perm			
Protected Phases	2	6			4				
Permitted Phases	2	6	6	6	4	4			
Detector Phases	2	6			4				
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0			
Initial Split (s)	39.0	39.0	39.0	39.0	39.0	39.0			
Total Split (%)	39%	39%	39%	39%	39%	39%			
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5			
All Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5			
Lead-Lag Optimize?									
Recall Mode?									
Act Effct Green (s)	37.7	37.7	37.7	37.7	37.7	37.7			
Act Effct Red (s)	0.99	0.99	0.99	0.99	0.99	0.99			
Act Effct Yellow (s)	0.84	0.59	0.52	0.51	0.51	0.51			
v/c Ratio									



Lane Configurations	1900	1900	1900	1900	1900	1900	1900	1900	1900
Peak Flow (Veh/h)	12	12	12	12	12	12	12	12	12
Lane Width (ft)	12	12	12	12	12	12	12	12	12
Grade (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%
Storage Length (ft)	0	175	120	0	0	0	0	0	0
Storage Lane(s)	1	1	1	1	1	1	1	1	1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0
Turning Speed (ft/h)	15	0	0	15	15	15	15	15	15
Lane Util. Factor	1.00	1.00	0.91	0.91	0.97	1.00	1.00	1.00	1.00
Pd/Bkpt Factor	0.999	0.850							
Flt	0.850								
Satd. Flow (prot)	1752	1845	3018	1427	3400	1588			
Flt Permitted	0.93				0.950				
Satd. Flow (perm)	356	1845	3018	1427	3400	1588			
Height/Width Ratio	1.65				1.65				
Satd. Flow (RTOP)	611	761			113				
Headway (ft)	100	100	100	100	100	100	100	100	100
Link Speed (mph)	35	35	30		30				
Link Distance (ft)	1642	629	1171	1371	371				
Travel Time (s)	32.0	10.3	8.4		8.4				
Volume (veh/h)	113	412	758	761	1747	113			
Cont. Peds. (#/hr)									
Cont. Bikes (#/hr)									
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97			
Green Time (s)	100%	100%	100%	100%	100%	100%			
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%			
Bus Stoppage (#/hr)	0	0	0	0	0	0			
Parking (#/hr)									
Mid-Block (ft)									
Lane Group Flow (veh)	113	412	758	761	1747	113			
Unit Type	Perm	Perm	Perm	Perm	Perm	Perm			
Protected Phases	2	6			4				
Permitted Phases	2	6	6	6	4	4			
Detector Phases	2	6			4				
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0			
Initial Split (s)	39.0	39.0	39.0	39.0	39.0	39.0			
Total Split (%)	39%	39%	39%	39%	39%	39%			
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5			
All Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5			
Lead-Lag Optimize?									
Recall Mode?									
Act Effct Green (s)	37.7	37.7	37.7	37.7	37.7	37.7			
Act Effct Red (s)	0.99	0.99	0.99	0.99	0.99	0.99			
Act Effct Yellow (s)	0.84	0.59	0.52	0.51	0.51	0.51			
v/c Ratio									

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset (s): 0
 Natural Cycle: 15
 Maximum v/c Ratio: 0.91
 Intersection Split Delay: 15.9 s
 Intersection Capacity Utilization: 66.7%
 ICU Level of Service: D
 Queue shown is maximum after two cycles.



Area Type:	Other
Cycle Length (s)	100
Actuated Cycle Length (s)	100
Control Type:	Actuated-Uncoordinated
Maximum Vehicle Ratio	1.00
Intersection Signal Delay (s)	142.6
Intersection LOS:	F
90th %ile Actuated Cycle:	100
70th %ile Actuated Cycle:	100
50th %ile Actuated Cycle:	100
10th %ile Actuated Cycle:	100
Queue shown is maximum after two cycles.	
Queue shown is maximum after two cycles.	
Queue shown is maximum after two cycles.	

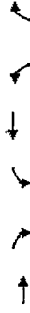
Area Type:	Other
Cycle Length (s)	100
Actuated Cycle Length (s)	100
Control Type:	Actuated-Uncoordinated
Maximum Vehicle Ratio	1.00
Intersection Signal Delay (s)	142.6
Intersection LOS:	F
90th %ile Actuated Cycle:	100
70th %ile Actuated Cycle:	100
50th %ile Actuated Cycle:	100
10th %ile Actuated Cycle:	100
Queue shown is maximum after two cycles.	
Queue shown is maximum after two cycles.	
Queue shown is maximum after two cycles.	

12: 88th St NE & State Ave
2030 Future Conditions without Project



116th Street EA
Gibson Traffic Consultants (02-079 B.J.L.)
PARAMELY13-FF51

1: 116th Street NE & 27th Ave NE
2030 Future Conditions with Project

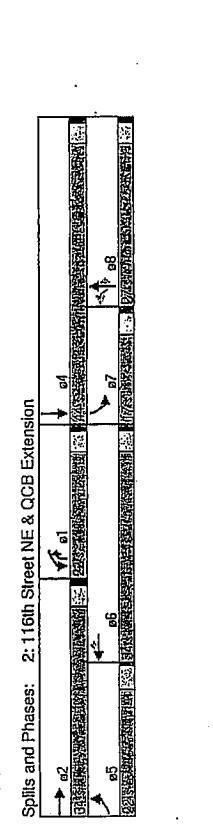


Lane Configurations	P		T		T		T	
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Volume (veh/h)	205	20	445	185	25	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	211	21	459	191	26	0	0	0
Volume Total (vph)	232	459	191	26				
Volume Left (vph)	0	459	0	26				
Volume Right (vph)	21	0	0	0				
Peak (s)	6.0	0.2	0.0	0.2				
Departure Headway (s)	4.6	5.0	4.8	5.9				
Departure Saturation	0.90	0.63	0.25	0.09				
Capacity (veh/h)	764	717	745	563				
Utilization	0.30	0.19	0.27	0.16				
Approach Delay (s)	8.6	12.9		9.1				
Approach LOS	A	B		B				
Level of Service	B							

116th Street EA
Gibson Traffic Consultants (02-079 B.J.L.)
PARAMELY13-FF51

Approach Delay (s)	57.9	30.2	28.2	22.0	1.5	32.1	55.0	12.9	65.0	17.5
LOS	C	B	C	A	D	B	E	B	E	B
Approach Delay	38.0		21.8			26.2			47.7	
Approach LOS	B		D			F			D	
90th %ile Green (s)	18.0	30.0	18.0	30.0	30.0	23.0	18.0	13.0	40.0	40.0
50th %ile Green (s)	18.0	30.0	18.0	30.0	30.0	23.0	18.0	13.0	40.0	40.0
10th %ile Green (s)	18.0	30.0	18.0	30.0	30.0	23.0	18.0	13.0	40.0	40.0
90th %ile Green (s)	18.0	30.0	18.0	30.0	30.0	23.0	18.0	13.0	40.0	40.0
50th %ile Green (s)	18.0	30.0	18.0	30.0	30.0	23.0	18.0	13.0	40.0	40.0
10th %ile Green (s)	18.0	30.0	18.0	30.0	30.0	23.0	18.0	13.0	40.0	40.0
Queue Length 50th (ft)	181	215	138	228	12	43	257	152	151	95
Queue Length 95th (ft)	383	263	212	396	18	74	497	204	249	159
Internal Link Dist (ft)	1003		343			1129				672
95th Up Block Time (%)			7%							
50th Bay Block Time %			8%							
Queueing Penalty (veh)	55	15				24				222

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Natural Cycle: 75
 Maximum v/c Ratio: 0.95
 Intersection Signal Delay: 0.0
 Intersection Capacity Utilization: 88.5%
 CU Level of Service: D
 Queue shown is maximum after two cycles.
 Delay values for 95th percentile queue are entered by upstream signal.



Lane Configurations	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Initial Flow (vph)	12	12	12	12	12	12	12	12	12	12
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12
Grade (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Storage Length (ft)	250	0	330	0	250	295	0	0	0	0
Storage Lanes	3	0	1	0	3	2	0	0	0	0
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0
Filtering Speed (ft/min)	115	9	15	9	15	9	15	9	15	9
Lane Util. Factor	1.00	0.95	0.97	1.00	1.00	0.88	0.97	1.00	1.00	1.00
Prd. Bkg. Factor	0.986		0.650		0.860		0.941			
Flt. Protected	0.950		0.950		0.950		0.950			
Satd. Flow (prot)	1703	3358	0	3367	1827	1553	1770	1863	2787	3433
Flt. Protected	0.950		0.950		0.950		0.950			
Satd. Flow (perm)	1703	3358	0	3367	1827	1553	1770	1863	2787	3433
Right Turn (Prot)	0	0	0	0	0	0	0	0	0	0
Satd. Flow (RTOR)	11		170		77		39			
Flt. Protected	0.950		0.950		0.950		0.950			
Link Speed (mph)	40		40		30		30			
Link Delay (s)	0.88		7.2		27.5		17.1			
Travel Time (s)	290	655	66	150	166	199	209	155	155	100
Conf. Peds. (ft/min)										
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Green Time (s)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	6%	6%	4%	4%	2%	2%	2%	2%	2%
BUS-Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)	0	0	0	0	0	0	0	0	0	0
Max. Delay (s)	289	742	0	526	464	170	82	412	923	459
Lane Group Flow (vph)	5	2	1	6	6	8	1	7	4	4
Protected Phases	5	2	1	6	6	8	1	7	4	4
Permitted Phases	5	2	1	6	6	8	1	7	4	4
Detector Phases	5	2	1	6	6	8	1	7	4	4
Minimum Interval (s)	12.0	20.0	0.0	20.0	20.0	20.0	12.0	12.0	20.0	20.0
Minimum Split (s)	12.0	20.0	0.0	20.0	20.0	20.0	12.0	12.0	20.0	20.0
Total Split (s)	22.0	34.0	0.0	34.0	34.0	27.0	22.0	22.0	34.0	34.0
Total Split (%)	22%	34%	0%	34%	34%	27%	22%	22%	34%	34%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lead/Lag (s)	Lead	Lead	Lead	Lead	Lead	Lead	Lead	Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Message	None	None	None	None	None	None	None	None	None	None
Act Eff. Green (s)	18.7	31.5	13.0	31.5	31.5	23.7	23.7	42.7	14.0	40.7
Actuated v/c Ratio	0.91	0.81	0.19	0.82	0.82	0.24	0.24	0.46	0.17	0.41
v/c Ratio	0.81	0.70	0.82	0.81	0.28	0.31	0.93	0.75	0.95	0.36

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Natural Cycle: 75
 Maximum v/c Ratio: 0.95
 Intersection Signal Delay: 0.0
 Intersection Capacity Utilization: 88.5%
 CU Level of Service: D
 Queue shown is maximum after two cycles.
 Delay values for 95th percentile queue are entered by upstream signal.

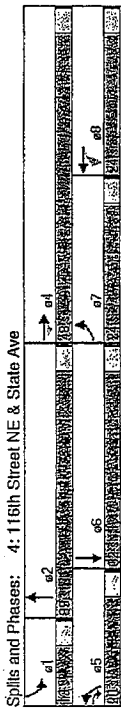




Approach	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
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Approach Delay	30.2	30.4	26.9	35.0
Approach LOS	C	C	C	D
90th %ile Green (s)	18.0	33.0	16.0	31.0
70th %ile Green (s)	16.0	33.0	16.0	31.0
50th %ile Green (s)	18.0	33.0	16.0	31.0
30th %ile Green (s)	16.0	33.0	16.0	31.0
10th %ile Green (s)	18.0	33.9	16.0	31.9
Queue Length 50th (ft)	166	313	177	131
Queue Length 95th (ft)	227	377	211	171
Internal Link Dist (ft)	95	95	95	150
95th Up Block Time (%)	48%	44%	47%	31%
95th Up Block Time (%)	48%	44%	47%	31%
50th Bay Block Time %				
95th Bay Block Time %				
Queueing Penalty (veh)	218	486	216	136
Area Type	Other			
Advanced Cycle Length	100			
Maximum v/c Ratio	0.83			
Intersection Capacity Utilization	77.7%			
95th percentile volume exceeds capacity, queue may be longer.	m Volume for 95th percentile queue is metered by upstream signal.			

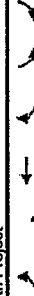




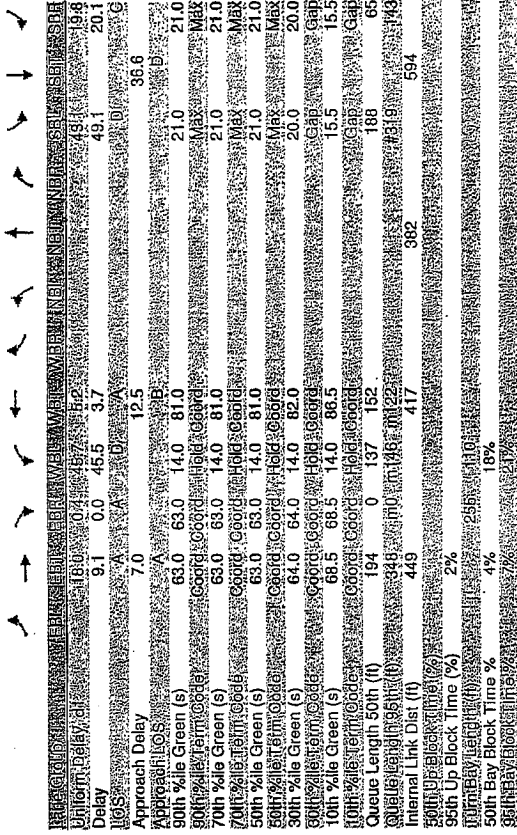
Volume (veh/h)	227	144	237	351	175	196
Hourly flow rate (veh/h)	227	144	237	351	175	196
Volume Total (vph)	227	144	588	371		
Volume Left (vph)	227	144	175			
Volume Right (vph)	0	144	351	0		
Volume Through (vph)	0	0	0	0		
Departure Headway (s)	7.1	6.3	5.3	5.9		
Departure Delay (s)	0.44	0.25	0.86	0.61		
Capacity (veh/h)	484	544	676	580		
Approach Delay (s)	12.7	10.1	11.5	7.9		
Approach Delay (s)			31.5	17.9		
Delay (s)	12.7	10.1	11.5	7.9		
Delay (s)			31.5	17.9		
HCM Level of Service	C					



Lane Configurations	12	12	12	12	12	12	12
Lane Width (ft)	12	12	12	12	12	12	12
Grade (%)	0%	0%	0%	0%	0%	0%	0%
Storage Length (ft)	0	175	120	0	0	0	0
Storage Lanes	3	3	3	3	3	3	3
Total Lost Time (s)	30	30	30	30	30	30	30
Leading Detector (ft)	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0
Trailing Speed (mph)	15	15	15	15	15	15	15
Lane Util. Factor	1.00	1.00	0.91	0.91	0.97	1.00	1.00
Peak Hour Factor	0.950	0.909	0.850	0.950	0.950	0.850	0.950
Satd. Flow (prot)	1752	1845	3052	1427	3400	1568	1568
Satd. Flow (perm)	1752	1845	3052	1427	3400	1568	1568
Satd. Flow (RTOR)	340	340	878	106	106	106	106
Link Satd (mch)	35	35	30	30	30	30	30
Link Satd (veh)	32	32	25	25	25	25	25
Travel Time (s)	32.0	10.3	8.4	8.4	8.4	8.4	8.4
Wait Time (veh)	110	200	125	160	110	110	110
Contnl. Peds. (#/hr)	0	0	0	0	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Green Time (s)	109	109	109	109	109	109	109
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%
Bus Blockade (ft)	0	0	0	0	0	0	0
Planning (#/hr)	0	0	0	0	0	0	0
Mid-Block Traffic (%)	0%	0%	0%	0%	0%	0%	0%
Lane Group Flow (vph)	113	412	653	878	1742	113	113
Protected Phases	5	2	6	4	4	4	4
Permitted Phases	5	2	6	4	4	4	4
Detector Phases	5	2	6	4	4	4	4
Minimum Split (s)	12.0	20.0	20.0	20.0	20.0	20.0	20.0
Minimum Split (%)	13.0%	40%	28%	0%	60%	60%	60%
Total Split (%)	12%	40%	28%	0%	60%	60%	60%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead-Lag Optimizes?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Headway (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Act Erlc Green (s)	10.0	42.8	29.8	110.0	61.2	61.2	61.2
Actuated G/O Ratio	0.09	0.99	0.27	1.00	0.55	0.55	0.55
v/c Ratio	0.71	0.57	0.61	0.62	0.92	0.92	0.92

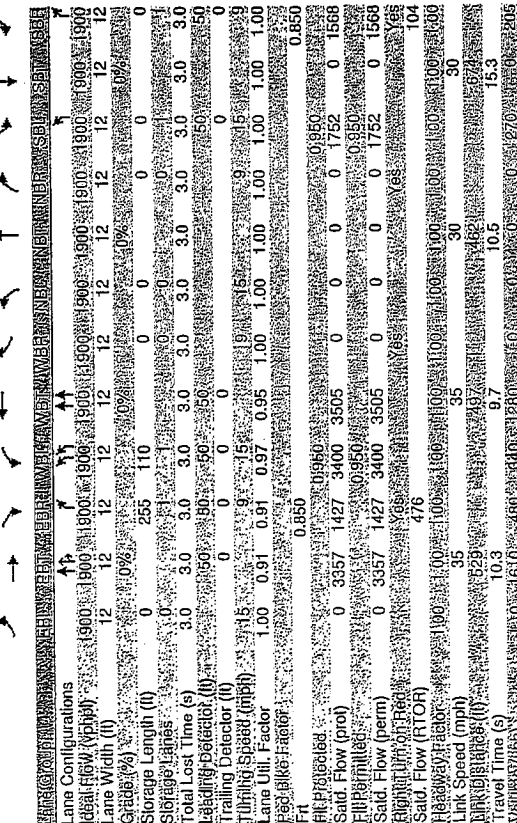


Approach Delay	495	267	198	0	222	0	0
Delay	58.5	27.6	16.7	1.9	24.2	2.4	2.4
Approach Delay	34.3	8.2	22.8	0	0	0	0
90th %ile Green (s)	9.0	40.0	27.0	62.0	62.0	62.0	62.0
70th %ile Green (s)	9.0	40.0	27.0	62.0	62.0	62.0	62.0
50th %ile Green (s)	9.0	40.0	27.0	62.0	62.0	62.0	62.0
30th %ile Green (s)	9.0	41.2	26.2	60.8	60.8	60.8	60.8
10th %ile Green (s)	9.0	47.8	34.8	54.2	54.2	54.2	54.2
Queue Length 50th (ft)	79	232	137	62	524	2	2
Internal Link Dist (ft)	1562	449	231	1	25%	1	25%
95th Up Block Time (%)	1	25%	1	25%	1	25%	1
50th Bay Block Time %	34%	34%	34%	34%	34%	34%	34%
Queueing Penalty (veh)	32	6	486	32	6	486	32
Area Type:	Other						
Accuated Cycle Length:	110						
Natural Cycle:	75						
Maximum v/c Ratio:	0.92						
Intersection Capacity Utilization:	67.2%						
CU Level of Service:	D						
Queue shown is maximum after two cycles.							



Approach Delay	7.0	12.5	36.6
90th %ile Green (s)	63.0	63.0	14.0
70th %ile Green (s)	63.0	63.0	14.0
50th %ile Green (s)	63.0	63.0	14.0
30th %ile Green (s)	64.0	64.0	14.0
10th %ile Green (s)	68.5	68.5	14.0
Queue Length 50th (ft)	194	0	137
Internal Link Dist (ft)	449	0	417
95th Up Block Time (%)	2%		
50th Bay Block Time (%)	4%	18%	
Queueing Penalty (veh)	26		34

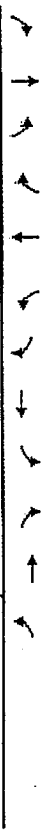
Area Type: Other
 Actuated Cycle Length: 110
 Natural Cycle: 90
 Maximum v/c Ratio: 0.84
 Intersection Capacity Utilization: 66.6%
 Queue shown is maximum after two cycles.
 Spills and Phases: 7: 88th St NE & SB On-Ramp



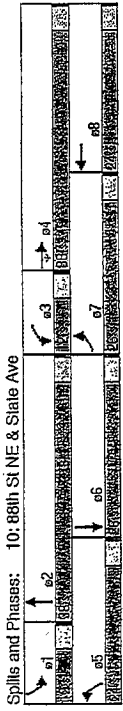
Storage Length (ft)	0	255	110	0	0	0	0
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Trailing Detector (ft)	0	0	0	0	0	0	0
Flashing Speed (mph)	15	9	15	15	15	15	15
Lane Util. Factor	1.00	0.91	0.91	0.97	0.95	1.00	1.00
Fit	0.850						0.850
Satd. Flow (prot)	0	3357	1427	3400	3505	0	0
Satd. Flow (norm)	0	3357	1427	3400	3505	0	0
Satd. Flow (RTOR)	1900	1000	1000	1000	1000	1000	1000
Link Speed (mph)	35			35		30	30
Travel Time (s)	10.3			9.7		10.5	15.3
Conf. Peds. (ft/hr)							
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%
Parking (ft/hr)							
Lane Group Flow (vph)	0	1660	495	351	1320	0	0
Protected Phases	2	1	6			4	
Detector Phases	2	5	1	6		4	
Minimum Spill (s)	24.0	24.0	12.0	24.0		24.0	24.0
Total Spill (%)	0%	61%	61%	16%	77%	0%	0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Act Effct Green (s)	65.3	65.3	15.0	83.3		20.7	20.7
v/c Ratio	0.83	0.48	0.76	0.50		0.84	0.56

Area Type: Other
 Actuated Cycle Length: 110
 Natural Cycle: 90
 Maximum v/c Ratio: 0.84
 Intersection Capacity Utilization: 66.6%
 Queue shown is maximum after two cycles.
 Spills and Phases: 7: 88th St NE & SB On-Ramp





Lane Configurations	12	12	12	12	14	12	14	12	12	12
Peak Flow (vph)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	14	12	14	12	12	12
Grade (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Storage Length (ft)	110	0	0	0	0	0	0	0	0	0
Storage Lanes	1	0	0	0	0	0	0	0	0	0
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	30	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15	15	15	15	15	15	15	15	15	15
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	0.95	0.91	0.95	1.00	1.00
Peak v/c Ratio	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Flt. Protected	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Satd. Flow (prot)	1752	3505	0	0	3344	0	1776	1450	1569	0
Flt. Protected	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Satd. Flow (perm)	129	3505	0	0	3344	0	1776	1450	1569	0
Flt. Protected	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Satd. Flow (RTOR)	80	32	32	32	32	32	32	32	32	32
Headway (ft)	100	100	100	100	100	100	100	100	100	100
Link Speed (mph)	35	35	35	35	35	35	35	35	35	35
Link Delay (s)	9.7	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Travel Time (s)	27.8	81.0	81.0	81.0	81.0	81.0	81.0	81.0	81.0	81.0
Confl. Peds. (#/hr)	0	0	0	0	0	0	0	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)	0	0	0	0	0	0	0	0	0	0
Min. Back Traffic (ft)	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	278	1660	0	0	1680	0	448	458	434	0
Turning Type	RTOR	RTOR	RTOR	RTOR	RTOR	RTOR	RTOR	RTOR	RTOR	RTOR
Protected Phases	5	2	6	6	8	8	8	8	8	8
Detector Phases	5	2	6	6	8	8	8	8	8	8
Minimum Initial (s)	80	80	80	80	80	80	80	80	80	80
Minimum Split (s)	12.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	15.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0
Total Split (%)	15%	66%	0%	0%	52%	0%	34%	34%	34%	0%
Yellow Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Head Mode	None	None	None	None	None	None	None	None	None	None
Act Elct Green (s)	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0
Actuated g/c Ratio	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
v/c Ratio	1.01	0.74	1.00	0.82	0.97	0.85	0.82	0.97	0.85	0.85



APPENDIX E

Freeway Level of Service Calculation Sheets (Highway Capacity Software)

Ramp Level of Service

Phone:
E-mail:

Fax:

Diverge Analysis

Analyst: Michael Horntvedt
 Agency/Co.: PMX
 Date performed: 4/21/2003
 Analysis time period: PM Peak
 Freeway/Dir of Travel: NB I-5
 Junction: 88th Street NB Off Ramp
 Jurisdiction: WSDOT
 Analysis Year: 2002
 Description: 2002 Existing Conditions

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	5550	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1225	vph
Length of first accel/decel lane	1200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5550	1225		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	1416	312		v
Trucks and buses	3	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00	%	0.00	%
Length	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5748	1269	pcph

Estimation of V12 Diverge Areas

L = (Equation 25-8 or 25-9)
 EQ
 P = 0.558 Using Equation 5
 FD
 $v_{12} = v_R + (v_F - v_R) P = 3768$ pc/h
 12 R F R FD

Capacity Checks

	Actual	Maximum	LOS F?
$v_{12} = v_{Fi}$	5748	7200	No
v_{12}	3768	4400	No
$v_{FO} = v_F - v_R$	4479	7200	No
v_R	1269	2000	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_{12} - 0.009 L_D = 25.9$ pc/mi/ln
 Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D = 0.542	
Space mean speed in ramp influence area,	S _R = 54.8	mph
Space mean speed in outer lanes,	S ₀ = 73.0	mph
Space mean speed for all vehicles,	S = 60.0	mph

Phone:
E-mail:

Fax:

Merge Analysis

Analyst: Michael Horntvedt
 Agency/Co.: Parametrix
 Date performed: 4/21/2003
 Analysis time period: PM Peak
 Freeway/Dir of Travel: NB I-5
 Junction: 88th Street NB On Ramp
 Jurisdiction: WSDOT
 Analysis Year: 2002
 Description: 2002 Existing

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4325	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	410	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4325	410		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	1103	105		v
Trucks and buses	3	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4479	425	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
 EQ
 P = 0.591 Using Equation 1
 FM
 $v_{12} = v_F (P_{FM}) = 2649 \text{ pc/h}$

Capacity Checks

	Actual	(Maximum	LOS F?
v _{FO}	4904	7200	No
v _{R12}	3074	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 26.1 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M = 0.370	
Space mean speed in ramp influence area,	S _R = 59.6	mph
Space mean speed in outer lanes,	S ₀ = 65.2	mph
Space mean speed for all vehicles,	S = 61.6	mph

Phone:
E-mail:

Fax:

Diverge Analysis

Analyst: SR 5, 128th StMichael Horntved
 Agency/Co.: PMX
 Date performed: 4/21/2003
 Analysis time period: PM Peak
 Freeway/Dir of Travel: NB I-5
 Junction: 116th Street NB Off Ramp
 Jurisdiction: WSDOT
 Analysis Year: 2002
 Description: 2002 Existing

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4735	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1100	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4735	1100		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	1208	281		v
Trucks and buses	3	5		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00	%	0.00	%
Length	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.976	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4904	1151	pcph

Estimation of V12 Diverge Areas

L = (Equation 25-8 or 25-9)
 EQ
 P = 0.584 Using Equation 5
 FD
 $v_{12} = v_R + (v_F - v_R) P = 3344$ pc/h
 12 R F R FD

Capacity Checks

	Actual	Maximum	LOS F?
$v_{12} = v_{Fi}$	4904	7200	No
v_{12}	3344	4400	No
$v_{FO} = v_F - v_R$	3753	7200	No
v_R	1151	2000	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_{12} - 0.009 L_D = 28.5$ pc/mi/ln
 R 12 D
 Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D = 0.532	
Space mean speed in ramp influence area,	S = 55.1	mph
Space mean speed in outer lanes,	S = 74.6	mph
Space mean speed for all vehicles,	S = 60.1	mph

Phone: . Fax:
E-mail:

Merge Analysis

Analyst: Michael Horntvedt
Agency/Co.: Parametrix
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 116th Street NB On Ramp
Jurisdiction: WSDOT
Analysis Year: 2002
Description: 2002 Existing

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3635	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	350	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3635	350		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	927	89		v
Trucks and buses	3	7		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.966	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3765	370	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
 EQ
 P = 0.591 Using Equation 1
 FM
 $v_{12} = v_F (P_{FM}) = 2227 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
v _{FO}	4135	7200	No
v _{R12}	2597	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 22.4 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M = 0.338	
Space mean speed in ramp influence area,	S _R = 60.5	mph
Space mean speed in outer lanes,	S ₀ = 66.3	mph
Space mean speed for all vehicles,	S = 62.5	mph

Michael Horntvedt
Parametrix

Phone:
E-mail:

Fax:

Diverge Analysis

Analyst: Michael Horntvedt
Agency/Co.: PMX
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: SB I-5
Junction: 116th Street SB Off Ramp
Jurisdiction: WSDOT
Analysis Year: 2002
Description: 2002 Existing

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2885	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	300	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2885	300		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	736	77		v
Trucks and buses	.3	24		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00	%	0.00	%
Length	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.893	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2988	343	pcph

Estimation of V12 Diverge Areas

L = (Equation 25-8 or 25-9)
 EQ
 P = 0.670 Using Equation 5
 FD
 $v_{12} = v_R + (v_F - v_R) P = 2114$ pc/h
 12 R F R FD

Capacity Checks

	Actual	Maximum	LOS F?
$v_{12} = v_{12}$	2988	7200	No
v_{12}	2114	4400	No
$v_{12} = v_F - v_R$	2645	7200	No
v_R	343	2000	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_{12} - 0.009 L_D = 17.9$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D = 0.459	
Space mean speed in ramp influence area,	S _R = 57.2	mph
Space mean speed in outer lanes,	S ₀ = 76.8	mph
Space mean speed for all vehicles,	S = 61.8	mph

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Merge Analysis

Analyst: Michael Horntvedt
Agency/Co.: Parametrix
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: SB I-5
Junction: 116th Street SB On Ramp
Jurisdiction: WSDOT
Analysis Year: 2002
Description: 2002 Existing

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2585	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	760	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2585	760		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	659	194		v
Trucks and buses	3	8		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.962	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2677	807	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
 EQ
 P = 0.591 Using Equation 1
 FM
 $v_{12} = v_{F} (P_{FM}) = 1583 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
v FO	3484	7200	No
v R12	2390	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 20.6 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M = 0.329	
Space mean speed in ramp influence area,	S _R = 60.8	mph
Space mean speed in outer lanes,	S ₀ = 67.9	mph
Space mean speed for all vehicles,	S = 62.9	mph

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Diverge Analysis

Analyst: Michael Horntvedt
 Agency/Co.: PMX
 Date performed: 4/21/2003
 Analysis time period: PM Peak
 Freeway/Dir of Travel: SB I-5
 Junction: 88th Street SB Off Ramp
 Jurisdiction: WSDOT
 Analysis Year: 2002
 Description: 2002 Existing

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3345	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	440	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion topc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3345	440		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	853	112		v
Trucks and buses	3	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00	%	0.00	%
Length	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3464	456	pcph

Estimation of V12 Diverge Areas

L = (Equation 25-8 or 25-9)
 EQ
 P = 0.652 Using Equation 5
 FD
 $v_{12} = v_R + (v_F - v_R) P = 2418$ pc/h
 12 R F R FD

Capacity Checks

	Actual	Maximum	LOS F?
$v_{12} = v_{Fi}$	3464	7200	No
v_{12}	2418	4400	No
$v_{FO} = v_F - v_R$	3008	7200	No
v_R	456	2000	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_{12} - 0.009 L_D = 20.5$ pc/mi/ln
 Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D = 0.469	
Space mean speed in ramp influence area,	S = 56.9	mph
Space mean speed in outer lanes,	S = 76.6	mph
Space mean speed for all vehicles,	S = 61.7	mph

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Merge Analysis

Analyst: Michael Horntvedt
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Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: SB I-5
Junction: 88th Street SB On Ramp
Jurisdiction: WSDOT
Analysis Year: 2002
Description: 2002 Existing

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	2905	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	750	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2905	750		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	741	191		v
Trucks and buses	3	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3009	777	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
 EQ
 P = 0.591 Using Equation 1
 FM
 $v_{12} = v_{F} (P) = 1780 \text{ pc/h}$
 12 F FM

Capacity Checks

	Actual	Maximum	LOS F?
v FO	3786	7200	No
v R12	2557	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 21.9 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M = 0.336	
Space mean speed in ramp influence area,	S _R = 60.6	mph
Space mean speed in outer lanes,	S ₀ = 67.4	mph
Space mean speed for all vehicles,	S = 62.6	mph

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Diverge Analysis

Analyst: Michael Horntvedt
Agency/Co.: PMX
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 88th Street NB Off Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 No-Action

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	7110	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1285	vph
Length of first accel/decel lane	1200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	7110	1285		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	1814	328		v
Trucks and buses	3	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00	%	0.00	%
Length	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	7364	1331	pcph

Estimation of V12 Diverge Areas

$$L = \text{EQ} \quad (\text{Equation 25-8 or 25-9})$$

$$P = 0.515 \quad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R) P = 4436 \text{ pc/h}$$

Capacity Checks

	Actual	Maximum	LOS F?
$v_{12} = v_F$	7364	7200	Yes
v_{12}	4436	4400	Yes
$v_{FO} = v_F - v_R$	6033	7200	No
v_R	1331	2000	No

Level of Service Determination (if not F)

$$\text{Density, } D = 4.252 + 0.0086 v_{12} - 0.009 L_D = 31.6 \text{ pc/mi/ln}$$

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	$D = 0.548$	
Space mean speed in ramp influence area,	$S_R = 54.7$	mph
Space mean speed in outer lanes,	$S_0 = 69.3$	mph
Space mean speed for all vehicles,	$S = 59.7$	mph

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Merge Analysis

Analyst: Michael Horntvedt
Agency/Co.: Parametrix
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 88th Street NB On Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 No-Build

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	5825	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	745	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp
Volume, V (vph)	5825	745	vph
Peak-hour factor, PHF	0.98	0.98	
Peak 15-min volume, v15	1486	190	v
Trucks and buses	3	3	%
Recreational vehicles	0	0	%
Terrain type:	Level	Level	
Grade		%	%
Length		mi	mi
Trucks and buses PCE, ET	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	6033	772	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
 EQ
 P = 0.591 Using Equation 1
 FM
 $v_{12} = v_{F} (P_{FM}) = 3569 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
v FO	6805	7200	No
v R12	4341	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 35.8 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence E

Speed Estimation

Intermediate speed variable,	M = 0.585	
Space mean speed in ramp influence area,	S _R = 53.6	mph
Space mean speed in outer lanes,	S ₀ = 62.5	mph
Space mean speed for all vehicles,	S = 56.5	mph

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Diverge Analysis

Analyst: Michael Horntved
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Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 116th Street NB Off Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 No-Action

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	6570	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1400	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	6570	1400		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	1676	357		v
Trucks and buses	3	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00	%	0.00	%
Length	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	1.000	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	6805	1429	pcph

Estimation of V12 Diverge Areas

L = (Equation 25-8 or 25-9)
 EQ
 P = 0.524 Using Equation 5
 FD
 $v_{12} = v_R + (v_F - v_R) P = 4247$ pc/h
 FD

Capacity Checks

	Actual	Maximum	LOS F?
$v_{12} = v_F$	6805	7200	No
v_{12}	4247	4400	No
$v_{FO} = v_F - v_R$	5376	7200	No
v_R	1429	2000	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 \frac{v_{12}}{R} - 0.009 \frac{L}{D} = 36.3$ pc/mi/ln
 Level of service for ramp-freeway junction areas of influence E

Speed Estimation

Intermediate speed variable,	D = 0.557	
Space mean speed in ramp influence area,	S = 54.4	mph
Space mean speed in outer lanes,	S = 70.7	mph
Space mean speed for all vehicles,	S = 59.6	mph

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Merge Analysis

Analyst: Michael Horntvedt
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Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 116th Street NB On Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 No-Build

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	5170	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	710	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5170	710		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	1319	181		v
Trucks and buses	2	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade			%	%
Length			mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.990	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5328	739	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
 EQ
 P = 0.591 Using Equation 1
 FM
 $v_{12} = v_{F} (P_{FM}) = 3152 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
v FO	6067	7200	No
v R12	3891	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 32.3 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	M = 0.477	
Space mean speed in ramp influence area,	S _R = 56.6	mph
Space mean speed in outer lanes,	S ₀ = 64.0	mph
Space mean speed for all vehicles,	S = 59.1	mph

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Diverge Analysis

Analyst: Michael Horntvedt
Agency/Co.: PMX
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: SB I-5
Junction: 116th Street SB Off Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 No-Action

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4405	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	590	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4405	590		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	1124	151		v
Trucks and buses	2	9		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00	%	0.00	%
Length	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.990	0.957	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4540	629	pcph

Estimation of V12 Diverge Areas

$$L = \frac{EQ}{FD} \quad (\text{Equation 25-8 or 25-9})$$

$$P = 0.618 \quad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R) P = 3044 \quad \text{pc/h}$$

Capacity Checks

	Actual	Maximum	LOS F?
$v_{12} = v_F$	4540	7200	No
v_{12}	3044	4400	No
$v_{FO} = v_F - v_R$	3911	7200	No
v_R	629	2000	No

Level of Service Determination (if not F)

$$\text{Density, } D = 4.252 + 0.0086 v_{12} - 0.009 L = 25.9 \quad \text{pc/mi/ln}$$

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D = 0.485	
Space mean speed in ramp influence area,	S _R = 56.4	mph
Space mean speed in outer lanes,	S ₀ = 74.9	mph
Space mean speed for all vehicles,	S = 61.4	mph

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Merge Analysis

Analyst: Michael Horntvedt
 Agency/Co.: Parametrix
 Date performed: 4/21/2003
 Analysis time period: PM Peak
 Freeway/Dir of Travel: SB I-5
 Junction: 116th Street SB On Ramp
 Jurisdiction: WSDOT
 Analysis Year: 2030
 Description: 2030 No-Build

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3815	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1010	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3815	1010		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	973	258		v
Trucks and buses	2	6		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.990	0.971	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3932	1062	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
 EQ
 P = 0.591 Using Equation 1
 FM
 $v_{12} = v_{F, FM} = 2326 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
v	4994	7200	No
FO			
v	3388	4600	No
R12			

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 28.3 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	M = 0.401	
	S	
Space mean speed in ramp influence area,	S = 58.8	mph
	R	
Space mean speed in outer lanes,	S = 66.0	mph
	O	
Space mean speed for all vehicles,	S = 60.9	mph

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Diverge Analysis

Analyst: Michael Horntvedt
Agency/Co.: PMX
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: SB I-5
Junction: 88th Street SB Off Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 No-Action

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4825	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	410	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4825	410		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	1231	105		v
Trucks and buses	3	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00	%	0.00	%
Length	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4997	425	pcph

Estimation of V12 Diverge Areas

L = (Equation 25-8 or 25-9)
 EQ
 P = 0.616 Using Equation 5
 FD
 $v_{12} = v_R + (v_F - v_R) P_{FD} = 3239 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
$v_{12} = v_{Fi}$	4997	7200	No
v_{12}	3239	4400	No
$v_{FO} = v_F - v_R$	4572	7200	No
v_R	425	2000	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_{12} - 0.009 L_D = 27.6 \text{ pc/mi/ln}$

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D = 0.466	
Space mean speed in ramp influence area,	S _R = 56.9	mph
Space mean speed in outer lanes,	S ₀ = 73.8	mph
Space mean speed for all vehicles,	S = 61.9	mph

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Merge Analysis

Analyst: Michael Horntvedt
Agency/Co.: Parametrix
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: SB I-5
Junction: 88th Street SB On Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 No-Build

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4415	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	830	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion topc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp
Volume, V (vph)	4415	830	vph
Peak-hour factor, PHF	0.98	0.98	
Peak 15-min volume, v15	1126	212	v
Trucks and buses	3	3	%
Recreational vehicles	0	0	%
Terrain type:	Level	Level	
Grade		%	%
Length		mi	mi
Trucks and buses PCE, ET	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4573	860	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
 EQ
 P = 0.591 Using Equation 1
 FM
 $v_{12} = v_F (P_{FM}) = 2705 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
v FO	5433	7200	No
v R12	3565	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 29.8 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	M = 0.424	
Space mean speed in ramp influence area,	S _R = 58.1	mph
Space mean speed in outer lanes,	S ₀ = 65.1	mph
Space mean speed for all vehicles,	S = 60.3	mph

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Diverge Analysis

Analyst: Michael Horntvedt
Agency/Co.: PMX
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 88th Street NB Off Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 Build

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	7130	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1300	vph
Length of first accel/decel lane	1200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	7130	1300		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	1819	332		v
Trucks and buses	3	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00	%	0.00	%
Length	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	7385	1346	pcph

Estimation of V12 Diverge Areas

L = (Equation 25-8 or 25-9)
 EQ
 P = 0.513 Using Equation 5
 FD
 $v_{12} = v_R + (v_F - v_R) P_{FD} = 4447 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	7385	7200	Yes
v_{12}	4447	4400	Yes
$v_{FO} = v_F - v_R$	6039	7200	No
v_R	1346	2000	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_{12} - 0.009 L_D = 31.7 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	D = 0.549	
Space mean speed in ramp influence area,	S = 54.6	mph
Space mean speed in outer lanes,	S = 69.2	mph
Space mean speed for all vehicles,	S = 59.6	mph

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Merge Analysis

Analyst: Michael Horntvedt
Agency/Co.: Parametrix
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 88th Street NB On Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 Build

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	5830	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	770	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp
Volume, V (vph)	5830	770	vph
Peak-hour factor, PHF	0.98	0.98	
Peak 15-min volume, v15	1487	196	v
Trucks and buses	3	3	%
Recreational vehicles	0	0	%
Terrain type:	Level	Level	
Grade		%	%
Length		mi	mi
Trucks and buses PCE, ET	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	6038	797	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
EQ
P = 0.591 Using Equation 1
FM
 $v_{12} = v_F (P_{FM}) = 3571 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
v _{FO}	6835	7200	No
v _{R12}	4368	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 36.0 \text{ pc/mi/ln}$
Level of service for ramp-freeway junction areas of influence E

Speed Estimation

Intermediate speed variable,	M = 0.594	
Space mean speed in ramp influence area,	S _R = 53.4	mph
Space mean speed in outer lanes,	S ₀ = 62.5	mph
Space mean speed for all vehicles,	S = 56.3	mph

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Diverge Analysis

Analyst: Michael Horntvedt
Agency/Co.: PMX
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 116th Street NB Off Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 Build

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	6600	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1445	vph
Length of first accel/decel lane	800	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp
Volume, V (vph)	6600	1445	vph
Peak-hour factor, PHF	0.98	0.98	
Peak 15-min volume, v15	1684	369	v
Trucks and buses	2	4	%
Recreational vehicles	0	0	%
Terrain type:	Level	Level	
Grade	0.00 %	0.00 %	%
Length	0.00 mi	0.00 mi	mi
Trucks and buses PCE, ET	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	

Heavy vehicle adjustment, fHV	0.990	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	6802	1504	pcph

Estimation of V12 Diverge Areas

L = (Equation 25-8 or 25-9)
 EQ
 P = 0.521 Using Equation 5
 FD
 $v_{12} = v_R + (v_F - v_R) P_{FD} = 4263 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
$v_{12} = v_{Fi}$	6802	7200	No
v_{12}	4263	4400	No
$v_{FO} = v_F - v_R$	5298	7200	No
v_R	1504	2000	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_{12} - 0.009 L_D = 33.7 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D = 0.563	
Space mean speed in ramp influence area,	S _R = 54.2	mph
Space mean speed in outer lanes,	S ₀ = 70.8	mph
Space mean speed for all vehicles,	S = 59.4	mph

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Merge Analysis

Analyst: Michael Horntvedt
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Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 116th Street NB On Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 Build

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	5155	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	750	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp
Volume, V (vph)	5155	750	vph
Peak-hour factor, PHF	0.98	0.98	
Peak 15-min volume, v15	1315	191	v
Trucks and buses	2	4	%
Recreational vehicles	0	0	%
Terrain type:	Level	Level	
Grade		%	%
Length		mi	mi
Trucks and buses PCE, ET	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	

Heavy vehicle adjustment, fHV	0.990	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5313	781	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
 EQ
 P = 0.591 Using Equation 1
 FM
 $v_{12} = v_{F} (P_{FM}) = 3143 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
v _{FO}	6094	7200	No
v _{R12}	3924	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 32.6 \text{ pc/mi/ln}$

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	M = 0.483	
Space mean speed in ramp influence area,	S _R = 56.5	mph
Space mean speed in outer lanes,	S ₀ = 64.0	mph
Space mean speed for all vehicles,	S = 58.9	mph

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Diverge Analysis

Analyst: Michael Horntvedt
Agency/Co.: PMX
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 116th Street SB Off Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 Build

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4465	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	605	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4465	605		vph
Peak-hour factor, PHF	0.98	0.98		
Peak 15-min volume, v15	1139	154		v
Trucks and buses	2	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00	%	0.00	%
Length	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.990	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4602	630	pcph

Estimation of V12 Diverge Areas

$$L = \text{(Equation 25-8 or 25-9)}$$

$$EQ$$

$$P = 0.616 \quad \text{Using Equation 5}$$

$$FD$$

$$v_{12} = v_R + (v_F - v_R) P = 3077 \quad \text{pc/h}$$

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4602	7200	No
v_{12}	3077	4400	No
$v_{FO} = v_F - v_R$	3972	7200	No
v_R	630	2000	No

Level of Service Determination (if not F)

$$\text{Density, } D = 4.252 + 0.0086 v_{12} - 0.009 L = 26.2 \quad \text{pc/mi/ln}$$

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	$D = 0.485$	
Space mean speed in ramp influence area,	$S_R = 56.4$	mph
Space mean speed in outer lanes,	$S_0 = 74.7$	mph
Space mean speed for all vehicles,	$S = 61.4$	mph

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Merge Analysis

Analyst: Michael Horntvedt
 Agency/Co.: Parametrix
 Date performed: 4/21/2003
 Analysis time period: PM Peak
 Freeway/Dir of Travel: SB I-5
 Junction: 116th Street SB On Ramp
 Jurisdiction: WSDOT
 Analysis Year: 2030
 Description: 2030 Build

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3860	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1020	vph
Length of first accel/decel lane	800	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp
Volume, V (vph)	3860	1020	vph
Peak-hour factor, PHF	0.98	0.98	
Peak 15-min volume, v15	985	260	v
Trucks and buses	2	6	%
Recreational vehicles	0	0	%
Terrain type:	Level	Level	
Grade		%	%
Length		mi	mi
Trucks and buses PCE, ET	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	

Heavy vehicle adjustment, fHV	0.990	0.971	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3978	1072	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)
 EQ
 P = 0.600 Using Equation 1
 FM
 $v_{12} = v_F (P_{FM}) = 2386 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
v _{FO}	5050	7200	No
v _{R12}	3458	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 26.9 \text{ pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M = 0.389	
Space mean speed in ramp influence area,	S _R = 59.1	mph
Space mean speed in outer lanes,	S ₀ = 66.1	mph
Space mean speed for all vehicles,	S = 61.1	mph

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Diverge Analysis

Analyst: Michael Horntvedt
Agency/Co.: PMX
Date performed: 4/21/2003
Analysis time period: PM Peak
Freeway/Dir of Travel: NB I-5
Junction: 88th Street SB Off Ramp
Jurisdiction: WSDOT
Analysis Year: 2030
Description: 2030 Build

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4880	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	475	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp
Volume, V (vph)	4880	475	vph
Peak-hour factor, PHF	0.98	0.98	
Peak 15-min volume, v15	1245	121	v
Trucks and buses	3	3	%
Recreational vehicles	0	0	%
Terrain type:	Level	Level	
Grade	0.00 %	0.00 %	%
Length	0.00 mi	0.00 mi	mi
Trucks and buses PCE, ET	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5054	492	pcph

Estimation of V12 Diverge Areas

L = (Equation 25-8 or 25-9)
 EQ
 P = 0.611 Using Equation 5
 FD
 $v_{12} = v_R + (v_F - v_R) P = 3279 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5054	7200	No
v_{12}	3279	4400	No
$v_{FO} = v_F - v_R$	4562	7200	No
v_R	492	2000	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_{12} - 0.009 L_D = 28.0 - \text{pc/mi/ln}$
 Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D = 0.472	
Space mean speed in ramp influence area,	S _R = 56.8	mph
Space mean speed in outer lanes,	S _O = 73.8	mph
Space mean speed for all vehicles,	S ₀ = 61.8	mph

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Merge Analysis

Analyst: Michael Horntvedt
 Agency/Co.: Parametrix
 Date performed: 4/21/2003
 Analysis time period: PM Peak
 Freeway/Dir of Travel: SB I-5
 Junction: 88th Street SB On Ramp
 Jurisdiction: WSDOT
 Analysis Year: 2030
 Description: 2030 Build

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4405	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	820	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp
Volume, V (vph)	4405	820	vph
Peak-hour factor, PHF	0.98	0.98	
Peak 15-min volume, v15	1124	209	v
Trucks and buses	3	3	%
Recreational vehicles	0	0	%
Terrain type:	Level	Level	
Grade		%	%
Length		mi	mi
Trucks and buses PCE, ET	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	

Heavy vehicle adjustment, fHV	0.985	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4562	849	pcph

Estimation of V12 Merge Areas

L = (Equation 25-2 or 25-3)

EQ

P = 0.591 Using Equation 1

FM

$v_{12} = v_F (P_{FM}) = 2698 \text{ pc/h}$

Capacity Checks

	Actual	Maximum	LOS F?
v _{FO}	5411	7200	No
v _{R12}	3547	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 29.6 \text{ pc/mi/ln}$

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	M = 0.421	
	S	
Space mean speed in ramp influence area,	S = 58.2	mph
	R	
Space mean speed in outer lanes,	S = 65.1	mph
	0	
Space mean speed for all vehicles,	S = 60.4	mph

Freeway Level of Service

Phone: _____ Fax: _____
 E-mail: _____

Operational Analysis

Analyst: Tresia Bass
 Agency or Company: Parametrix
 Date Performed: 10/15/2004
 Analysis Time Period: PM Peak Hour
 Freeway/Direction: Southbound I-5
 From/To: North of 116th Street
 Jurisdiction:
 Analysis Year:
 Description: Year 2002 Existing Conditions

Flow Inputs and Adjustments

Volume, V	2885	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	801	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1085	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1085	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	15.5	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
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Operational Analysis

Analyst: Tresia Bass
 Agency or Company: Parametrix
 Date Performed: 10/15/2004
 Analysis Time Period: PM Peak Hour
 Freeway/Direction: Southbound I-5
 From/To: at 116th Street
 Jurisdiction:
 Analysis Year:
 Description: Year 2002 Existing Conditions

Flow Inputs and Adjustments

Volume, V	2585	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	718	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fhv	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	972	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	972	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	13.9	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

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Operational Analysis

Analyst: Tresia Bass
 Agency or Company: Parametrix
 Date Performed: 10/15/2004
 Analysis Time Period: PM Peak Hour
 Freeway/Direction: Southbound I-5
 From/To: Between 116th and 88th Street
 Jurisdiction:
 Analysis Year:
 Description: Year 2002 Existing Conditions

Flow Inputs and Adjustments

Volume, V	3345	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	929	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1257	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1257	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	18.0-	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

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Operational Analysis

Analyst: Tresa Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Southbound I-5
From/To: at 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2002 Existing Conditions

Flow Inputs and Adjustments

Volume, V	2905	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	807	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fhv	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1092	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, flw	0.0	mi/h
Lateral clearance adjustment, flc	0.0	mi/h
Interchange density adjustment, fid	0.0	mi/h
Number of lanes adjustment, fn	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	1092	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	15.6	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

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Operational Analysis

Analyst: Tresia Bass
 Agency or Company: Parametrix
 Date Performed: 10/15/2004
 Analysis Time Period: PM Peak Hour
 Freeway/Direction: Southbound I-5
 From/To: South of 88th Street
 Jurisdiction:
 Analysis Year:
 Description: Year 2002 Existing Conditions

Flow Inputs and Adjustments

Volume, V	3655	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1015	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1374	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1374	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	19.6	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
E-mail:

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Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: South of 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2002 Existing Conditions

Flow Inputs and Adjustments

Volume, V	5550	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1542	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	2086	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2086	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	63.0	mi/h
Number of lanes, N	3	
Density, D	33.1	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

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E-mail:

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Operational Analysis

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 Agency or Company: Parametrix
 Date Performed: 10/15/2004
 Analysis Time Period: PM Peak Hour
 Freeway/Direction: Northbound I-5
 From/To: at 88th Street
 Jurisdiction:
 Analysis Year:
 Description: Year 2002 Existing Conditions

Flow Inputs and Adjustments

Volume, V	4325	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1201	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1626	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1626	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.3	mi/h
Number of lanes, N	3	
Density, D	23.5	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

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Operational Analysis

Analyst: Tresa Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: Between 116th and 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2002 Existing Conditions

Flow Inputs and Adjustments

Volume, V	4735	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1315	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1780	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	1780	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	68.1	mi/h
Number of lanes, N	3	
Density, D	26.1	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

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Operational Analysis

Analyst: Tresia Bass
 Agency or Company: Parametrix
 Date Performed: 10/15/2004
 Analysis Time Period: PM Peak Hour
 Freeway/Direction: Northbound I-5
 From/To: at 116th Street
 Jurisdiction:
 Analysis Year:
 Description: Year 2002 Existing Conditions

Flow Inputs and Adjustments

Volume, V	3635	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1010	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1366	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, flw	0.0	mi/h
Lateral clearance adjustment, flc	0.0	mi/h
Interchange density adjustment, fid	0.0	mi/h
Number of lanes adjustment, fn	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1366	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	70.0	mi/h
Number of lanes, N	3	
Density, D	19.5	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

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Operational Analysis

Analyst: Tresa Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: North of 116th Street
Jurisdiction:
Analysis Year:
Description: Year 2002 Existing Conditions

Flow Inputs and Adjustments

Volume, V	3985	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1107	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fhv	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1498	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, flw	0.0	mi/h
Lateral clearance adjustment, flc	0.0	mi/h
Interchange density adjustment, fid	0.0	mi/h
Number of lanes adjustment, fn	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1498	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.8	mi/h
Number of lanes, N	3	
Density, D	21.5	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

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Operational Analysis

Analyst: Tresa Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Southbound I-5
From/To: North of 116th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 No Build

Flow Inputs and Adjustments

Volume, V	4405	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1224	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	1648	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1648	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.2	mi/h
Number of lanes, N	3	
Density, D	23.8	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

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E-mail:

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Operational Analysis

Analyst: Tresia Bass
 Agency or Company: Parametrix
 Date Performed: 10/15/2004
 Analysis Time Period: PM Peak Hour
 Freeway/Direction: Southbound I-5
 From/To: at 116th Street
 Jurisdiction:
 Analysis Year:
 Description: Year 2030 No Build

Flow Inputs and Adjustments

Volume, V	3815	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1060	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	1427	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1427	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.9	mi/h
Number of lanes, N	3	
Density, D	20.4	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

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Operational Analysis

Analyst: Tresia Bass
 Agency or Company: Parametrix
 Date Performed: 10/15/2004
 Analysis Time Period: PM Peak Hour
 Freeway/Direction: Southbound I-5
 From/To: Between 116th and 88th Street
 Jurisdiction:
 Analysis Year:
 Description: Year 2030 No Build

Flow Inputs and Adjustments

Volume, V	4825	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1340	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1814	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1814	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	67.7	mi/h
Number of lanes, N	3	
Density, D	26.8	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
E-mail:

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Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Southbound I-5
From/To: at 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 No Build

Flow Inputs and Adjustments

Volume, V	4415	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1226	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fhv	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1660	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, flw	0.0	mi/h
Lateral clearance adjustment, flc	0.0	mi/h
Interchange density adjustment, fid	0.0	mi/h
Number of lanes adjustment, fn	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	1660	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.1	mi/h
Number of lanes, N	3	
Density, D	24.0	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
E-mail:

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Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Southbound I-5
From/To: South of 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 No Build

Flow Inputs and Adjustments

Volume, V	5245	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1457	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fhv	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1972	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, flw	0.0	mi/h
Lateral clearance adjustment, flc	0.0	mi/h
Interchange density adjustment, fid	0.0	mi/h
Number of lanes adjustment, fn	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	1972	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	65.4	mi/h
Number of lanes, N	3	
Density, D	30.2	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
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Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: South of 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 No Build

Flow Inputs and Adjustments

Volume, V	7110	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1975	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	2673	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	2673	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	3	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
E-mail:

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Operational Analysis

Analyst: Tresia Bass
 Agency or Company: Parametrix
 Date Performed: 10/15/2004
 Analysis Time Period: PM Peak Hour
 Freeway/Direction: Northbound I-5
 From/To: at 88th Street
 Jurisdiction:
 Analysis Year:
 Description: Year 2030 No Build

Flow Inputs and Adjustments

Volume, V	5825	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1618	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	2190	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	2190	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	60.4	mi/h
Number of lanes, N	3	
Density, D	36.3	pc/mi/ln
Level of service, LOS	E	

Overall results are not computed when free-flow speed is less than 55 mph.

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E-mail:

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Operational Analysis

Analyst: Tresia Bass
 Agency or Company: Parametrix
 Date Performed: 10/15/2004
 Analysis Time Period: PM Peak Hour
 Freeway/Direction: Northbound I-5
 From/To: Between 116th and 88th Street
 Jurisdiction:
 Analysis Year:
 Description: Year 2030 No Build

Flow Inputs and Adjustments

Volume, V	6570	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1825	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fhv	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	2470	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	2470	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	3	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
E-mail:

Fax:

Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: at 116th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 No Build

Flow Inputs and Adjustments

Volume, V	5170	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1436	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	1934	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	1934	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	66.0	mi/h
Number of lanes, N	3	
Density, D	29.3	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

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E-mail:

Fax:

Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: North of 116th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 No Build

Flow Inputs and Adjustments

Volume, V	5880	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1633	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	2200	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	2200	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	60.1	mi/h
Number of lanes, N	3	
Density, D	36.6	pc/mi/ln
Level of service, LOS	E	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
E-mail:

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Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Southbound I-5
From/To: North of 116th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 Build

Flow Inputs and Adjustments

Volume, V	4465	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1240	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	1670	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1670	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.0	mi/h
Number of lanes, N	3	
Density, D	24.2	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
E-mail:

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Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Southbound I-5
From/To: at 116th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 Build

Flow Inputs and Adjustments

Volume, V	3860	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1072	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	1444	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	1444	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.9	mi/h
Number of lanes, N	3	
Density, D	20.7	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

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E-mail:

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Operational Analysis

Analyst: Tresa Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Southbound I-5
From/To: Between 116th and 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 Build

Flow Inputs and Adjustments

Volume, V	4880	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1356	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fhv	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1835	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, flw	0.0	mi/h
Lateral clearance adjustment, flc	0.0	mi/h
Interchange density adjustment, fid	0.0	mi/h
Number of lanes adjustment, fn	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1835	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	67.4	mi/h
Number of lanes, N	3	
Density, D	27.2	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
E-mail:

Fax:

Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Southbound I-5
From/To: at 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 Build

Flow Inputs and Adjustments

Volume, V	4405	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1224	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fhv	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1656	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, flw	0.0	mi/h
Lateral clearance adjustment, flc	0.0	mi/h
Interchange density adjustment, fid	0.0	mi/h
Number of lanes adjustment, fn	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	1656	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	69.1	mi/h
Number of lanes, N	3	
Density, D	24.0	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

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E-mail:

Fax:

Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Southbound I-5
From/To: South of 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 Build

Flow Inputs and Adjustments

Volume, V	5225	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1451	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1964	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	1964	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	65.5	mi/h
Number of lanes, N	3	
Density, D	30.0	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

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E-mail:

Fax:

Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: South of 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 Build

Flow Inputs and Adjustments

Volume, V	7130	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1981	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	2680	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	2680	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	3	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

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E-mail:

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Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: at 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 Build

Flow Inputs and Adjustments

Volume, V	5830	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1619	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	2192	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	2192	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	60.3	mi/h
Number of lanes, N	3	
Density, D	36.3	pc/mi/ln
Level of service, LOS	E	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
E-mail:

Fax:

Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: Between 116th and 88th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 Build

Flow Inputs and Adjustments

Volume, V	6600	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1833	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fhv	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	2469	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, flw	0.0	mi/h
Lateral clearance adjustment, flc	0.0	mi/h
Interchange density adjustment, fid	0.0	mi/h
Number of lanes adjustment, fn	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	2469	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	3	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
E-mail:

Fax:

Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: at 116th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 Build

Flow Inputs and Adjustments

Volume, V	5155	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1432	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	1928	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	1928	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	66.1	mi/h
Number of lanes, N	3	
Density, D	29.2	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

Phone:
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Fax:

Operational Analysis

Analyst: Tresia Bass
Agency or Company: Parametrix
Date Performed: 10/15/2004
Analysis Time Period: PM Peak Hour
Freeway/Direction: Northbound I-5
From/To: North of 116th Street
Jurisdiction:
Analysis Year:
Description: Year 2030 Build

Flow Inputs and Adjustments

Volume, V	5905	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1640	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fhv	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	2209	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	70.0	mi/h
Lane width adjustment, flw	0.0	mi/h
Lateral clearance adjustment, flc	0.0	mi/h
Interchange density adjustment, fid	0.0	mi/h
Number of lanes adjustment, fn	3.0	mi/h
Free-flow speed, FFS	70.0	mi/h

Urban Freeway

LOS and Performance Measures

Flow rate, vp	2209	pc/h/ln
Free-flow speed, FFS	70.0	mi/h
Average passenger-car speed, S	59.8	mi/h
Number of lanes, N	3	
Density, D	36.9	pc/mi/ln
Level of service, LOS	E	

Overall results are not computed when free-flow speed is less than 55 mph.