PB No. 13830B

Technical Memorandum

To: Bob Brannan

From: Jay Lyman

Date: March 3, 1999

Subject: ODOT No. 16962 – I-5 Trade Corridor Study
Existing Geometrics and Identified Deficiencies

OBJECTIVE

The purpose of this technical memorandum is to identify existing geometrics and any geometric deficiencies that exist along the Interstate 5 mainline and interchange ramps. The study area for this analysis extends from the I-84 interchange in the state of Oregon to the I-205 interchange in the state of Washington.

INTRODUCTION AND BACKGROUND

As part of the existing transportation conditions inventory for the I-5 Trade Corridor Study, data was collected for the I-5 mainline and all successive ramp terminals using the following sources of information:

Oregon Department of Transportation

- Video coverage of I-5 between the Marquam Bridge and the Columbia River Bridge.
- Design plans for the Delta Park-Marquam Bridge Section, May 1989.
- Design plans for the Interstate Bridge- I-405 Section, May 1998.
- Design plans for the Swift Interchange-Delta Park Interchange Section, March 1990.
- Design plans for the Jantzen Beach Interchange, October 1970.

Washington State Department of Transportation

- Video (SR View Program) coverage of I-5 between the Columbia River Bridge and I-205.
- State Highway Log Planning Report, 1998.
- Design plans for all interchanges and highway sections within the study area.

Characteristics specific to the highway's mainline and intersecting ramp terminals were compiled from the above data. This information is presented graphically in Figures 1, 2, and 3. Mainline information for the northbound and southbound directions was separated into individual sections

wherever a major change in roadway geometry occurs, such as the addition or elimination of a travel lane or a major change in shoulder width. Mainline and ramp terminal data is geographically tied to the highway in each figure. Information shown for the I-5 mainline includes the number of lanes and lane widths, the presence of auxiliary lanes (AUX) and high-occupancy-vehicle lanes (HOV) ~~lanes~~, inside and outside paved shoulder widths, and ramp terminal spacing (when auxiliary lanes are present). A range of paved shoulder widths are often shown in these figures, as the width of paved shoulders (both inside and outside) may vary somewhat along a section of highway. Ramp terminal spacings were measured along auxiliary lanes from the painted gore of an on-ramp to the painted gore of the next successive off-ramp.

Interchange information shown in the following figures includes the ramp type (straight, cloverleaf, or partial cloverleaf), the number of lanes exiting or entering the highway, total pavement width, general grade, and the presence of a ramp meter. The general grade along a ramp terminal is expressed as a percentage of the slope. A positive (+) grade indicates the ramp terminal is gaining in elevation in the direction of travel while a negative (-) grade indicates a loss of elevation. Some ramp terminals are shown to go through a transition from one grade to another as the ramp terminal exits from or merges into the highway.

ANALYSIS

Potential geometric deficiencies along the I-5 mainline and intersecting ramp terminals were assessed by comparing the geometric data depicted in Figures 1, 2, and 3 with the standards used by ODOT and WSDOT for highway design, and with the minimum requirements set forth by the American Association of State Highway and Transportation Officials (AASHTO) for urban freeways. Some preferred standards applied in the assessment include:

- 12-foot travel lanes along the mainline.
- 4-foot inside shoulders along a four-lane freeway.
- 10-foot inside shoulders along a freeway with 6 or more lanes.
- 10- to 12-foot outside shoulders along the mainline.
- A 2,000 foot weaving area where an on-ramp is followed by a freeway-to-freeway off-ramp connection.
- A general ramp terminal grade not exceeding +6% over an extended length.
- A minimum taper length of 800 feet for an on-ramp merging into the through traffic lane of a high speed freeway (no auxiliary lane).

Potential deficiencies were noted wherever existing highway geometrics were judged to not meet preferred standards.

As indicated in Figures 1, 2, and 3, several sections of I-5 currently do not meet preferred design standards. The following table highlights each of these areas including location, potential deficiencies, and any physical constraints that may be the cause of these deficiencies.

EXISTING GEOMETRIC DEFICIENCIES ALONG I-5

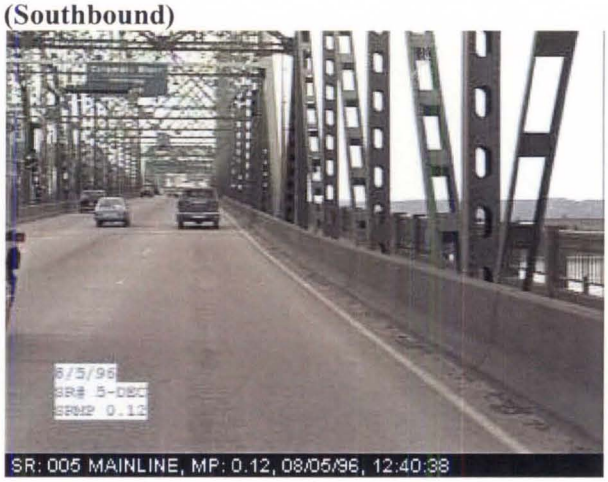
Location	Direction	Potential Deficiency(ies)	Constraint(s)
Weidler St. on-ramp to I-84 off-ramp (MP 301.90 to MP 302.14)	SB	– Insufficient ramp terminal spacing of 995 ft.. – Outside shoulder width of 2 feet.	– Short interchange spacing.
Between I-405 on/off-ramps (MP 302.95 to MP 303.18)	NB SB	– Inside and outside shoulder widths of 3 feet. – Outside shoulder width of 2 feet.	– Narrow bridge structure. – Narrow bridge structure.
Between Portland Blvd. on/off-ramps (MP 304.75 to MP 305.09)	Both	– Outside shoulder widths of only 1 foot.	– Portland Boulevard overpass (both directions). – HOV lane (northbound.
Portland Blvd. on-ramp to Lombard Ave. off-ramp (MP 305.09 to MP 305.27)	NB	– Inside shoulder width of 3 feet and outside shoulder width of 1 foot.	– HOV lane. – Pedestrian overpass.
Columbia Slough Bridge (MP 305.81 to MP 306.47)	NB	– Inside shoulder width of 2 feet and outside shoulder width of 0.5 feet.	– HOV Lane. – Narrow bridge structure.
Victory Blvd. on-ramp to Columbia Slough Bridge	SB	– Insufficient taper length for merging.	– Short distance between on-ramp and bridge structure.
Jantzen Beach/Hayden Island on-ramp to Columbia River Bridge (MP 307.95 to MP 307.98)	NB	– Insufficient taper length of 158 feet for merging with mainstream traffic lane.	– The proximity of the on-ramp relative to the Columbia River Bridge structure.
Columbia River Bridge (MP 308.38 to SR 0.28)	Both	– Inside and outside shoulder widths of 0- to 1-ft.	– Narrow bridge structure.
SR 14 Westbound on-ramp to Columbia River Bridge (SR 0.36 to SR 0.33)	SB	– Insufficient taper length of 211 feet for merging with mainstream traffic lane.	– The proximity of the on-ramp relative to the Columbia River Bridge structure.
Mill Plain Blvd. on-ramp to SR 14 off-ramp (SR 0.64 to SR 0.82)	SB	– Insufficient ramp terminal spacing of 666 ft..	– Short interchange spacing.
Salmon Creek Bridge (SR 6.30 to SR 6.38)	Both	– Outside shoulder widths of 2 feet.	– Narrow bridge structure.
I-205 Overpass (SR 7.49 to SR 7.54)	Both	– Outside shoulder widths of 4 feet.	– Narrow bridge structure.

Most of the deficiencies identified in the table above are substandard shoulder widths. These substandard widths are mostly due to the limited deck widths along bridge structures. Some examples include the Columbia River Bridge (inside and outside shoulder widths vary between zero and one foot), the Salmon Creek Bridge (outside shoulder widths of 2 feet), and the Interstate 205 overpass (outside shoulder widths of 4 feet). These examples are pictured below for both the northbound and southbound directions.

Examples Substandard Shoulders

Columbia River Bridge
(Northbound)

(Southbound)



Salmon Creek Bridge
(Northbound)

(Southbound)

Interstate 205 Overpass

(Northbound)

(Southbound)

Other factors contributed to the identification of substandard shoulder widths along I-5 such as restriping the highway in the northbound direction to include an HOV lane (provision of the HOV lane between the Going Street and Marine Drive interchanges reduced shoulder widths to as little as 2 feet on the inside shoulder and 0.5 feet on the outside shoulder); and the presence of pedestrian and vehicle overpasses where column supports for these structures are located immediately adjacent to the highway travel lanes (e.g. Interstate 405 and Portland Boulevard overpasses, and the pedestrian overpass north of Portland Boulevard).

Two areas have been noted along I-5 where spacing between ramp terminals is insufficient. The first location is in the state of Oregon along the southbound auxiliary lane located between the Weidler Street on-ramp and the I-84 off-ramp. The weaving area length was measured to be 995 feet. The second location (pictured below) is in the state of Washington along the southbound auxiliary lane located between the Mill Plain Boulevard on-ramp and the SR14 off-ramp. The weaving area length was measured to be 666 feet.

Insufficient Weaving Area In The Southbound Direction Between Mill Plain Boulevard On-Ramp and SR 14 Off-Ramp

(Mill Plain Boulevard On-Ramp)

(SR 14 Off-Ramp)

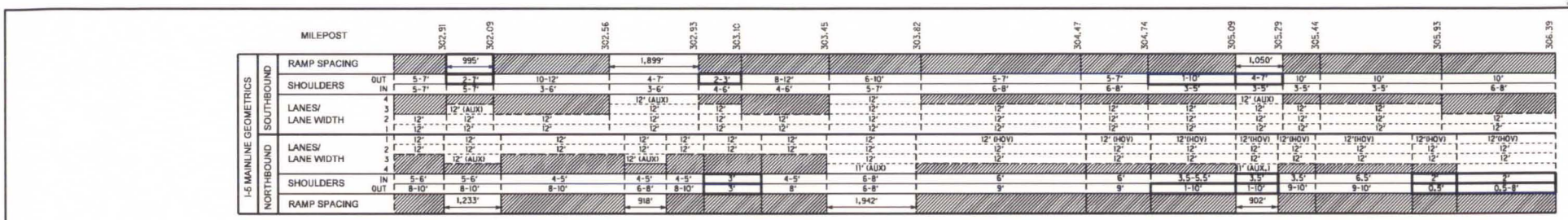
In both cases, the measured distances between ramp terminals do not meet the recommended minimum ramp terminal spacing of 2,000 feet for a freeway-to-freeway connection.

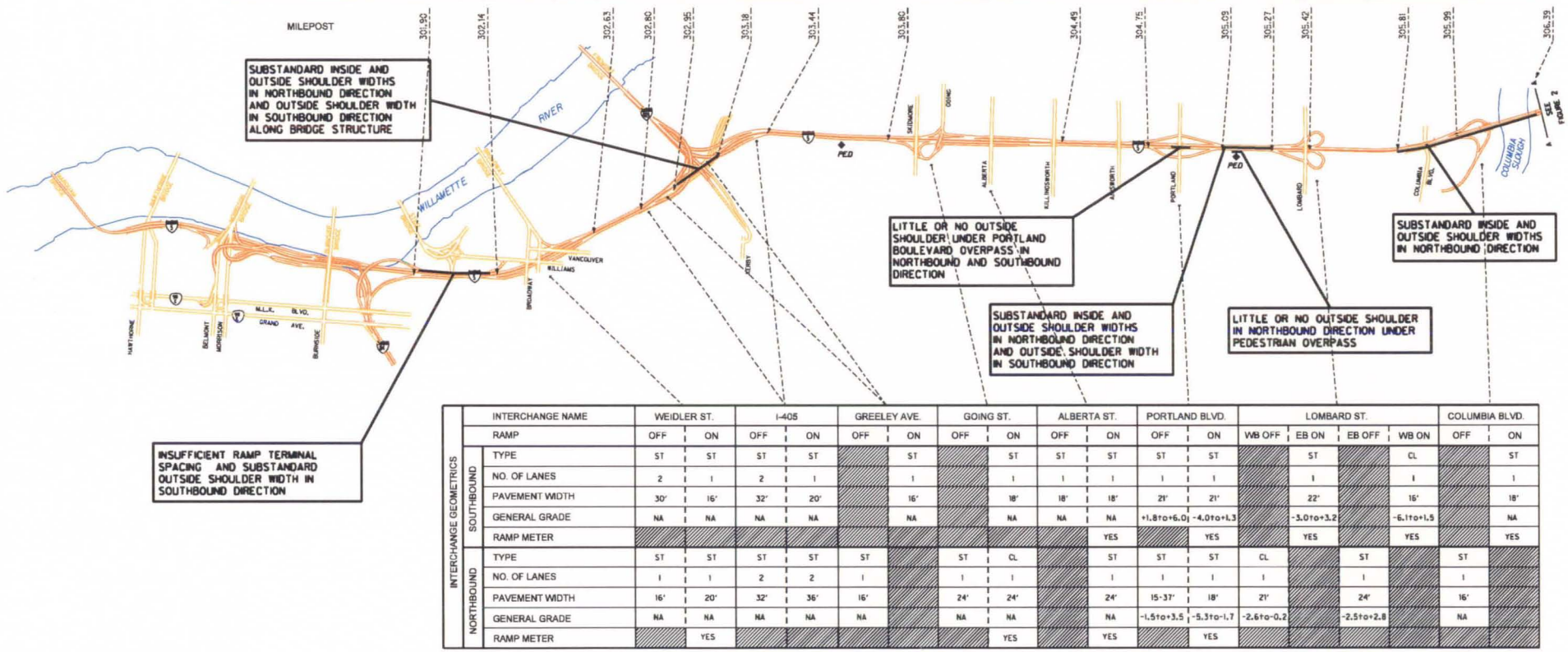
Three areas have been identified along I-5 where the taper length of a merging on-ramp is insufficient. These areas are located at the Victory Boulevard on-ramp in the southbound direction (520 feet of taper), and the Jantzen Beach/Hayden Island on-ramp in the northbound direction (158 feet of taper) in Oregon, and the SR 14 westbound on-ramp in the southbound direction (211 feet of taper) in Washington. These distances do not meet AASHTO's minimum taper length of 800 feet assuming a 50:1 taper length ratio and an average on-ramp travel lane width of 16 feet. In all cases the taper length is limited by the presence of a bridge structure along I-5 (i.e., the Columbia Slough Bridge and the Columbia River Bridge). These substandard lengths create operations as well as safety hazard issues.

Further investigation was done at the discretion of ODOT officials to determine if the ramp grades along existing ramp terminals are adequate for trucks. Several short sections of on- and off-ramps along I-5 do have general grades that exceed a value of 6.0%, which is typically the maximum slope trucks can safely negotiate. However, in most cases the grades work to the benefit of trucks by helping them to decelerate on an off ramp (+ve grade) or accelerate on an off-ramp (-ve grade). For example, the Portland Boulevard off-ramp in the southbound direction along I-5 ends with a +6.0% grade, effectively acting to slow traffic exiting the highway.

There are two known locations where the general grade acts against traffic exiting and entering the highway, and exceeds the critical 6.0% grade for trucks. These locations are at the SR14 westbound on-

ramp in the southbound direction along I-5 and the Mill Plain Boulevard on-ramp in the northbound direction. However, no deficiencies were identified at either location. The SR 14 on-ramp begins with a +6.3% grade to cross over I-5 and then ends with a –4.2% grade helping traffic accelerate to merge into I-5 mainstream traffic. The Mill Plain Boulevard on-ramp does have a –6.5% grade but only over a short distance which is unlikely to affect truck traffic.





INTERCHANGE GEOMETRICS		INTERCHANGE NAME	WEIDLER ST.		I-405		GREELEY AVE.		GOING ST.		ALBERTA ST.		PORTLAND BLVD.		LOMBARD ST.				COLUMBIA BLVD.	
		RAMP	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	WB OFF	EB ON	EB OFF	WB ON	OFF	ON
	SOUTHBOUND	TYPE	ST	ST	ST	ST		ST		ST	ST	ST	ST	ST		ST		CL		ST
		NO. OF LANES	2	1	2	1		1		1	1	1	1	1		1		1		1
		PAVEMENT WIDTH	30'	16'	32'	20'		16'		18'	18'	18'	21'	21'		22'		16'		18'
		GENERAL GRADE	NA	NA	NA	NA		NA		NA	NA	NA	+1.8to+6.0	-4.0to+1.3		-3.0to+3.2		-6.1to+1.5		NA
		RAMP METER										YES		YES		YES		YES		YES
	NORTHBOUND	TYPE	ST	ST	ST	ST	ST		ST	CL		ST	ST	ST	CL		ST		ST	
		NO. OF LANES	1	1	2	2	1		1	1		1	1	1	1		1		1	
		PAVEMENT WIDTH	16'	20'	32'	36'	16'		24'	24'		24'	15-37'	18'	21'		24'		16'	
		GENERAL GRADE	NA	NA	NA	NA	NA		NA	NA		NA	-1.5to+3.5	-5.3to-1.7	-2.6to-0.2		-2.5to+2.8		NA	
		RAMP METER		YES						YES		YES		YES						

DAVID EVANS AND ASSOCIATES, INC.
2828 S.W. CORBETT AVENUE
PORTLAND, OR. 97201-4830 (503) 223-6663

NORTH

0.2 0 0.4
SCALE IN MILES

LEGEND:

IDENTIFIED AREA OF DEFICIENCY

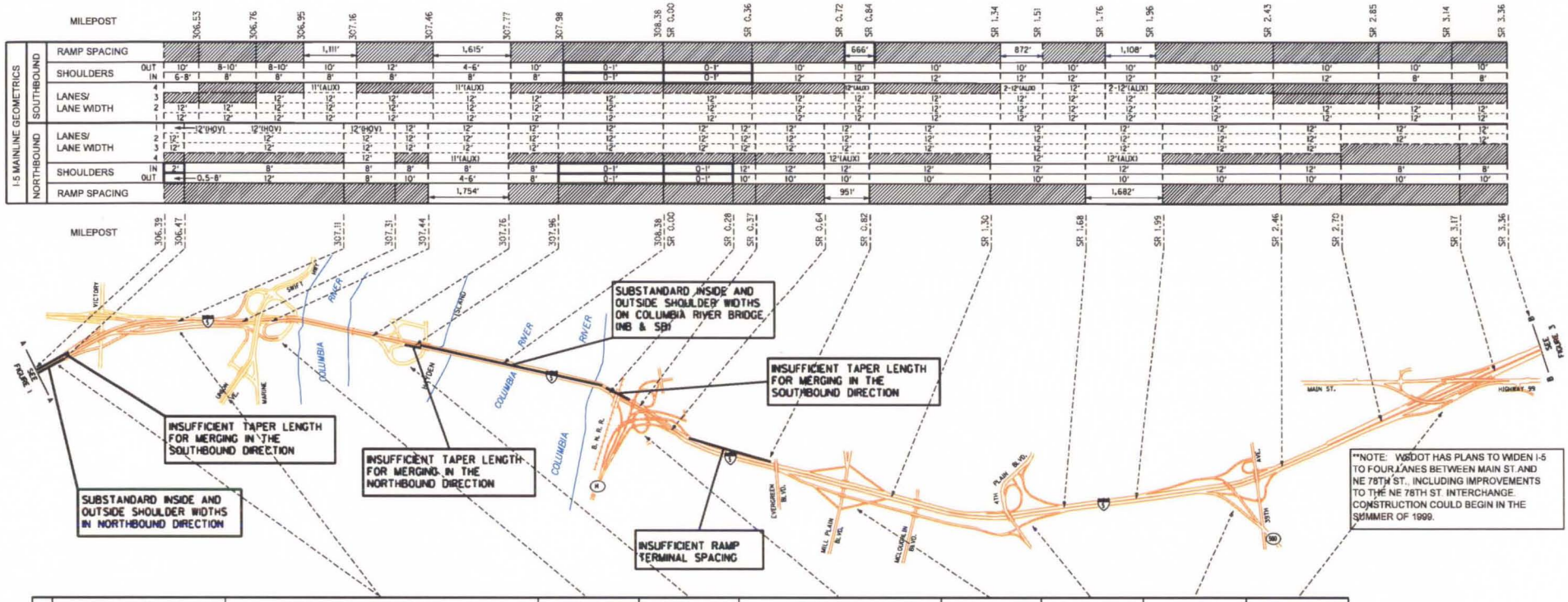
PEDESTRIAN STRUCTURE

(AUX) - AUXILIARY LANE
(HOV) - HIGH OCCUPANCY VEHICLE LANE
NA - INFORMATION NOT AVAILABLE
ST - STRAIGHT RAMP TERMINAL
CL - CLOVERLEAF RAMP TERMINAL
PCL - PARTIAL CLOVERLEAF RAMP TERMINAL

FIGURE 1

Interstate 5 -Existing Geometrics and Identified Deficiencies

I-5 Trade Corridor Study



INTERCHANGE GEOMETRICS

	INTERCHANGE NAME	VICTORY BLVD./INTERSTATE AVE.				MARINE DR.		JANTZEN BEACH		SR 14/CITY CENTER			MILL PLAIN BLVD.		4TH PLAIN BLVD.		39th ST.		MAIN ST.	
	RAMP	INTERSTATE OFF	VICTORY BLVD OFF	MARINE DR. OFF	VICTORY BLVD ON	OFF	ON	OFF	ON	EB OFF	WB ON	CITY CENTER OFF	OFF	ON	OFF	ON	OFF	ON	OFF	ON
SOUTHBOUND		ST			ST	CL	ST	PCL	PCL	ST	CL		ST	ST	ST	CL	CL	ST	ST	ST
	NO. OF LANES	2			1	1	1	1	1	1	1		1	1	1	1	1	1	1	1
	PAVEMENT WIDTH	36'			22'	18'	22'	22'	35'	27'	14'		24'	20'	19'	19'	14'	19'	14'	13'
	GENERAL GRADE	+1.0to-2.3			NA	NA	NA	NA	NA	-3.2to+2.4	-2.0		+2.8to+8.4	+1.8to-2.8	-1.8to-2.6	NA	+4.1to+5.9	+2.9to-3.8	-2.1to+2.9	+3.3to-0.7
	RAMP METER										YES									
NORTHBOUND	TYPE		ST	ST	ST		CL	ST	CL	ST	ST	CL	ST	ST		ST	ST	ST	ST	ST
	NO. OF LANES		1	1	1		1	1	1	1	1	1	1	2		1	2	1	1	1
	PAVEMENT WIDTH		22'	26'	26'		22-18'	30'	24'	24'	14'	28'	12'	32'		22'	28'	17'	14'	13'
	GENERAL GRADE		NA	+0.76	-0.04		-6.0to-1.7	NA	NA	-2.5to+4.3	+6.3to-4.2	+1.8to+5.9	+2.8to+3.0	-3.0to+6.5		-1.5to+1.5	-0.9to+0.2	-1.4to-5.9	-2.4to2.6	-4.6to+2.7
	RAMP METER																			

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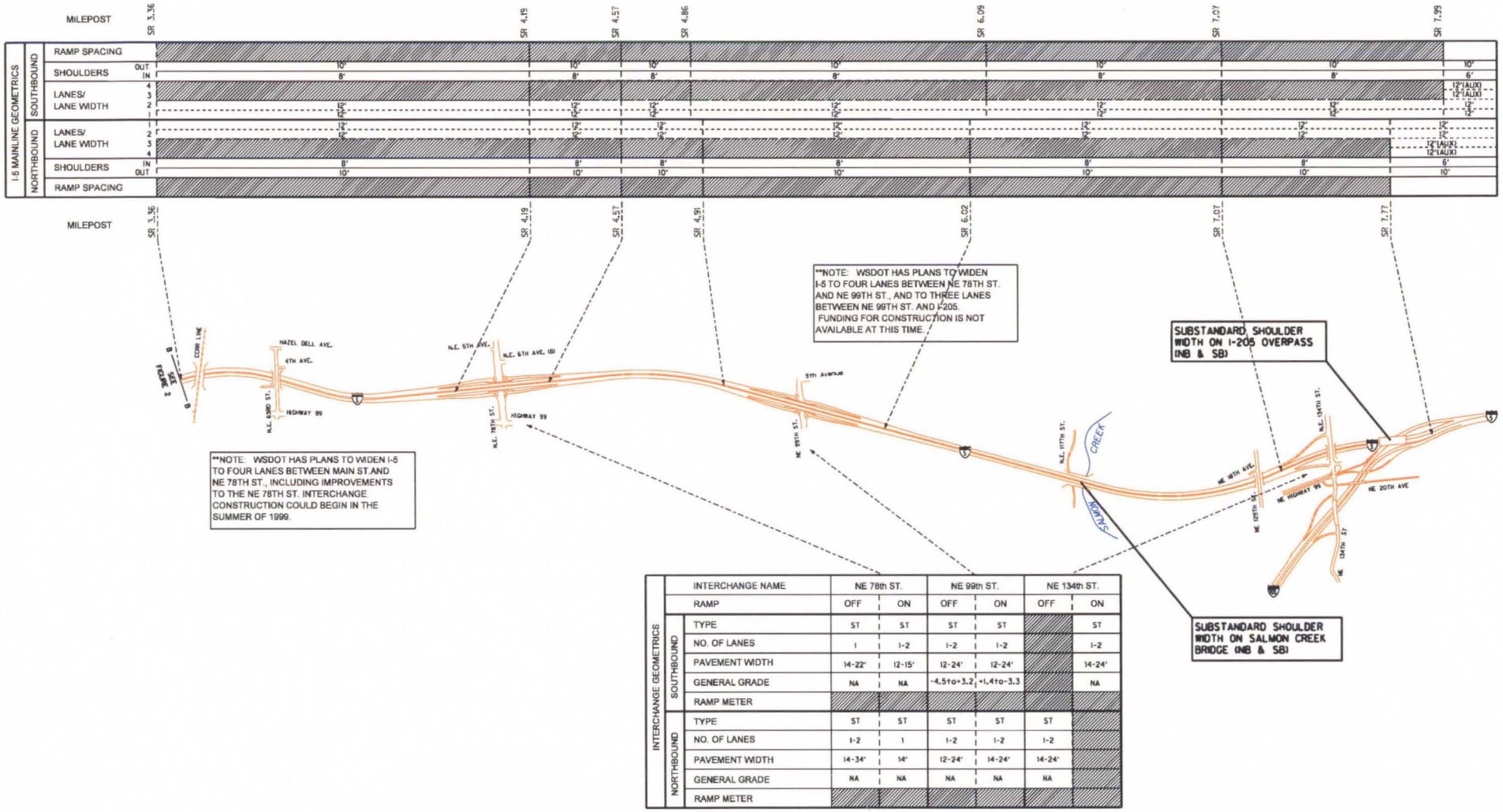
FIGURE 2

Interstate 5 –Existing Geometrics and Identified Deficiencies

I-5 Trade Corridor Study

PBQX0023/I-5GEOM.DGN/BJD/03-04-99



INTERCHANGE GEOMETRICS		INTERCHANGE NAME	NE 78th ST.		NE 99th ST.		NE 134th ST.	
		RAMP	OFF	ON	OFF	ON	OFF	ON
	SOUTHBOUND	TYPE	ST	ST	ST	ST		ST
		NO. OF LANES	1	1-2	1-2	1-2		1-2
		PAVEMENT WIDTH	14-22'	12-15'	12-24'	12-24'		14-24'
		GENERAL GRADE	NA	NA	-4.5to+3.2	+1.4to-3.3		NA
		RAMP METER						
	NORTHBOUND	TYPE	ST	ST	ST	ST	ST	
		NO. OF LANES	1-2	1	1-2	1-2	1-2	
		PAVEMENT WIDTH	14-34'	14'	12-24'	14-24'	14-24'	
		GENERAL GRADE	NA	NA	NA	NA	NA	
		RAMP METER						

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FIGURE 3

Interstate 5 --Existing Geometrics and Identified Deficiencies

I-5 Trade Corridor Study

PBQX0023/I-5GEOM.DGN/BJD/03-04-99