APPENDIX T3

Interchange Modification Analysis
NE 116th Street

I-405, SR520 to SR522 Stage 1
(Kirkland Stage 1)

Final Package Review – 15%

January 25, 2005

INTERSTATE 405 Project Team

Congestion Relief & Bus Rapid Transit Projects

INTERSTATE 405 Project Team

Congestion Relief & Bus Rapid Transit Projects

Interchange Modification Analysis

NE 116th Street

I-405 MP 19.83

November 24, 2004

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Purpose of this Paper

The purpose of this paper is to document the traffic operations and safety analysis results of the proposed modifications to the NE 116th St interchange on I-405 in the City of Kirkland. This document will serve as the traffic analysis documentation to be used in the design-build ready and design-build efforts. Similar documentation will be developed for each of the I-405 Corridor design projects.

Since there are no significant access modifications made in the I-405 Kirkland Nickel project, no APDR will be completed for this project and any proposed improvements are not anticipated to have negative impacts on the interchange operations. This was discussed at a meeting held on June 11, 2003 and is noted in the meeting minutes. Typically, discussion of the alternatives considered but rejected is documented in an Access Point Decision Report (APDR). Since an APDR is not required for this project, this document includes discussion of the design options considered but rejected at the NE 116th St interchange.

Background

The I-405 Kirkland Nickel project proposes to add one additional lane to northbound and southbound I-405 in the Kirkland area. In addition to these mainline lanes, the Kirkland Nickel project will also rebuild the existing NE 116th St interchange to address operational issues and accommodate future plans.

The Kirkland Nickel project proposes to add one additional lane northbound on I-405 from the NE 70th St exit to the NE 124th St exit. Currently there is an auxiliary lane northbound between SR 520 and NE 70th St.

In the southbound direction, the Kirkland Nickel project proposes adding one additional lane from SR 522 to SR 520. Currently, the SR 522 eastbound and westbound ramps add a southbound lane to I-405. This project would create an additional lane from the SR 522 ramp and extend it to the existing drop lane at SR 520.

The Kirkland Nickel project would also reconstruct the NE 116th St interchange to improve operations and accommodate the future plans for the I-405 corridor. In this area, there are two plans for future improvements. The first improvement titled "2014 Implementation Plan" would supplement the Kirkland Nickel project improvements in this area by extending the additional lane northbound from NE 124th St to SR 522. The second level of improvements, "Full Build Out", would add an additional lane northbound and southbound through the interchange area and reconstruct the NE 124th St interchange. The proposed NE 116th structure width and ramp design accommodates these future additions. The reconstructed interchange at NE 116th St is part of the long-term plans for this area and would not require modification when these future projects come online.

Summary

Six different options were analyzed and the best performing option was selected. The selection option improves both the operation and the safety of this interchange. The proposed improvements from this option to the 116th Ave NE interchange will improve operations and reduce queuing compared to the no action alternative. The ramp intersection LOS is projected to be C for 2030 peak hour conditions. The adjacent local street intersections are projected to be LOS C to LOS F for 2030 peak hour conditions. The LOS F is caused by high volumes on the side street, not specifically associated with the interchange operations. The freeway merge and diverge LOS will operate between LOS C and F in 2030 peak hour conditions. Much of the freeway LOS deficiency is caused by the mainline traffic congestion, not the ramp merge or diverge movements. These deficiencies will be addressed and improved as part of the 2014 Implementation Plan and the Full Build Out improvements planned for the corridor

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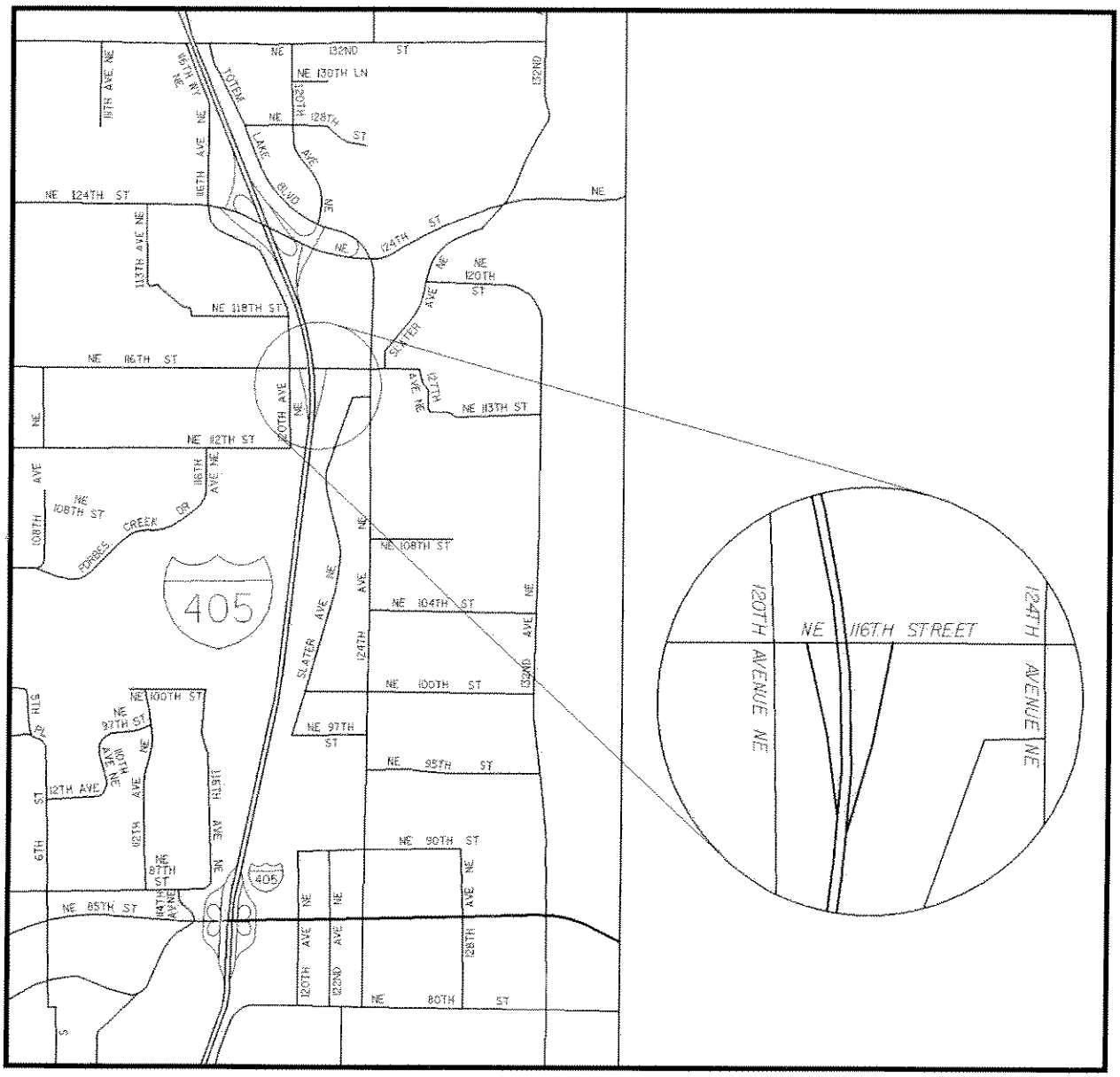


Figure 1 – Vicinity Map

Existing Conditions

Interchange Area

The existing 116th Interchange is a half diamond to and from the south. The interchange ties into NE 116th St, a principal arterial in the City of Kirkland that runs east and west. The intersection of NE 116th St/120th Ave NE is 180 feet west of the NE 116th St southbound on-ramp. The intersection of NE 116th St/124th Ave NE is 615 feet east of the NE 116th St northbound off-ramp.

The existing (year 2002) interchange and arterial both experience poor levels of service (LOS) and queuing in the AM and PM peak hours. Table 1 shows the existing intersection LOS. Table 2 shows the max queue expected at the intersection but does not specify whether it represents through, right turns, or left turns. The intersection turning movement volumes are in Appendix A.

		2002 Existing Conditions			
		AM		PM	
Intersection Name	Control Type	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)	LOS
NE 116th St/124th Ave NE	Signal	28.2	C	34.9	C
NE 116th St/120th Ave NE	Signal	48.2	D	29.5	C
NE 116th St/I-405 NB Off ramp	Signal	23.1	C	18.7	B

Table 1 – 2002 Intersection LOS

NE 116th St/120th Ave NE				
	Max Queue (feet) [Available Storage]			
AM Peak	**EB [>2200]**	**WB [500]**	**NB [1250]**	**SB [775]**
2002 Existing Conditions	870	160	220	280
PM Peak	**EB**	**WB**	**NB**	**SB**
2002 Existing Conditions	260	260	160	240
NE 116th St/I-405 NB Off ramp				
	Max Queue (feet)			
AM Peak	**EB [500]**	**WB [615]**	**NB [1150]**	
2002 Existing Conditions	400	210	210	
PM Peak	**EB**	**WB**	**NB**	
2002 Existing Conditions	240	340	240	
NE 116th St/124th Ave NE				
	Max Queue (feet)			
AM Peak	**EB [615]**	**WB [850]**	**NB [930]**	**SB [1700]**
2002 Existing Conditions	410	330	140	390
PM Peak	**EB**	**WB**	**NB**	**SB**
2002 Existing Conditions	280	280	640	400

Table 2 – 2002 Max Queue Lengths

The close proximity of the intersections, high traffic volumes, and limited storage behind the southbound ramp meter are the primary contributors to the intersection delays and queuing. During the AM peak hour, the vehicles destined to driveways and southbound I-405 queue up at the interchange and through the NE 116th St/120th Ave intersection.

Freeway

The mainline freeway in this area has three general purpose and one HOV lane in both the northbound and southbound directions. The NE 116th St on and off ramps are both single lane. The on-ramp has two metered lanes and one HOV bypass lane before they join into one.

During the AM peak hour, southbound I-405 has recurring congestion through this area. Northbound I-405 has recurring congestion during the PM peak hour. Table 3 shows the existing LOS for the AM and PM merge and diverge. The freeway volumes are attached in Appendix A. Some of these volumes will be lower than expected due to upstream or downstream congestion; these volumes are noted with an asterisk in the Appendix.

	I-405 NB to NE 116th St Off-ramp ***NB Diverge***		**NE 116th St to I-405 SB On-ramp** ***SB Merge***	
AM Peak	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**
2002 Existing Conditions	24.4	C	>45.0	F
PM Peak				
2002 Existing Conditions	>45.0	F	35.6	E

Table 3 – 2002 Freeway/Ramp LOS

The LOS values presented above are for the two outside lanes of the freeway in the vicinity of the corresponding merge and diverge movements. These calculations are consistent with Highway Capacity Manual measurement criteria for ramp areas. The LOS F values are largely due to the mainline traffic congestion.

Safety

The existing NE 116th St/124th Ave NE intersection, east of the interchange, has an average accident rate of 2.11 accidents per million vehicles entering (based on City of Kirkland data for 1996 to 2000). The primary accident types are vehicles leaving driveways, rear ends, and left turning vehicles. These accidents occurred on 124th Ave NE. The City of Kirkland has a project scheduled for summer 2004 to modify the channelization and signal timing at this intersection to minimize these accidents and improve traffic operations.

The existing NE 116th St/120th Ave NE intersection, west of the interchange, has an average accident rate of 1.05 accidents per million vehicles entering. Rear-end accidents are the primary type at this intersection and the majority involve eastbound vehicles. The probable cause of the accidents is insufficient capacity in eastbound direction.

The northbound off-ramp to NE 116th St had 16 accidents between the years of 2000 to 2002. Eight of the accidents were entering at angle and five were rear-ends. The probable cause of these accidents is the geometry at the intersection. As part of the Kirkland Nickel project, this ramp and intersection will be reconstructed.

The southbound on-ramp to I-405 had 7 accidents from the years 2000 to 2002. These accidents were spread out and therefore the cause of the accidents could not be determined. As part of the Kirkland Nickel project, this ramp will be reconstructed.

Future No Build Conditions

2014 and 2030 No Build Interchange Area
Capacity analysis was conducted for 2014 (year of opening) and 2030 (design year) conditions. The future year assumptions are discussed in Appendix B.

The 2014 and 2030 No Build conditions on the freeway and local street system degrade from existing as traffic volumes increase. The City of Kirkland programmed improvements at the NE 116th St/124th Ave intersection help improve traffic operations along the NE 116th St corridor, however there is still significant queuing on the local streets and the northbound off-ramp. The City of Kirkland has other planned but unfunded improvement projects for the 124th Ave NE corridor. Tables 4-6 show the LOS and queuing.

		2014 No Action			
		AM		PM	
Intersection Name	Control Type	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)	LOS
NE 116th St/124th Ave NE	Signal	27.5	C	65.9	E
NE 116th St/120th Ave NE	Signal	74.1	E	35.0	C
NE 116th St/I-405 NB Off-ramp	Signal	16.0	B	41.7	D

Table 4 – 2014 No Build Intersection LOS

		2030 No Action			
		AM		PM	
Intersection Name	Control Type	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)	LOS
NE 116th St/124th Ave NE	Signal	29.7	C	72.2	E
NE 116th St/120th Ave NE	Signal	130.0	F	72.7	E
NE 116th St/I-405 NB Off-ramp	Signal	21.6	C	91.5	F

Table 5 – 2030 No Build Intersection LOS

NE 116th St/120th Ave NE

Max Queue (feet) [Available Storage]

AM Peak	EB [>2200]	WB [500]	NB [1250]	SB [775]
2014 No Action	1520	160	160	320
2030 No Action	1750	180	220	1140

PM Peak	EB	WB	NB	SB
2014 No Action	400	200	280	310
2030 No Action	1620	200	200	560

NE 116th St/I-405 NB Off ramp

Max Queue (feet)

AM Peak	EB [500]	WB [615]	NB [1150]
2014 No Action	240	120	260
2030 No Action	260	170	490

PM Peak	EB	WB	NB
2014 No Action	240	370	1020
2030 No Action	400	700	1270

NE 116th St/124th Ave NE

Max Queue (feet)

AM Peak	EB [615]	WB [850]	NB [930]	SB [1700]
2014 No Action	340	160	160	240
2030 No Action	320	180	200	240

PM Peak	EB	WB	NB	SB
2014 No Action	490	250	1880	230
2030 No Action	530	320	1830	240

Table 6 – 2014 and 2030 No Build Max Queue Lengths

The local street approaches experience significant delays and queuing in the no action conditions. The northbound off-ramp has a queue of 1270 feet in the 2030 PM peak hour, which backs onto the freeway.

2014 and 2030 No Build Freeway

The freeway system has very high demands in year 2014 and 2030. These demands exceed the capacity of the freeway resulting in unstable flow and congested conditions. Table 7 shows the LOS and density for 2014 and 2030 AM and PM peak hour merges and diverges.

	I-405 NB to NE 116th St Off-ramp ***NB Diverge***		**NE 116th St to I-405 SB On-ramp** ***SB Merge***	
AM Peak	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**
2014 No Action	25.5	C	>45.0	F
2030 No Action	26.1	C	>45.0	F
PM Peak	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**
2014 No Action	>45.0	F	>45.0	F
2030 No Action	>45.0	F	>45.0	F

Table 7 – 2014 and 2030 No Build Freeway/Ramp LOS

I-405 southbound has significant congestion in the 2014 and 2030 AM and PM peak hour conditions. All locations are projected to operate at LOS F in 2014 and 2030 except the northbound diverge which operates at LOS C in both years.

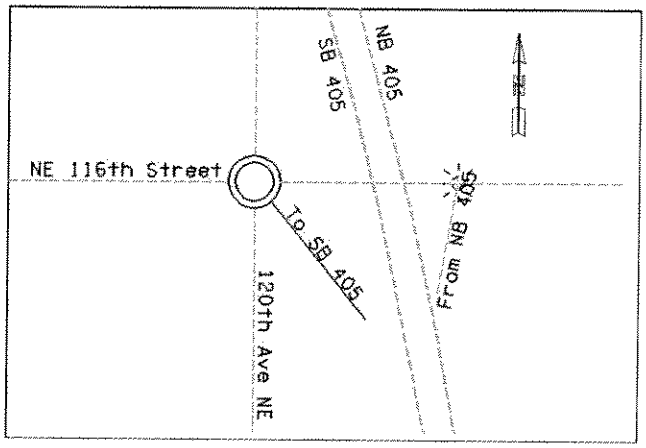
Design Options Considered

Several design options were considered to improve traffic operations and reduce queuing in the vicinity of NE 116th St. The reasonable alternatives along with reasons they were not selected are listed below.

Option 1 – Signalize the Southbound On-Ramp

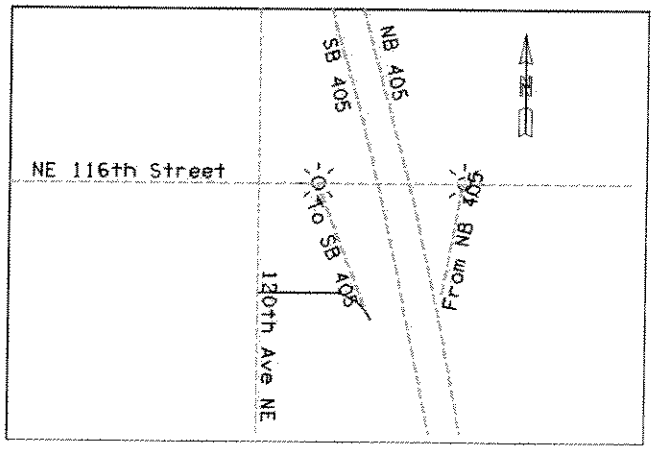
This option signalized the southbound on-ramp on NE 116th St. This option had poor LOS due to the close proximity of this intersection to the northbound off ramp and 120th Ave NE signalized intersections.

Option 2 – Roundabout at 120th Ave NE
A roundabout design option was considered at the 120th Ave NE intersection. The option added the southbound on-ramp to the intersection. The option had significant queuing and resulted in LOS F at the northbound and southbound ramp intersections.



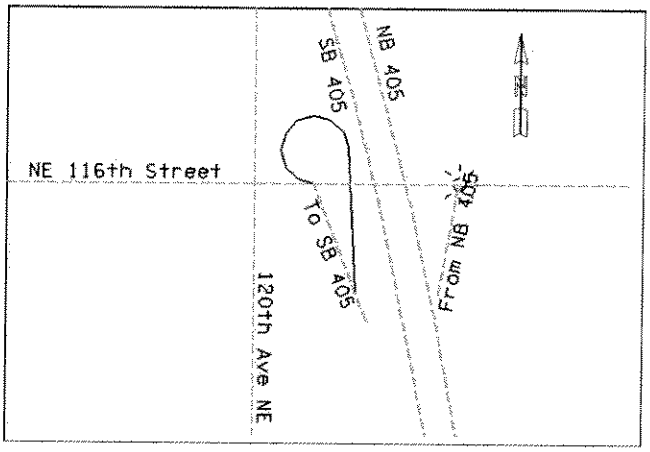
Option 2

Option 3 – 120th Ave NE Slip Ramp
A slip ramp on 120th Ave NE south of NE 116th St was evaluated. This option had significant right of way impacts, high costs, and environmental impacts as it extended the southbound on-ramp gore to the south which is closer to Forbes Creek. It is also not compatible with the long term vision for the corridor.



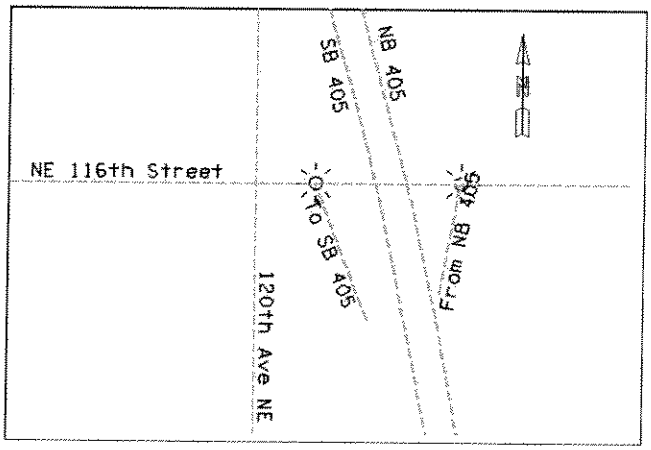
Option 3

Option 4 – Addition of a Southbound Loop Ramp
This option supplemented the existing southbound on-ramp with a loop ramp for westbound vehicles on NE 116th St. This option had an acceptable LOS, but would not accommodate the planned additional lane southbound on I-405. It also had substandard ramps and is not compatible with the long term vision for the corridor.



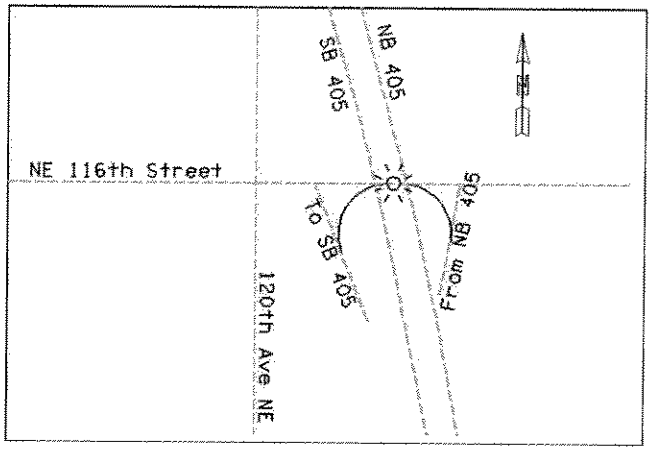
Option 4

Option 5 – Half Diamond Interchange
This option reconstructs the interchange using the existing half diamond configuration. Similar to Option 1, this alternative has LOS deficiencies at the on and off ramps.



Option 5

Option 6 – Half Single Point Interchange
This option reconstructs the interchange to a half single point interchange configuration. This configuration reduces queuing and has an acceptable LOS.



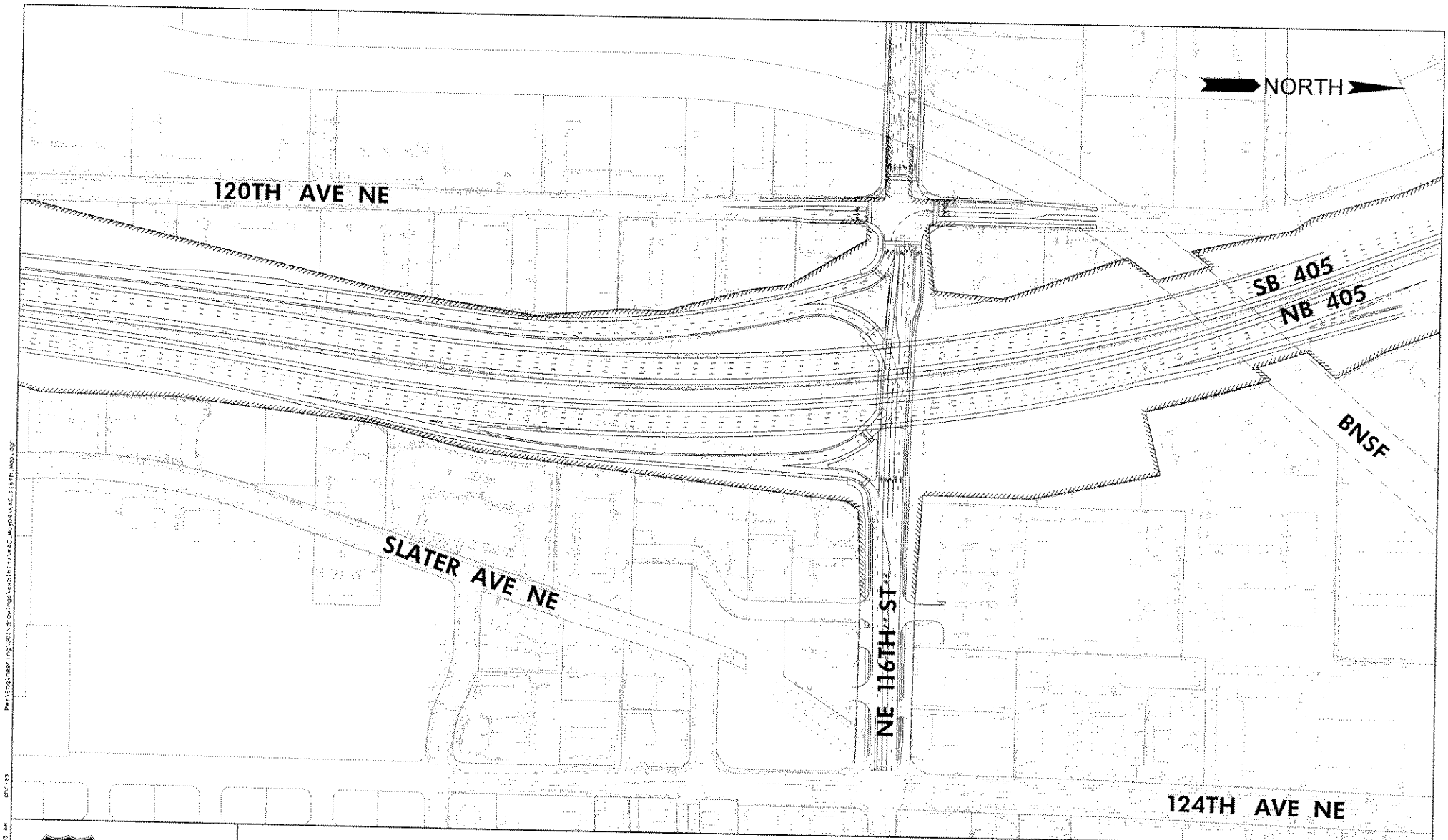
Option 6

Proposed Design
The proposed design configuration for this area is shown in Figure 2. This improvement constructs a new structure at NE 116th St, rebuilds the on and off ramps, widens NE 116th St, and adds channelization improvements to the NE 116th St/120th Ave NE intersection. The southbound on-ramp will continue have a two lane ramp meter with an HOV bypass lane. The northbound off ramp will exit the freeway as a single lane.

The proposed design will move the northbound gore point 160 feet to the south. The southbound gore point will be moved 2,000 feet to the south. The southbound gore point relocation allows for increased storage area behind the ramp meter. The new southbound gore point will be 3,500 feet from the southbound off-ramp to SR 908 (NE 85th St) and will not introduce any weaving issues.

Design Deviations
Currently, there are two deviations at the NE 116th St interchange. The profile of NE 116th St has a sag vertical curve under the I-405 structure before climbing over the BNSF railroad and continuing on into Downtown Kirkland. This curve begins 75' east of the existing I-405 structure and continues to the intersection with 120th Ave NE. The sight distance for this curve meets a 35 mph speed. Design speed on NE 116th St is 45 mph, with a posted speed limit of 35 mph. To mitigate this condition, the underdeck of the new structure will be lit.

The profile of NE 120th Ave in this area climbs steeply from a sag vertical curve at the at-grade BNSF crossing to a crest vertical curve at the intersection with NE 116th St. Both of these curves have existing stopping sight distances that meet a 25 mph speed. The design speed for NE 120th Ave is 30 mph, with a posted speed limit of 25 mph. Mitigation of the sag curve is not possible because of the at-grade crossing with the BNSF railroad. The crest curve could not be lowered without lowering NE 116th St. While that would help with the sag vertical curve on NE 116th St, it would not be possible to meet clearance requirements for the NE 116th St crossing over the BNSF railroad, approximately 100' west of the intersection. These vertical curve deviations will remain.



INTERSTATE 405 Project Team
Washington State Department of Transportation

FIGURE 2

0 100 200
SCALE IN FEET

I-405 CONGESTION RELIEF & BUS RAPID TRANSIT PROJECTS

NE 116TH STREET
NICKEL PROPOSED CHANNELIZATION

DATE 11/23/04

Future Build Conditions

2014 and 2030 Build Interchange Area

The half single point interchange configuration improves operations at the interchange. This configuration reduces vehicle queue lengths and improves overall LOS. Tables 8-10 show the LOS and queue information.

		2014 Nickel			
		AM		PM	
Intersection Name	Control Type	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)	LOS
NE 116th St/124th Ave NE	Signal	27.6	C	55.4	E
NE 116th St/120th Ave NE	Signal	25.3	C	29.1	C
NE 116th St/I-405 NB Off ramp (SPUI)	Signal	21.0	C	23.6	C

Table 8 – 2014 Nickel Intersection LOS

		2030 Nickel			
		AM		PM	
Intersection Name	Control Type	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)	LOS
NE 116th St/124th Ave NE	Signal	34.0	C	65.4	E
NE 116th St/120th Ave NE	Signal	35.6	D	30.7	C
NE 116th St/I-405 NB Off ramp (SPUI)	Signal	33.4	C	31.3	C

Table 9 – 2030 Nickel Intersection LOS

In 2014, the intersections operate at LOS C for both peak hours, with the exception of NE 116th St/124th Ave NE which intersection operates at LOS E in the PM. The I-405 SPUI ramp intersection operates as a single signal with LOS C. In 2030 conditions, the intersections operate at LOS D or better for both peak hours, with the exception of NE 116th St/124th Ave NE intersection which operates at LOS E in the PM. The NE 116th St/124th Ave NE intersection delays are due to high northbound demand at the intersection. This demand and delay is not related to the interchange. The I-405 SPUI intersection operates at LOS C in both 2030 peak hours.

NE 116th St/120th Ave NE

Max Queue (feet) [Available Storage]

AM Peak	EB [>2200]	WB [260]	NB [1250]	SB [775]
2014 Nickel	320	200	240	160
2030 Nickel	480	220	400	260

PM Peak	EB	WB	NB	SB
2014 Nickel	250	260	240	200
2030 Nickel	420	260	250	260

NE 116th St/I-405 NB Off ramp

Max Queue (feet)

AM Peak	EB [220]	WB [800]	NB [1300]
2014 Nickel	220	150	210
2030 Nickel	220	190	290

PM Peak	EB	WB	NB
2014 Nickel	220	200	260
2030 Nickel	220	270	280

NE 116th St/124th Ave NE

Max Queue (feet)

AM Peak	EB [615]	WB [850]	NB [930]	SB [1700]
2014 Nickel	280	150	210	250
2030 Nickel	600	210	260	260

PM Peak	EB	WB	NB	SB
2014 Nickel	340	250	1690	240
2030 Nickel	615	300	1750	260

Table 10 – Nickel Intersection Max Queue Lengths

The local street intersections have reduced queues as a result of the Kirkland Nickel project. The northbound approach to the NE 116th St/124th Ave NE intersection has queues in excess of 1000 feet; however this is for the northbound movements and is not associated with the interchange. The northbound off ramp queue is reduced to 280 feet in the 2030 PM conditions.

2014 and 2030 Build Freeway

With the proposed Nickel freeway and interchange improvements, the freeway conditions show some improvement, however there is still congestion in the PM peak hour for northbound and southbound movements. Table 11 shows the density and LOS of the merge and diverge areas.

	I-405 NB to NE 116th St Off ramp *NB Diverge*		NE 116th St to I-405 SB Onramp *SB Merge*	
AM Peak	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**
2014 Nickel	19.7	B	36.8	E
2030 Nickel	22	C	40.9	E
PM Peak	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**
2014 Nickel	>45.0	F	>45.0	F
2030 Nickel	>45.0	F	>45.0	F

Table 11 – 2014 and 2030 Freeway/Ramp LOS

The AM has improvements for both the northbound and southbound merge and diverge locations compared to the no build. The PM peak hour still has LOS deficiencies due to the mainline congestion that is projected to occur in 2014 and 2030. The Kirkland Nickel project will have a southbound ramp meter with approximately 900 feet of two lane storage.

As discussed earlier, the I-405 mainline operation will be improved through this area as part of the 2014 Implementation Plan and the Full Build Out improvements planned for the corridor.

Safety

The proposed improvements should reduce the number of rear-end, side-swipe, and entering at angle accidents as well as accidents caused by driver inattention at the NE 116th St/120th Ave, NE 116th St/I-405 ramps, NE 116th St/124th Ave NE intersections.

Environmental Coordination

NEPA environmental documentation work is currently underway. This work could be completed as soon as January 2005 depending on the type of document used. A follow-up memorandum to this analysis will be submitted when the environmental documentation is complete.

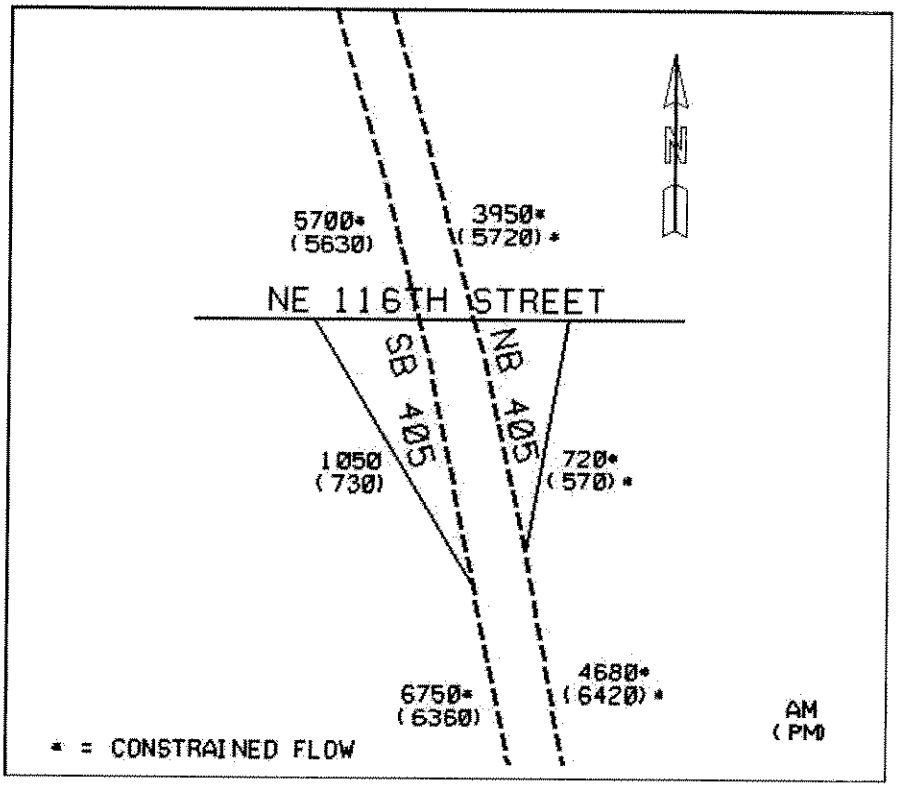
Summary

The proposed improvements to the 116th Ave NE interchange will improve operations and reduce queuing compared to the no action alternative. The ramp intersection LOS is projected to be C for 2030 peak hour conditions. The adjacent local street intersection LOS is projected to be LOS E or better for 2030 peak hour conditions, with the exception of NE 116th St/124th Ave NE intersection which operates at LOS F in the PM because of the long queue for the North Bound movement. The freeway merge and diverge LOS will operate between LOS C and F in 2030 peak hour conditions. Much of the freeway LOS deficiency is caused by the mainline traffic congestion, not the ramp

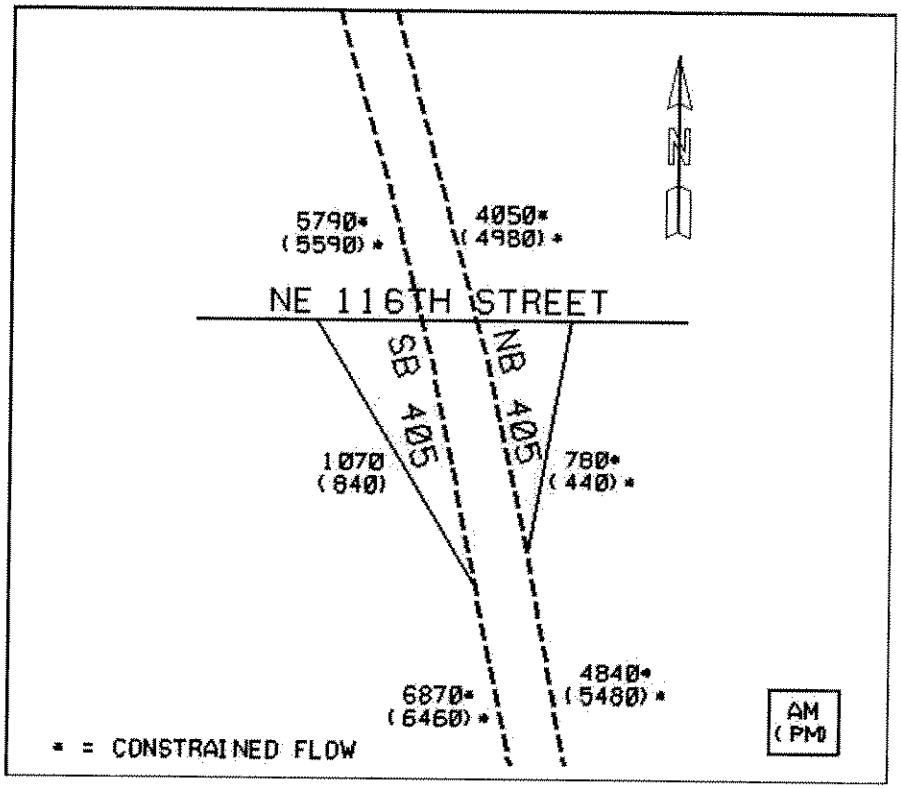
merge or diverge movements. These deficiencies will be addressed and improved as part of the 2014 Implementation Plan and the Full Build Out improvements planned for the corridor.

APPENDIX A

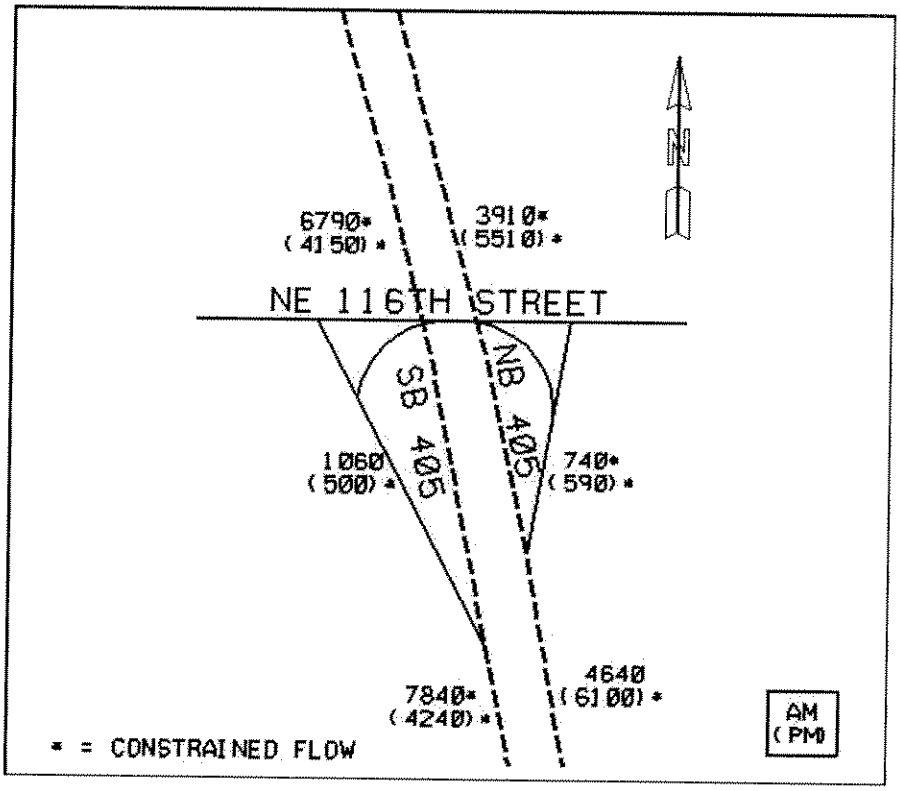
TRAFFIC VOLUMES



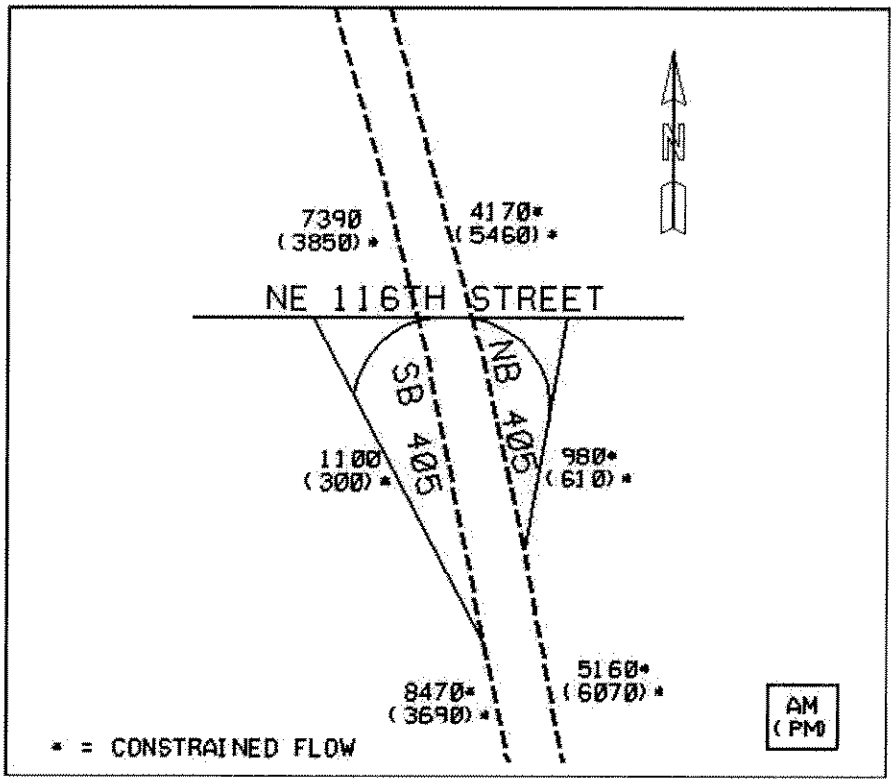
2014 No Action Freeway Volumes



2030 No Action Freeway Volumes



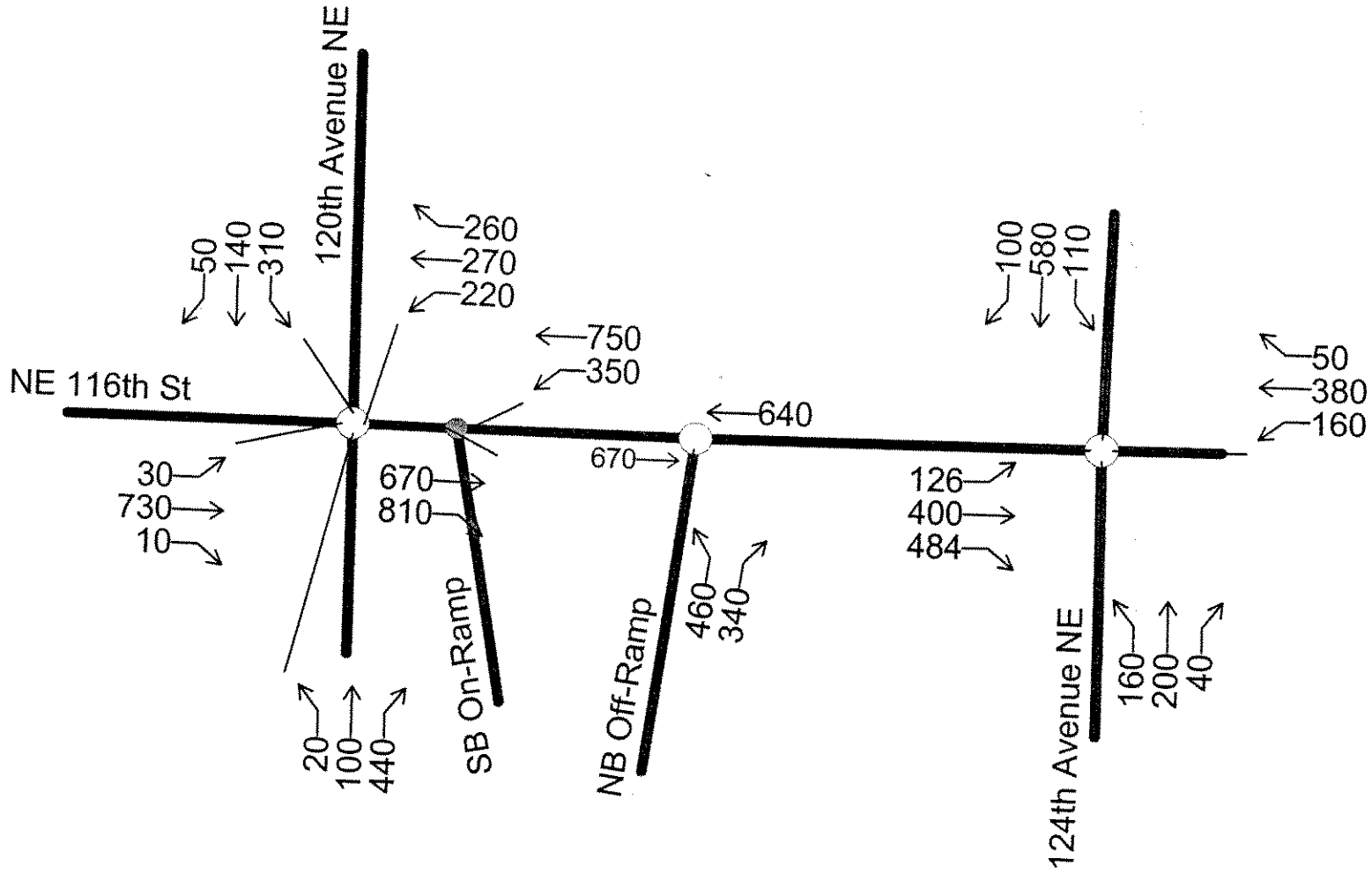
2014 Nickel Freeway Volumes



2030 Nickel Freeway Volumes

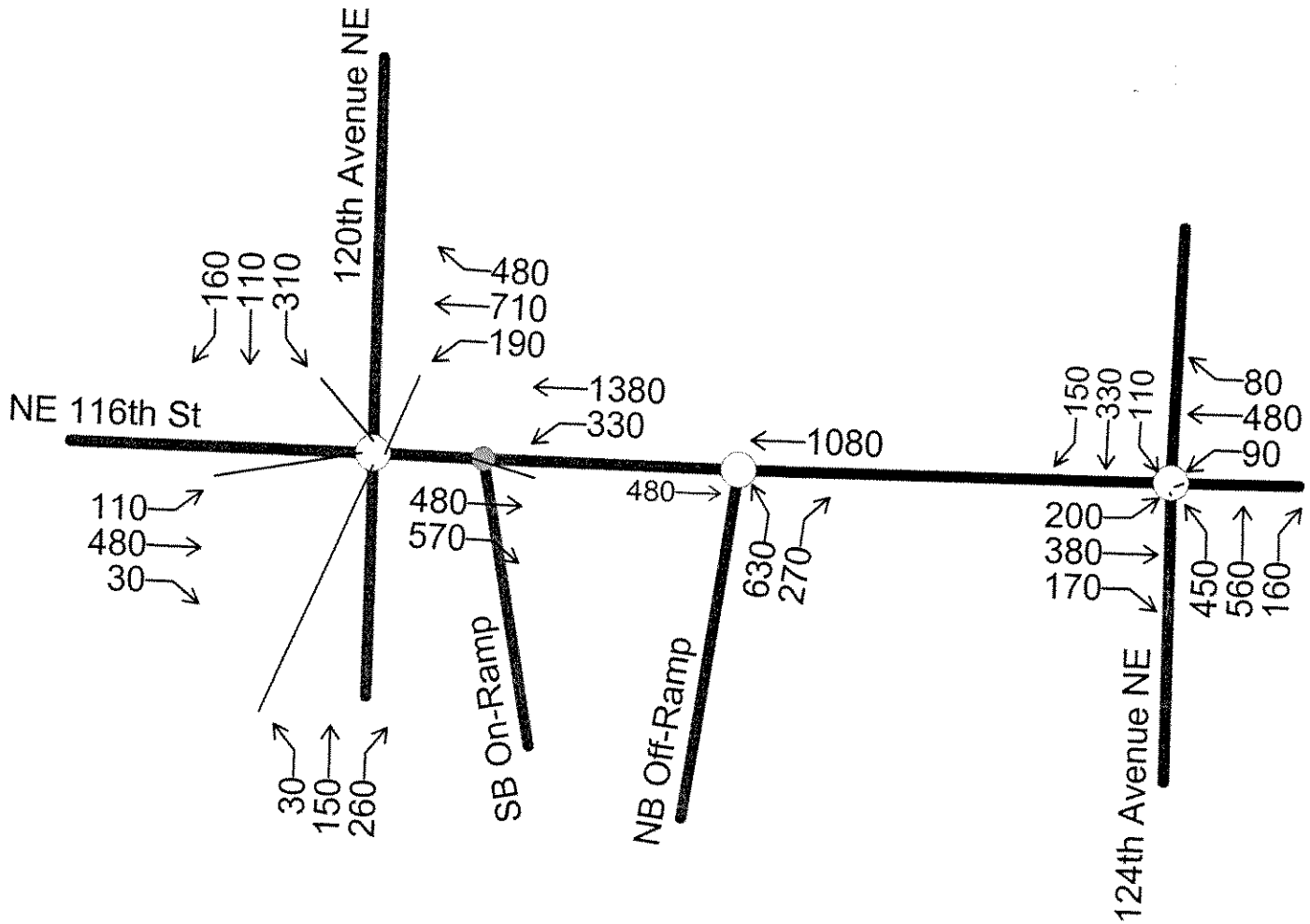
2002 AM Peak Hour Volume

5/12/2004



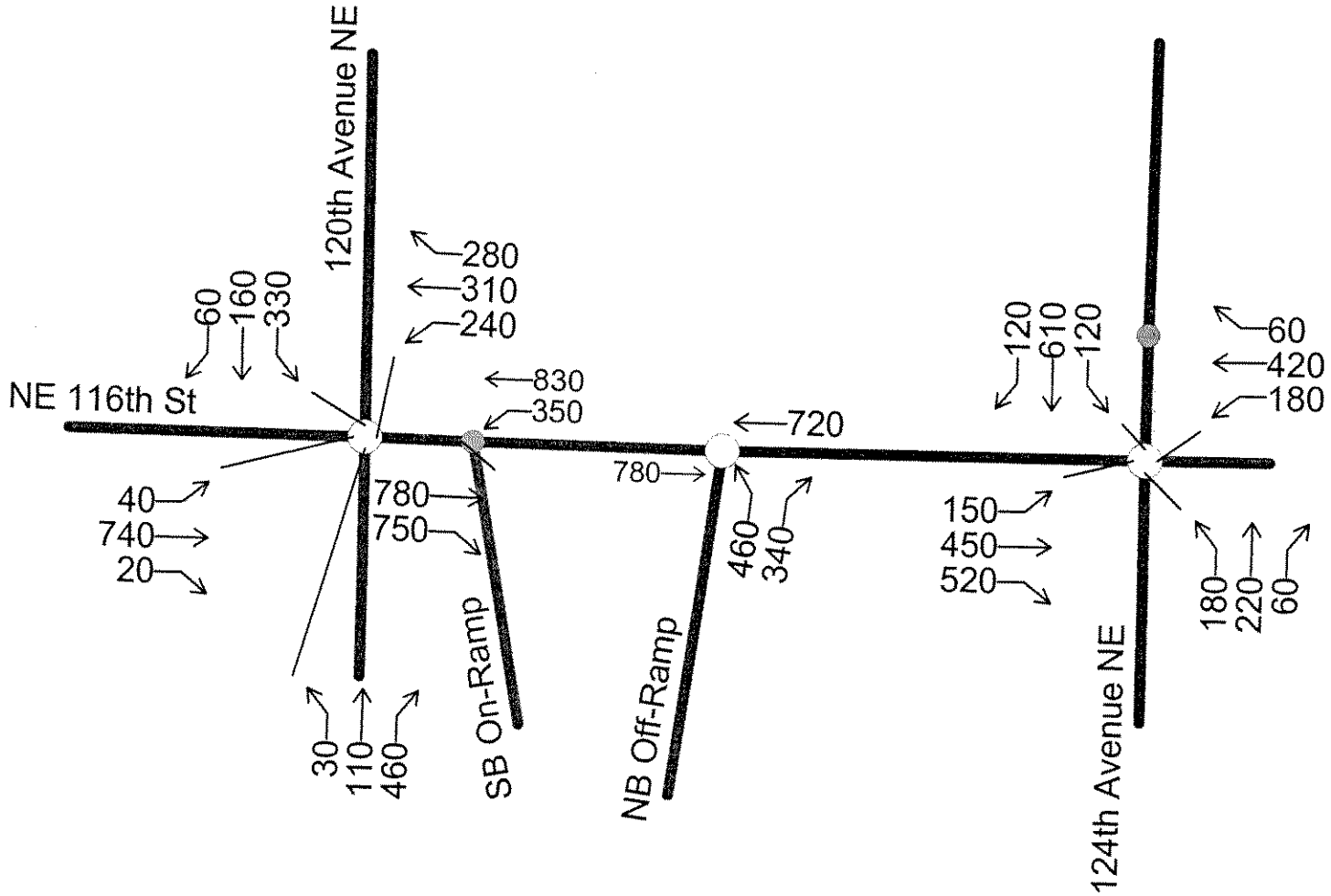
2002 PM Peak Hour

5/12/2004



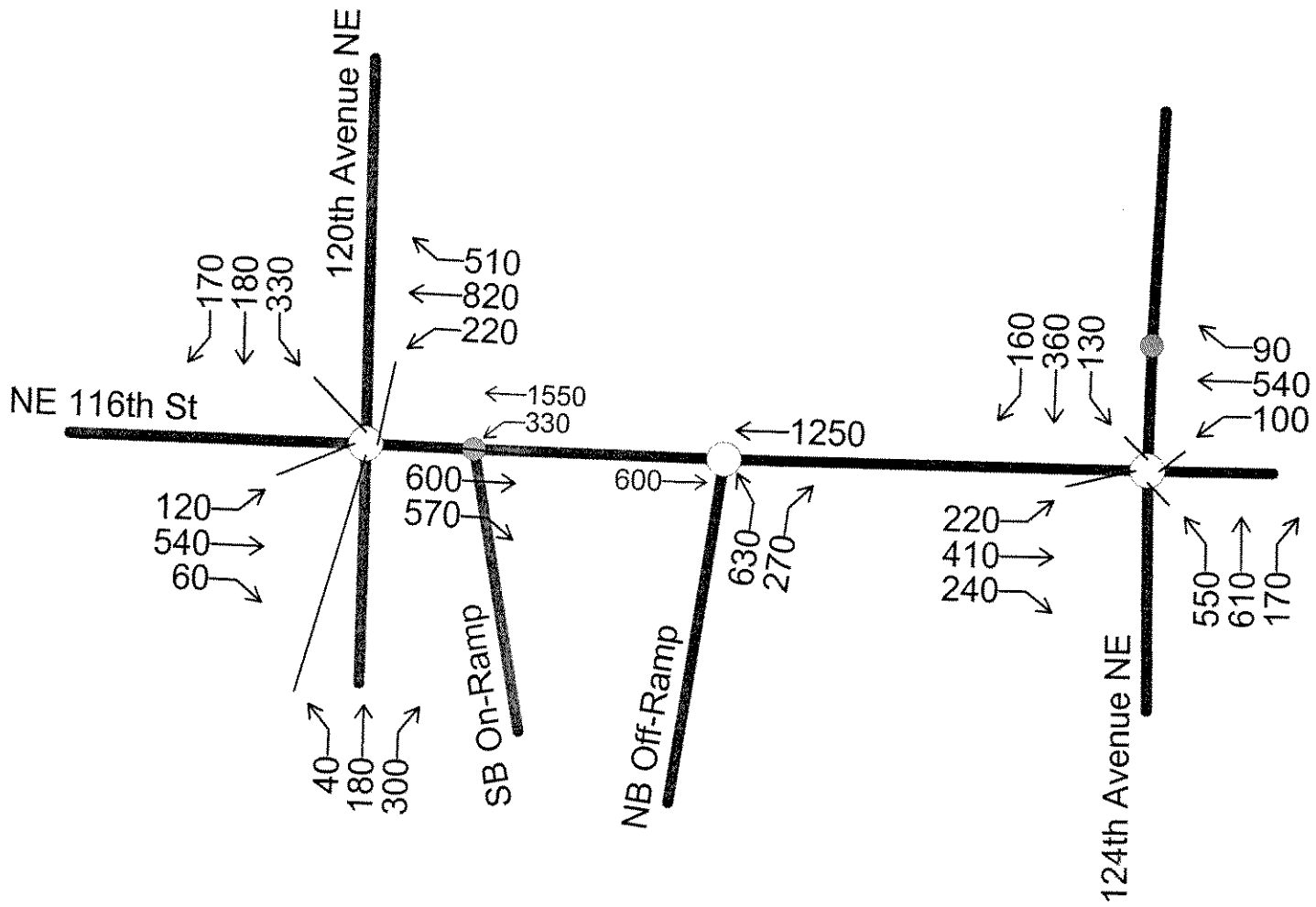
2014 No Action AM Peak Hour Volume

5/12/2004



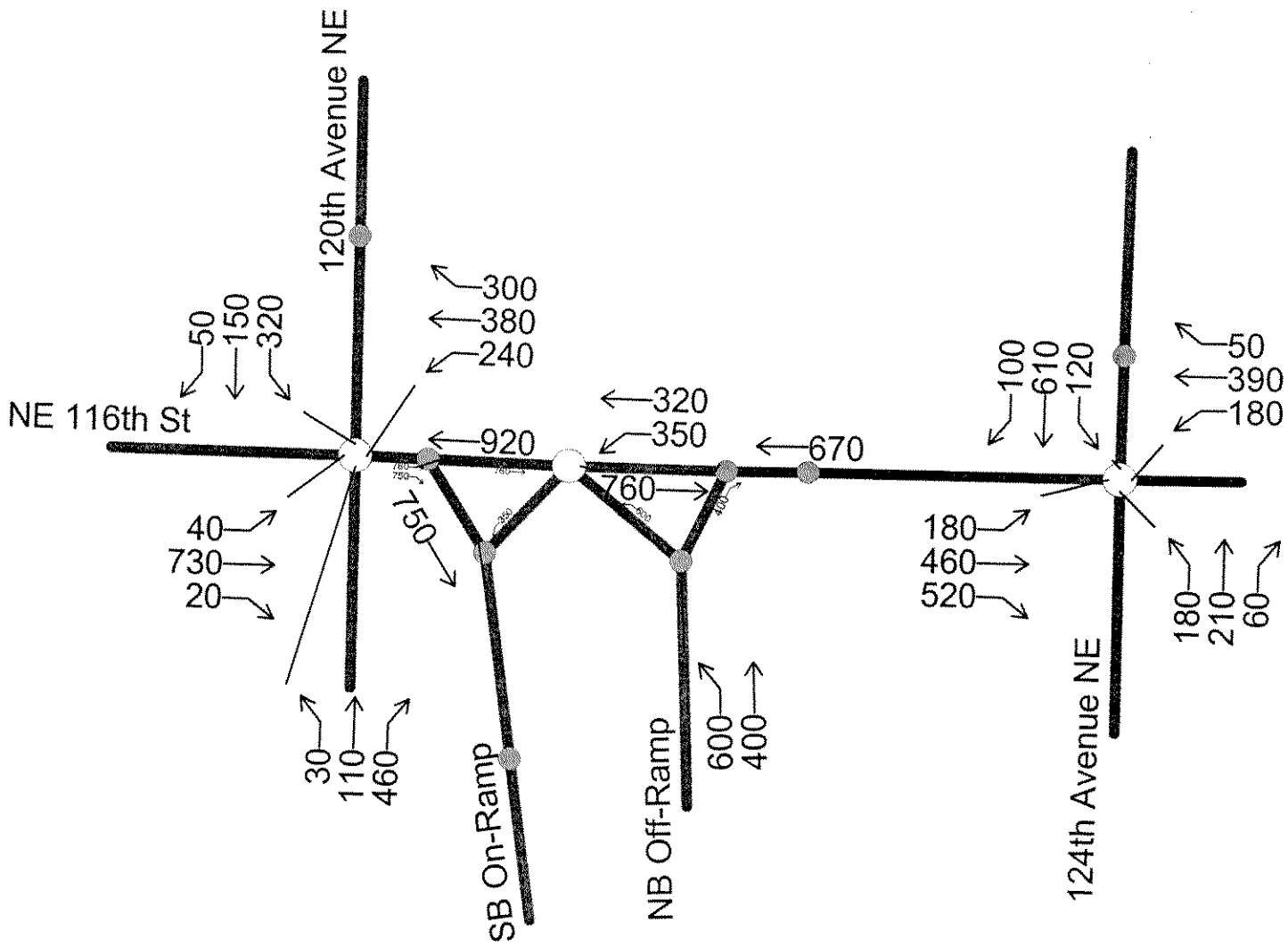
2014 No Action PM Peak Hour Volume

5/12/2004



2014 Nickel AM Peak Hour Volume

5/12/2004



2014 Nickel PM Peak Hour Volume

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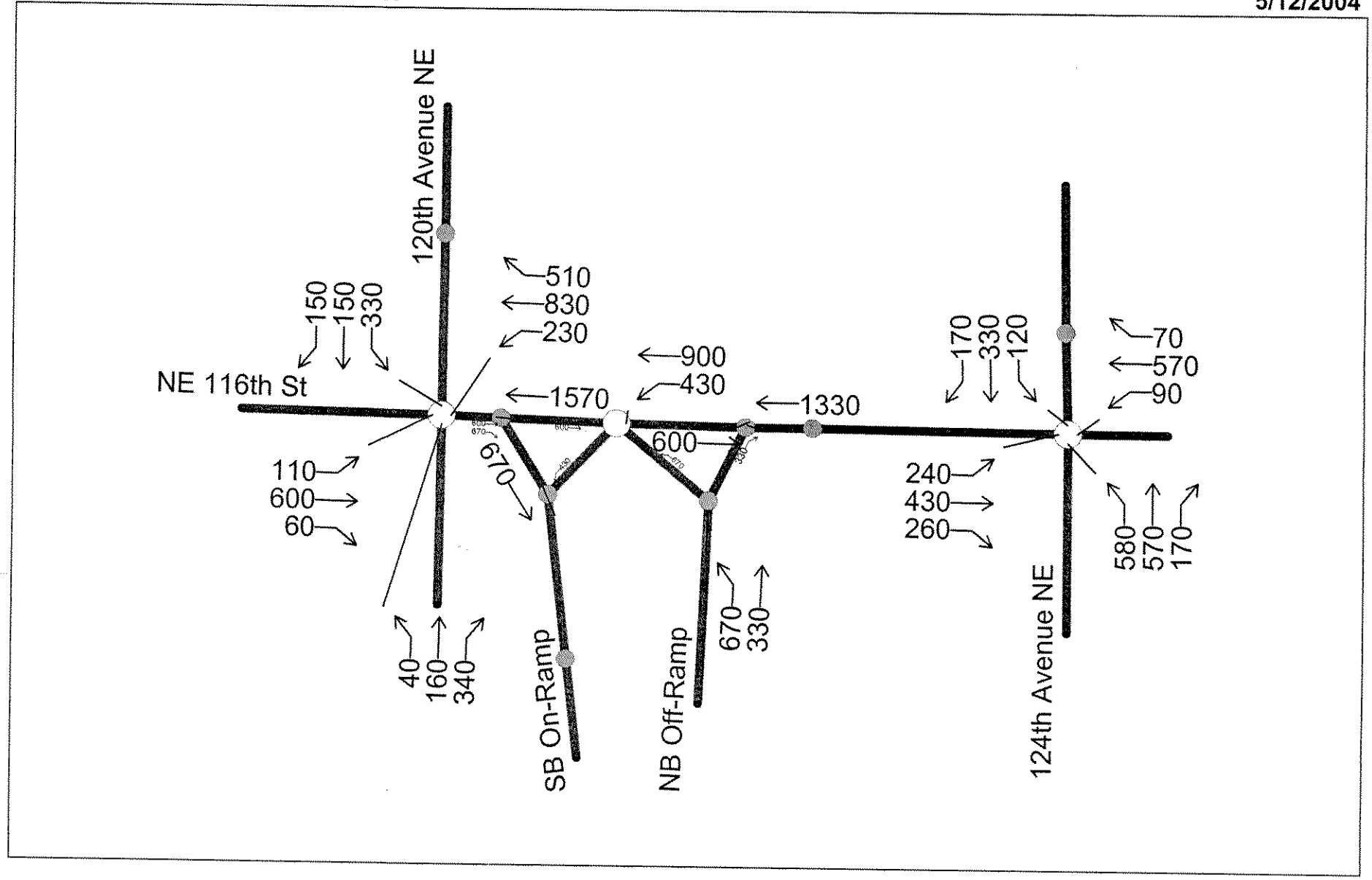

2030 No Action AM Peak Hour Volume

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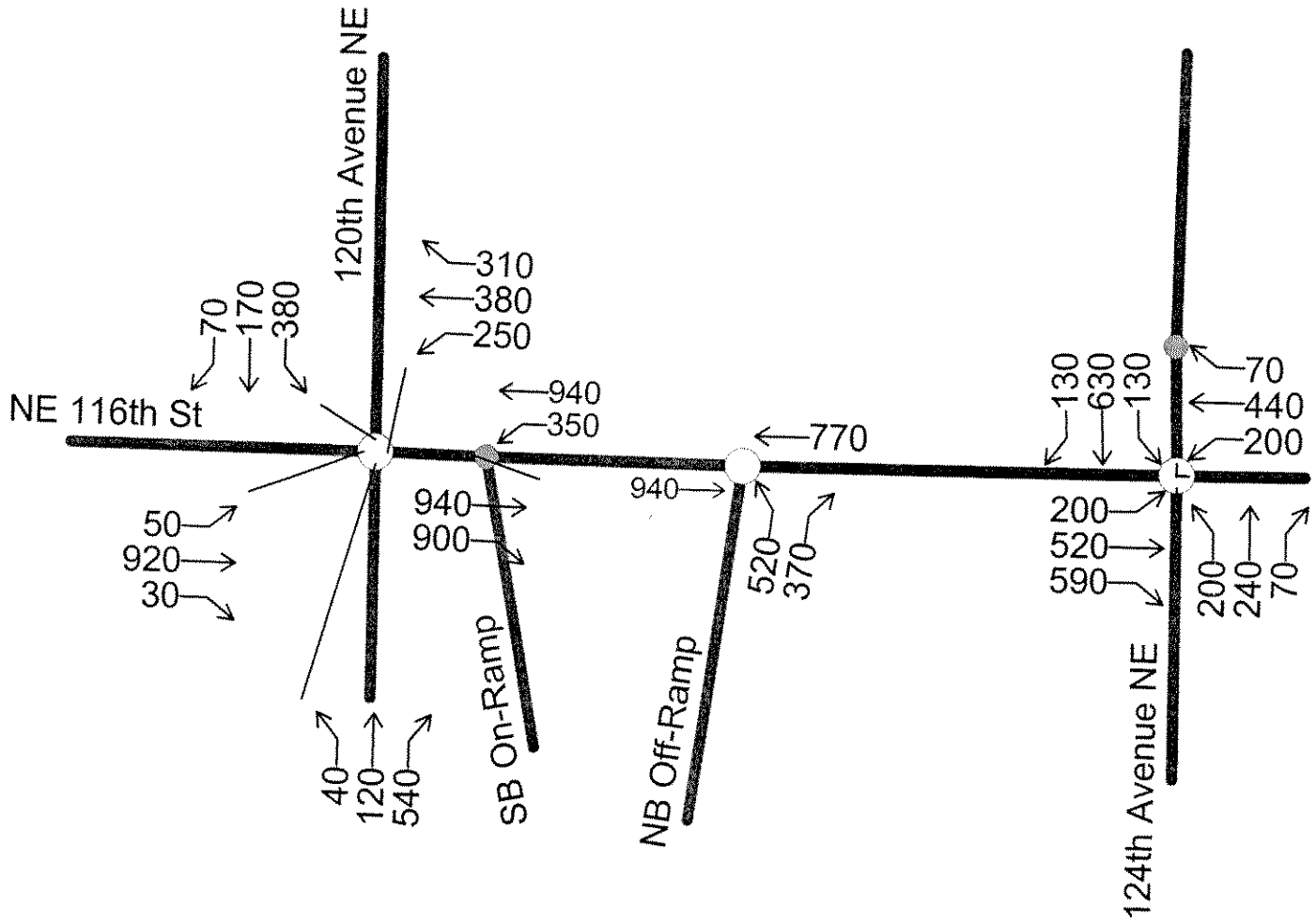

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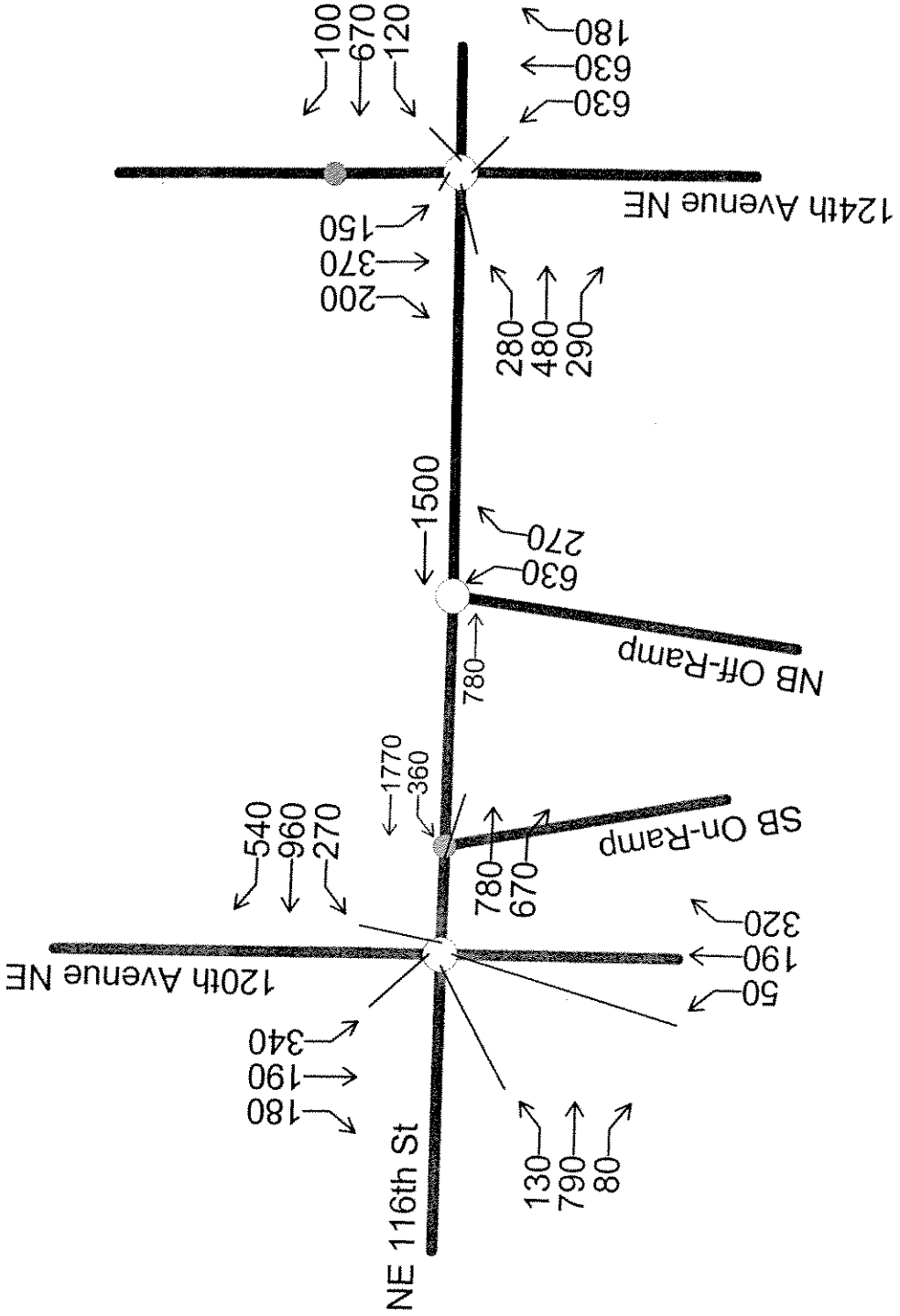

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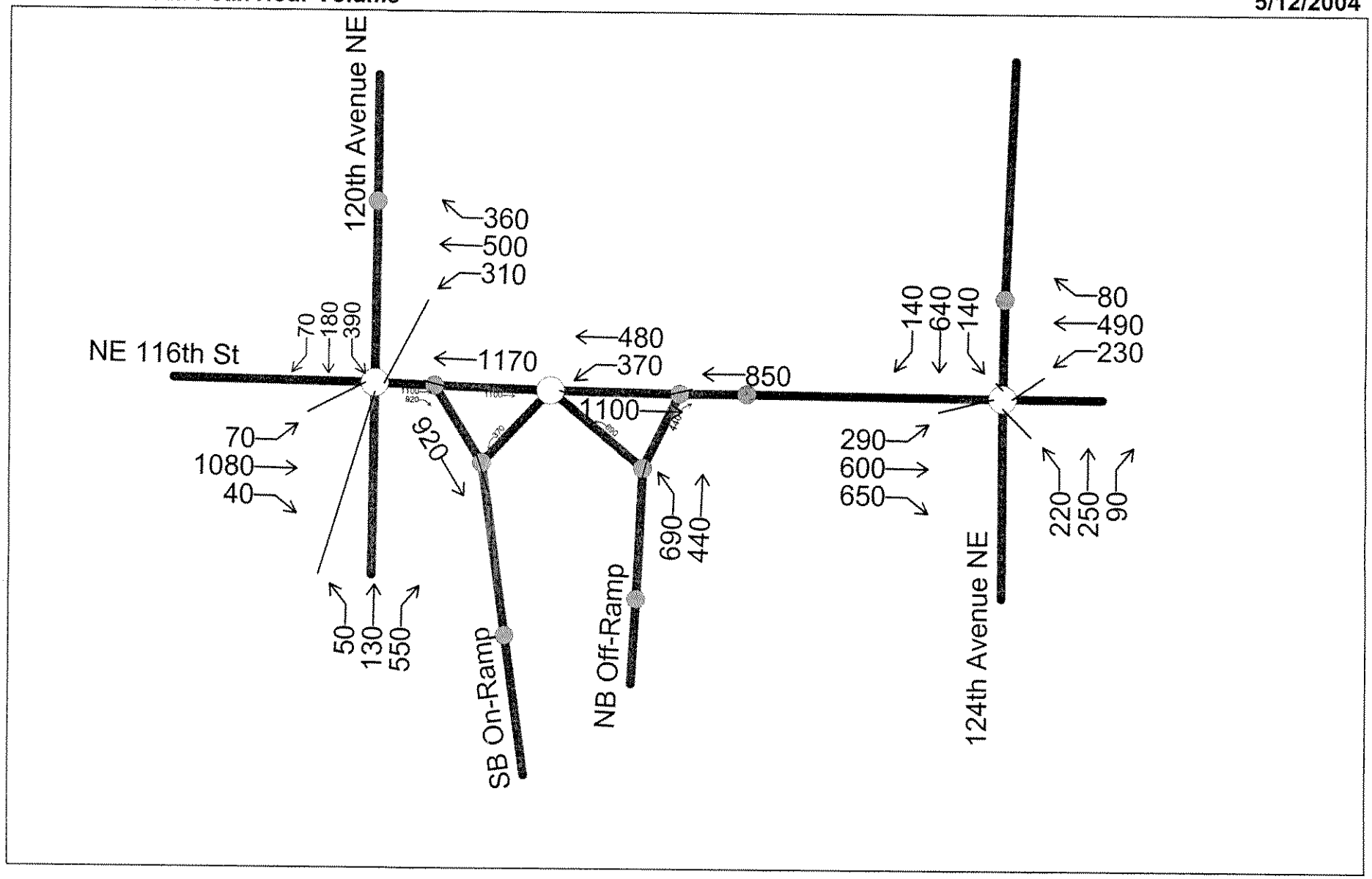

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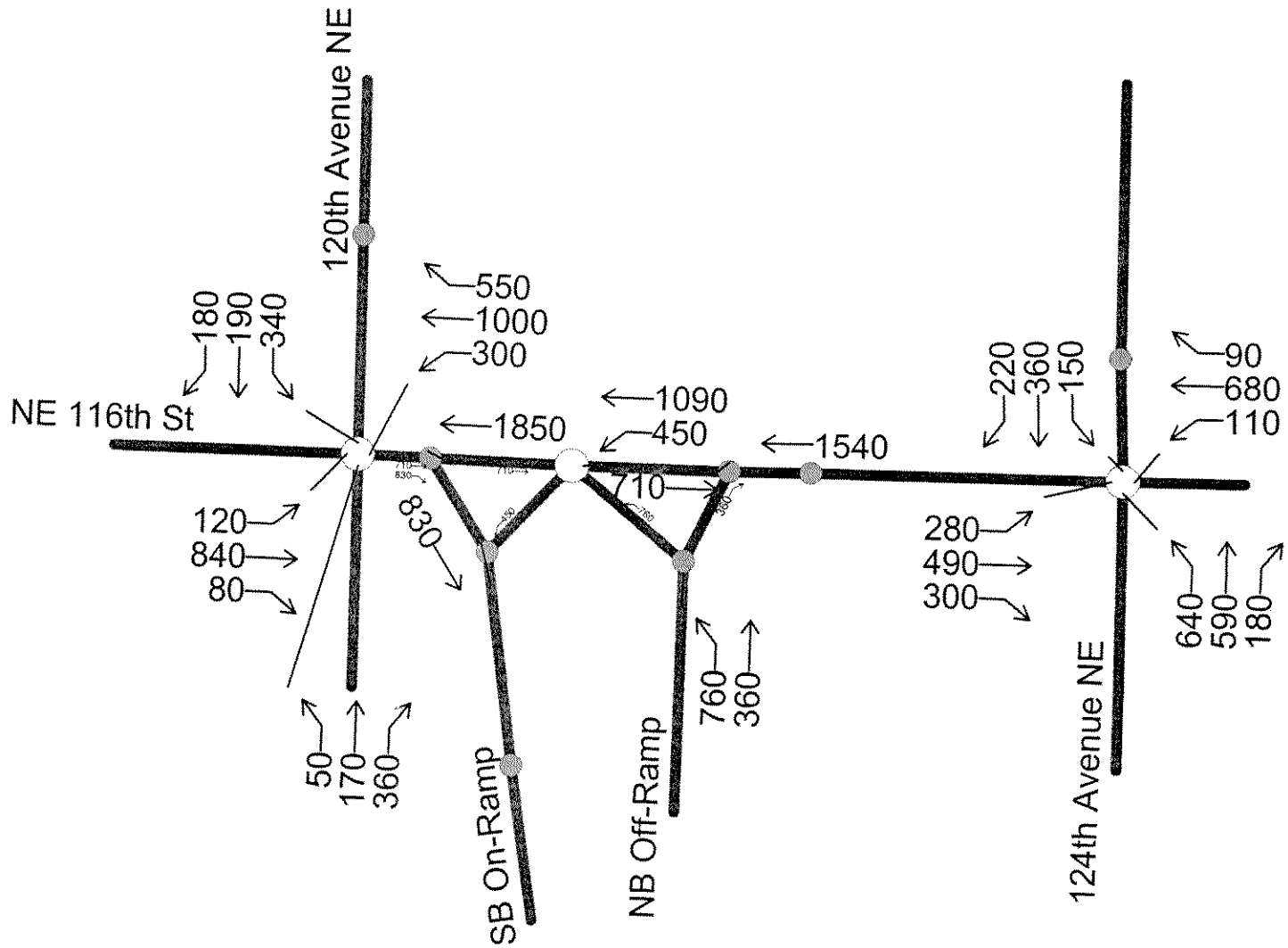
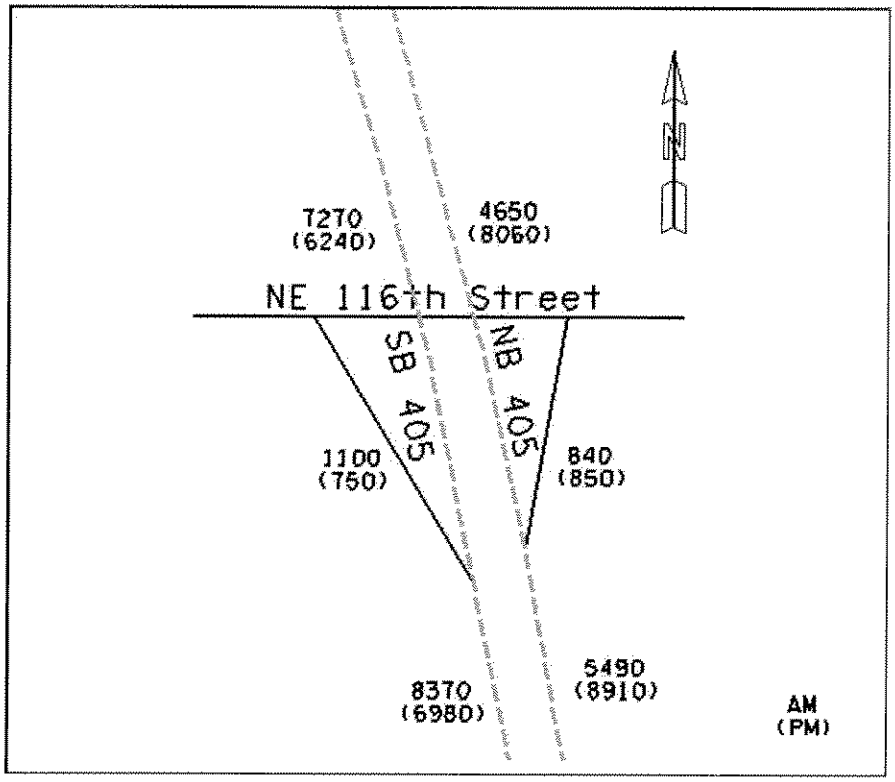
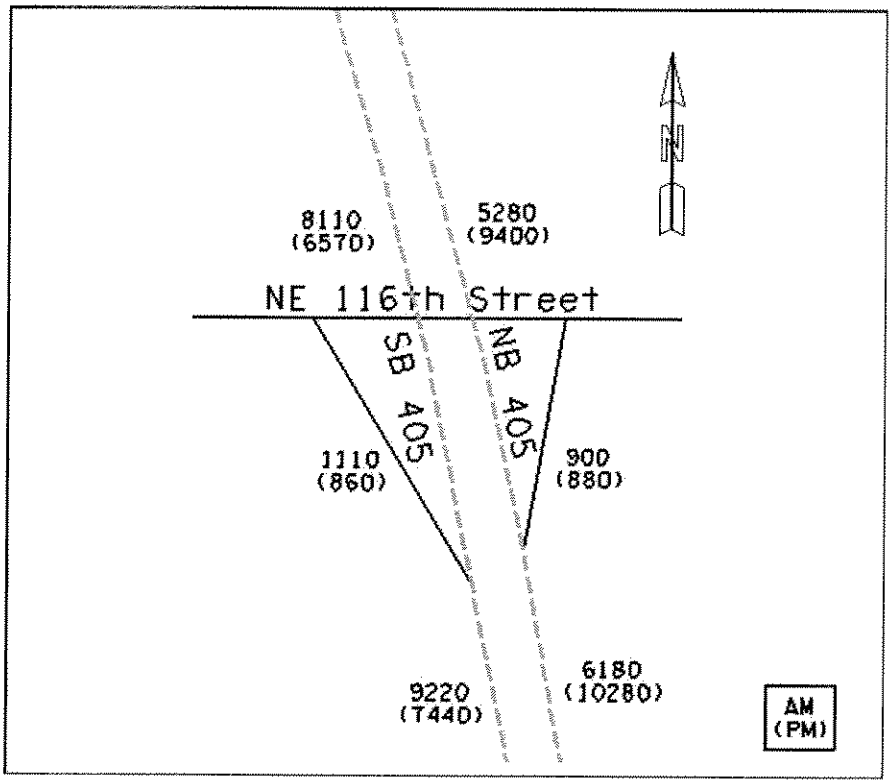




2014 No Action Freeway Demand Volumes



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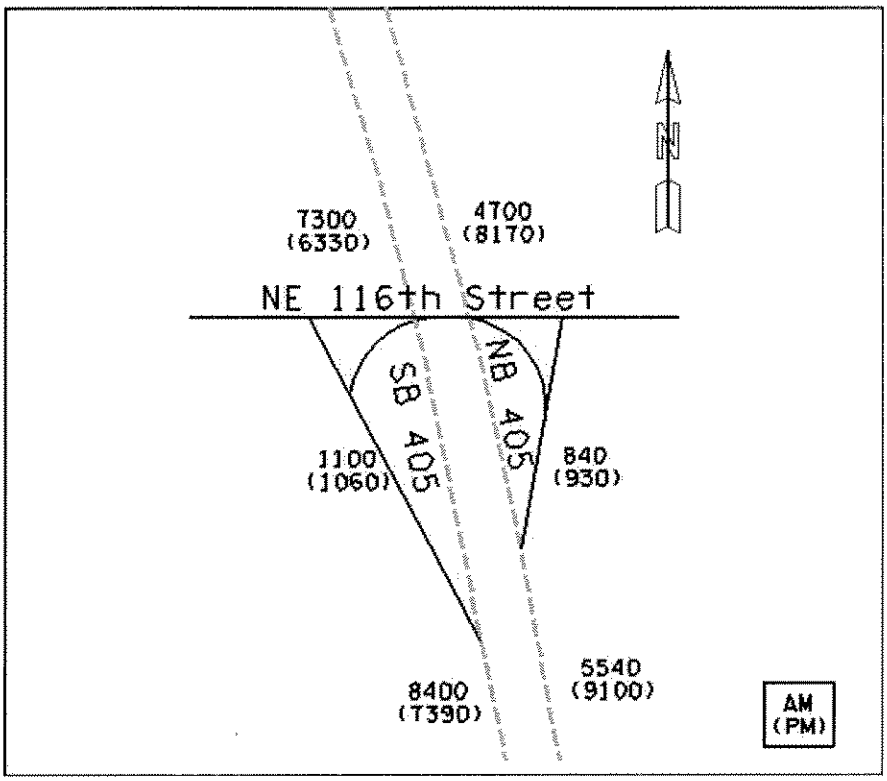
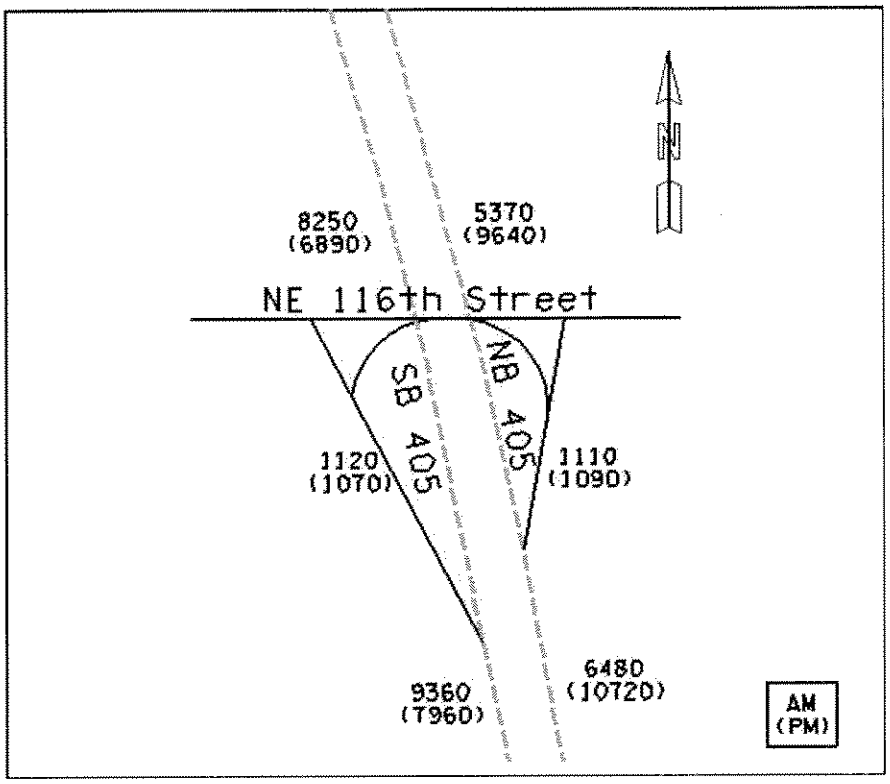


2014 Nickel Freeway Demand Volumes



2030 Nickel Freeway Demand Volumes

APPENDIX B

TRAFFIC ASSUMPTIONS

Introduction and Project Description

The following description of the I-405 Corridor Program is from the June 2002 Final EIS.

The proposed I-405 Corridor Program improvements include freeway widening, new high capacity transit (HCT), added arterial capacity, and other improvements that address multimodal transportation needs throughout the length of the I-405 corridor. The southern terminus of I-405, at its intersection with I-5 in the city of Tukwila, and northern terminus of I-405, at its intersection with I-5 in Snohomish County, was identified as logical limits for the proposal because the termini encompass the entire length of the I-405 facility. This enables proposed solutions to be examined at a level that demonstrates independent utility, and ensures that solutions consider the direct relationship with I-5, which is the major north-south travel route in western Washington.

The EIS Selected Alternative would provide expansion of I-405 by up to two lanes in each direction, along with improving major interchanges and connecting arterial/freeway capacity. In addition, collector-distributor lanes, auxiliary lanes, and truck climbing lanes would be added along I-405 at locations where they are warranted. The I-405/SR 167 interchange would be improved and SR 167 would be widened by up to two lanes in each direction south of I-405 to S 180th St in Kent. Arterial capacity and continuity improvements would be implemented, together with arterial improvements planned by local jurisdictions. A bus rapid transit (BRT) system would be developed throughout the I-405 corridor with east-west connections to Redmond and Issaquah. Local bus transit service within the study area would be increased by up to 75 percent based on demand. HOV direct access ramps on I-405, arterial HOV priority for transit, additional park-and-ride capacity, additional transit center capacity, a new bus maintenance and operating facility, and pedestrian and bicycle improvements would be provided.

The freeway design includes an added 4-foot buffer between the general purpose lanes and the HOV lane on I-405. The 4-foot buffer separation will allow for HOV safety and operations, and will also allow for future consideration of an expanded managed lanes operation along I-405.
Truck freight traffic improvements and an expanded package of TDM strategies will be implemented. The expanded TDM strategies may include pricing if adopted as part of a regional pricing policy.

Design Year and Opening Year

The assumed year of opening will be 2014. This year was selected as being a reasonable implementation year for both the Nickel gas tax projects and Implementation Plan improvements, based upon corridor priorities and assumed funding availability. Individual improvements within the corridor project sections may be open to traffic before 2014.

The design year, 2030, is consistent with the corridor strategic planning horizon and environmental documentation. It is 20 years past the start of construction, and is the forecast year for the regional Metropolitan Transportation Plan (MTP), "Destination 2030," adopted in May 2001. "Destination 2030" contains household, employment, and population forecasts for 2030. This plan, which superceded the 1995 MTP, meets federal and state planning process requirements. Federal law requires that the MTP be reviewed every three years and that a new plan be prepared or the existing plan be updated. The adoption of the next MTP update is assumed to be mid to late 2004, so the I-405 project forecasts are based on the current "Destination 2030" forecasts.

Year 2014 and 2030 both assume that the HOV lane and direct access ramps will operate at a 3+ eligibility requirement. The HOV bypass lanes at on ramps will have a 2+ requirement.

Intersection Analysis

Arterial street impacts are evaluated using the Synchro and CORSIM models at signalized intersections. Intersection traffic volumes were developed from the travel forecasts using a Fratar (matrix balancing) post-processing technique. The existing peak hour timing for intersection splits were recorded and entered into the Synchro files. The intersection operations analysis includes interchange ramp intersections and adjacent arterial intersections as required to demonstrate their ability to collect and distribute traffic to and from the interchange with revised access points.

The intersection peak hours occur earlier than the freeway peak hour. To be conservative, the intersection peak hour was used for the interchange analysis and the freeway peak hour volumes were used for the merge and diverge analysis.

Traffic Operations Analysis

The I-405 Projects require a simulation model capable of analyzing freeway and interchange/intersection geometry including weaving sections, multiple vehicle classes, and transit operations. VISSIM was selected for the I-405 Projects microsimulation, meets these needs, and also provides animation graphics. Operational modeling of the corridor was conducted over two six-hour periods (5-11 AM and 2-8 PM) using the VISSIM software. The existing **peak one-hour volumes** generally fall into the 7:00 – 8:00 AM and 4:00 – 5:00 PM time periods. The six-hour periods were required to capture the effects of total peak-period congestion on I-405 operations, particularly in the horizon years when significant peak-spreading is forecast to occur. All traffic analysis results are reported for the AM and PM peak hours only.
The following scenarios will be analyzed:

- 2002 Base Year
- 2014 No Action
- 2014 Nickel
- 2030 No Action
- 2030 Nickel

All results will be based on the AM and PM peak hours.

Travel Forecasts

For this study, the current regional model from PSRC is utilized for 2014 (year of opening) and 2030 (design year). The 2030 model includes projects adopted in the region's Metropolitan Transportation Plan ("Destination 2030," adopted May 24, 2001). Detailed analysis of each project section required roadway network detail not available in the four-county regional traffic model. Additional zonal and network detail was obtained from the local agency EMME/2 models in conjunction with the PSRC model. The network was checked to make sure all the future projects in the PSRC model are represented. Validation of the model at the screen line level was carried out for different time periods.

Existing volumes in the study area were used as a base for all forecasts of future year volumes. Volumes were derived from the following sources:

- AM and PM peak mixed-use traffic volumes on the mainline and associated ramps: WSDOT *Ramp & Roadway Traffic Report* – 2000 & 2002 and the Northwest Regional Traffic Data (2000, 2001, 2002, 2003)
- AM and PM peak intersection turning movement volumes at study area intersections: City of Bellevue, City of Bothell, City of Kirkland, City of Renton, City of Tukwila and Traffic Count Consultants.

Travel Forecast Model Assumptions

The projects listed below are assumed to be completed by the year 2014. These committed projects are included in all future forecast scenarios.

Projects Completed or Assumed Completed by 2004 / 2005	
• HOV I-405	SR-527 (Canyon Park) to I-5
• HOV I-5	S 320th termini
• SR-519	Phase 1
• SR-525	SR-99 to Paine Field (5 lanes)
• I-5	Direct HOV/Transit access Lynnwood Transit Center
• I-405	NE 128th Lane Access
• I-405	Direct HOV/Transit access Bellevue Transit Center
• I-90	Direct HOV/Transit access Eastgate Park and Ride
• King Co.	Sammamish Plateau Access Road
• WSDOT	Sunset Interchange
• ST	Tacoma Link
• ST	Commuter Rail: Tacoma to Seattle
• ST	2006 Service concepts
Nickel Projects Constructed by 2005	
• Pierce	SR7/SR 507 to SR 512
• Pierce	SR 161 Corridor Improvements – 176th to 234th
• Pierce	SR 16 HOV Imp - Olympic View Dr. to Union Ave.
• King	I-5 NE 175th St. to NE 205th St. - NB Auxiliary Lane
• King	I-90 - Two-Way Transit & HOV
• King	SR 161 - Jovita Blvd to S. 360th St.- Widen to 5 Lanes
• King	SR 167 - 15th St SW to 15th St NW - HOV
• King	SR 522 - Bothell - UW Campus Access
• King	I-5 - Pierce County Line to S 320th (Stage 4 HOV)
• King	SR 99 - Aurora Ave - N Corridor Transit/HOV Lanes
• Snohomish	SR 9 - SR 522 to 176th St. SE - Stage 1 and 2
• Snohomish	SR 527 - 132nd SE to 112th SE Additional Lanes
Nickel Projects Constructed After 2005	
• Pierce	I-5 - Port of Tacoma Road to King/Pierce Co. Line HOV
• Pierce	SR 161 - 36th to Jovita - Additional Lanes
• Pierce	SR 410 - Additional Lanes (214th to 234th
• Snohomish	I-5 - Everett - SR 526 to US 2 - HOV Lanes
• Snohomish	SR 522 - Snohomish River to US 2, 4 Lane Widening
• King	SR 520 - W Lake Sammamish Pkwy to SR 202 -Add HOV
2014 Committed Arterial Projects (I-405 Corridor Program EIS Project # shown in second column)	

• Bothell, Snohomish	R.AC-21	120th NE/39th SE - NE 195th to Maltby Rd - 4/5 lanes including new connection
• Bellevue	R-08	NE 29th Pl (148th Ave NE to NE 24th St)/Construct new 2-lane road
• Snohomish	R-10	SR 524 (24 St SW to SR 527)--- Widen to 4/5 lanes including sidewalks, bike lanes
• Kirkland	R-21	NE 120 St (Slater Ave to 124 Ave NE)--- Construct new 3-lane roadway with ped/bike facilities
• Redmond/ WSDOT	R-25	SR 202 Corridor Improvements (East Lake Sammamish Pkwy to Sahalee Way)--- Widen to 3/5 lanes; intersection improvements with bike/ped facilities
• Redmond	R-26	NE 90 St (Willows Rd to SR 202)--- Construct new 4/5 lanes + bike facilities
• Redmond	R-28	West Lake Sammamish Parkway (Leary Way to Bel-Red Rd) --- Widen to 4/5 lanes + CGS, bike lanes
• Renton	R-36	Oakesdale Ave SW (SW 31st to SW 16th)--- Construct new 5 lane roadway with CGS
• KCDOT	R-39 & R.AC-2	140 Ave SE (SR 169 to SE 208 St) --- Widen to 5 lanes SR 169 to SE 196 St, widen for turn channels on SE 196. Combines 2 King County CIP projects. A major North-South arterial that serves the Soos Creek Plateau and Fairwood.
• KCDOT	R-40 & R.IC-24	Juanita-Woodinville Way (NE 145 St to 112th Ave NE) Widen to 4/5 lanes + CGS, walkway/pathway
• KCDOT	R-47	NE 124 St (Willows Rd to SR 202)--- Widen to 3/4 lanes + CGS, bike facilities; traffic signal.
• Woodinville	R-51	Woodinville-Snohomish Rd/140 Ave NE (NE 175 St to SR 522)--- Widen to 4/5 lanes + CGS, bike lanes
• Bellevue	R-101	150th Ave SE---Widen to 7 lanes from SE 36th to SE 38th; add turn lanes
• Redmond	R-111 & R.AC-15	Willows Rd Corridor Improvements-- Channelization of Willows Rd/Redmond Way intersection and widening of Willows Rd from NE 116th to NE 124th
• Snohomish	R-117	39th Ave SE Realignment at SR 524 and York Rd--- Construct 4-way intersection to replace 2 offset intersections
• WSDOT	R.PA-27	SR 520/SR 202 Interchange --- Complete interchange by constructing a new ramp and thru lane on 202 to SR 520 (ETP R-29) NOTE: Part of Nickel Package

Outside of the I-405 corridor, the 2030 network consists of planned, programmed and reasonably foreseeable projects to be implemented during the next 20-25 years. This network includes all of the projects assumed for 2014, plus additional regional and local projects that have been given high priority in recent programming processes. Several of these projects have the potential to affect the travel conditions along the I-405 corridor, so their inclusion in the No Action network is important to establish realistic traffic forecasts for environmental and design purposes. All of the projects are included within the PSRC *Destination 2030* as being important to implement by 2030. While several are currently not funded, they have been consistently included in multi-jurisdictional funding forums, such as the RTID and ETP 10-year Mobility Action Priorities. Given the importance of transportation in the Puget Sound Region, it is

reasonable to assume that transportation investments will continue throughout the next 30 years. The assumed projects represent only a portion of the overall regional needs.

The following table provides a listing of the projects assumed to be completed by 2030. The selection of these projects met the following rationale:

- Included within Destination 2030;
- Included within established funding and prioritization processes (e.g. RTID; ETP, SKATBD etc);
- Potential to affect transportation conditions along the I-405 corridor; and
- Environmental processes either complete, in process or expected to be underway by 2005.

Regional Projects to Include for 2030 No Action Definition for I-405

Project	Project Description for Modeling Purposes (2030 No Action)	Description in Metropolitan Transportation Plan (MTP)	Justification for Assumed Model Description
Alaskan Way Viaduct	Existing capacity (4/6 lane expressway)	Existing capacity (4/6 lane expressway)	DEIS started- March 2004 completion
I-90 - Two-way Transit and HOV	Alternative R-8A- no rail across I-90.	Not specifically listed except for potential future conversion to light rail	DEIS done; FEIS 2004; preferred alternative selected; ties to future light rail across corridor
SR 18 (Auburn to I-90)	4 lane expressway SR 516 to I-90	4 lane expressway SR 516to I-90	EIS starting (nickel funding)

Intersection Traffic Forecasts

Future intersection volumes were developed using traffic forecasts from the PSRC models and post processed ramp volumes. The future estimates of demand were then applied to the existing turning movement counts to determine future traffic volumes.