

Exhibit C-2: Supplement for Traffic Analysis for Title 4

April 19, 2010

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Portland Bureau of Transportation (PBOT) finished the Transportation Planning Analysis two years ago in supporting the Northwest District Plan (NWDP) Remand Project by Portland Bureau of Planning and Sustainability (BPS).

This supplement provides the analysis needed to determine whether the changes proposed meet the requirements set by Metro's Urban Growth Management Function Plan (UGMFP), Title 4. I-405 is designated as a Main Freight Roadway and NW Nicolai St is designated as a Freight Road Connector in the RTP (Regional Transportation Plan). Therefore, an analysis to demonstrate their off-peak hour traffic operational conditions is warranted.

The standards set by the Title 4 Section 3.07.450.C.4 are listed in Table 1. This supplement provides data to show that standard in Criteria 2 is met. The main report (Exhibit C-1 Traffic Analysis for Title 4) contains the analysis showing that the standard in Criterion 1 is met.

Table 1. Off-Peak Performance Standards

		Standards
Criteria 1	Metro RTP Standards ¹ in LOS	E
Criteria 2	ODOT 1999 OHP ² in v/c	0.99

1. Metro's RTP Table 2.4, Regional Mobility Policy, LOS = Level of Service

2. ODOT's 1999 Oregon Highway Plan, Table 7.

Three intersections are analyzed in this supplement:

- NW Nicolai St at NW Wardway St / NW 29th Ave.
- NW Nicolai St at US 30
- NW Vaughn St at NW 23rd Ave / I-405 ramps

Findings

The analysis finds that volume-to-capacity ratios for all three intersections are projected increase slightly between 2010 and 2030, as indicated in Table 2. However, they all will continue to meet the standard in Criteria 2. Furthermore, they all will continue to have the same level of service, as shown in Table 3.

Table 2. Off-Peak Operational Conditions in volume-to-capacity ratios

	2010	2030
NW Nicolai St at NW Wardway St	0.44	0.56
NW Nicolai St at US 30	0.51	0.76
NW Vaughn St at NW 23 rd Ave	0.8	0.93

Table 3. Off-Peak Operational Conditions in LOS

	2010	2030
NW Nicolai St at NW Wardway St	C	C
NW Nicolai St at US 30	B	B
NW Vaughn St at NW 23 rd Ave	D	D

Methodology

No off-peak TMC (turning movement counts) were collected two years ago when the NW Remand traffic analysis were performed. For this Title-4 analysis, fresh 2010 off-peak TMCs are collected¹ for evaluating the current conditions. City doesn't have off-peak demand model to produce the future off-peak demands for NW Remand traffic analysis. The future off-peak traffic demands are estimated from the projected future PM demands by the formula:

$$V_{2030\text{offpeak}} = V_{2010\text{off-peak}} + \Delta V_{\text{pm2030-pm2007}} \times (V_{\text{offpeak}} / V_{\text{pmpeak}})$$

Where Δ is the model projected PM traffic growth in turning movements from 2007 to 2030.

Synchro software is used in the operational analysis to derive the LOS and V/C data. All three signals are evaluated as the controller of Actuated & Uncoordinated, which are the specifications of current signal timing plans on the site. All other current signal settings are applied in the analysis. Intersection geometric configurations coded in the model are all as same as current street layouts.

The LOS readings are extracted from Synchro's HCM (Highway Capacity Manual) Signalized Intersection Capacity Analysis Reports.

Traffic Data

Table 4 lists the 2010 TMCs and projected 2030 traffic demands for the three intersections supporting the analysis.

Table 4. Off-Peak Hour Turning Movement Volumes in the Analysis

		eastbound			westbound			northbound			southbound			total
		L	T	R	L	T	R	L	T	R	L	T	R	
Nicolai / US30	2010	85	15	305	40	25	70	150	885	45	45	985	115	2765
	2030	85	15	345	70	25	70	560	1090	85	45	1270	115	3775
Nicolai / Wardway	2010	5	220	225	20	185	20	210	45	15	25	55	5	1030
	2030	10	345	335	20	310	20	255	45	15	25	55	5	1440
Vaughn / 23rd	2010	0	495	85	165/305	475	155	100	65	420	120	60	25	2470
	2030	0	555	85	180/360	510	340	100	65	455	155	75	25	2905



















¹ NW 29th Ave. n/ NW Nicolai St is closed to through traffic due to constructions currently, and it is a important leg of the intersection. Therefore, 24-hour link counts on all three other major approaching legs are collected and the existing TMC is estimated from the time of day factor and two AM / PM TMCs collected in 2007. The time of the day factor is calculated at approach level, and the formula of (am+pm)/2 is used to distribute the turn movements.

Appendix

- a. HCM (highway Capacity Manual) Reports from Synchro for the three intersections, 2010 and 2030
- b. 2010 off-peak TMCs on the two intersections
- c. 24-hour counts on legs of the intersection of Nicolai St at NW Wardway St.

HCM Signalized Intersection Capacity Analysis

2010 Off-Peak
NW Nicolai St @ Wardway & 29th Ave

												
Movement	EBL	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	NBR2
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0	4.0			4.0		
Lane Util. Factor	1.00	1.00	1.00			1.00	1.00			1.00		
Frt	1.00	1.00	0.85			1.00	0.99			0.88		
Flt Protected	0.95	1.00	1.00			0.95	1.00			0.99		
Satd. Flow (prot)	1770	1863	1583			1770	1835			1634		
Flt Permitted	0.55	1.00	1.00			0.95	1.00			0.96		
Satd. Flow (perm)	1024	1863	1583			1770	1835			1580		
Volume (vph)	5	220	225	5	5	20	185	20	3	0	5	13
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	239	245	5	5	22	201	22	3	0	5	14
RTOR Reduction (vph)	0	0	0	0	0	0	3	0	0	12	0	0
Lane Group Flow (vph)	5	239	250	0	0	27	220	0	0	10	0	0
Turn Type	pm+pt		custom		Prot	Prot			Perm			
Protected Phases	1	3 6	6 7		5	5	2 3			4		
Permitted Phases	3 6								4			
Actuated Green, G (s)	35.9	34.3	36.6			2.0	32.5			8.5		
Effective Green, g (s)	36.1	33.3	38.4			1.0	31.5			8.7		
Actuated g/C Ratio	0.49	0.45	0.52			0.01	0.43			0.12		
Clearance Time (s)	5.2					3.0				4.2		
Vehicle Extension (s)	3.0					3.0				3.0		
Lane Grp Cap (vph)	531	844	827			24	786			187		
v/s Ratio Prot	c0.00	c0.13	c0.16			c0.02	0.12					
v/s Ratio Perm	0.00									0.01		
v/c Ratio	0.01	0.28	0.30			1.12	0.28			0.05		
Uniform Delay, d1	9.6	12.6	9.9			36.2	13.6			28.7		
Progression Factor	1.00	1.00	1.00			1.00	1.00			1.00		
Incremental Delay, d2	0.0	0.2	0.2			225.0	0.2			0.1		
Delay (s)	9.6	12.8	10.2			261.2	13.8			28.9		
Level of Service	A	B	B			F	B			C		
Approach Delay (s)		11.4					40.5			28.9		
Approach LOS		B					D			C		
Intersection Summary												
HCM Average Control Delay			24.8			HCM Level of Service				C		
HCM Volume to Capacity ratio			0.44									
Actuated Cycle Length (s)			73.5			Sum of lost time (s)				16.0		
Intersection Capacity Utilization			54.2%			ICU Level of Service				A		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis






















2010 Off-Peak
NW Nicolai St @ Wardway & 29th Ave



Movement	SBL2	SBL	SBT	SBR	NWL	NWR	NWR2
Lane Configurations			↔		↔	↔	↔
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0		4.0	4.0	4.0
Lane Util. Factor			1.00		1.00	1.00	1.00
Frt			0.98		1.00	0.85	0.85
Flt Protected			0.96		0.95	1.00	1.00
Satd. Flow (prot)			1758		1770	1583	1583
Flt Permitted			0.74		0.95	1.00	1.00
Satd. Flow (perm)			1351		1770	1583	1583
Volume (vph)	25	55	1	10	210	45	15
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	60	1	11	228	49	16
RTOR Reduction (vph)	0	0	5	0	0	0	13
Lane Group Flow (vph)	0	0	94	0	228	49	3
Turn Type	Perm	Perm				Prot	Prot
Protected Phases			4		7	7	7
Permitted Phases	4	4					
Actuated Green, G (s)			8.5		13.3	13.3	13.3
Effective Green, g (s)			8.7		14.5	14.5	14.5
Actuated g/C Ratio			0.12		0.20	0.20	0.20
Clearance Time (s)			4.2		5.2	5.2	5.2
Vehicle Extension (s)			3.0		3.0	3.0	3.0
Lane Grp Cap (vph)			160		349	312	312
v/s Ratio Prot					c0.13	0.03	0.00
v/s Ratio Perm			c0.07				
v/c Ratio			0.59		0.65	0.16	0.01
Uniform Delay, d1			30.7		27.2	24.4	23.7
Progression Factor			1.00		1.00	1.00	1.00
Incremental Delay, d2			5.4		4.3	0.2	0.0
Delay (s)			36.1		31.5	24.7	23.7
Level of Service			D		C	C	C
Approach Delay (s)			36.1		30.0		
Approach LOS			D		C		
Intersection Summary							













HCM Signalized Intersection Capacity Analysis

2010 Off Peak
NW Nicolai St / US-30 & Yeon Ave

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00		0.97	0.91		1.00	0.95	1.00
Frpb, ped/bikes		1.00	1.00		0.99		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes		0.99	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.95		0.93		1.00	0.99		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1777	1770		1682		3433	5042		1770	3539	1549
Flt Permitted		0.60	1.00		0.88		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1102	1770		1495		3433	5042		1770	3539	1549
Volume (vph)	85	15	305	40	25	70	150	885	45	45	985	115
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	89	16	321	42	26	74	158	932	47	47	1037	121
RTOR Reduction (vph)	0	0	0	0	48	0	0	5	0	0	0	57
Lane Group Flow (vph)	0	105	321	0	94	0	158	974	0	47	1037	64
Confl. Peds. (#/hr)	4					4	8		4	4		8
Turn Type	Perm	custom		Perm			Prot			Prot	custom	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		5 6 8	4								6
Actuated Green, G (s)		12.2	81.2		12.2		14.4	40.8		11.9	39.4	40.8
Effective Green, g (s)		13.8	81.2		13.8		14.5	42.8		12.6	40.9	42.8
Actuated g/C Ratio		0.17	1.00		0.17		0.18	0.53		0.16	0.50	0.53
Clearance Time (s)		5.6			5.6		4.1	6.0		4.7	5.5	6.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		187	1770		254		613	2658		275	1783	816
v/s Ratio Prot							c0.05	0.19		0.03	c0.29	
v/s Ratio Perm		c0.10	c0.18		0.06							0.04
v/c Ratio		0.56	0.18		0.37		0.26	0.37		0.17	0.58	0.08
Uniform Delay, d1		30.9	0.0		29.8		28.7	11.3		29.8	14.1	9.5
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		3.8	0.0		0.9		1.0	0.4		1.3	1.4	0.2
Delay (s)		34.7	0.0		30.8		29.7	11.6		31.1	15.5	9.7
Level of Service		C	A		C		C	B		C	B	A
Approach Delay (s)		8.6			30.8			14.2			15.6	
Approach LOS		A			C			B			B	
Intersection Summary												
HCM Average Control Delay		14.7					HCM Level of Service			B		
HCM Volume to Capacity ratio		0.51										
Actuated Cycle Length (s)		81.2					Sum of lost time (s)		12.0			
Intersection Capacity Utilization		64.2%					ICU Level of Service		C			
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis



















2010 Off Peak
I-405 Ramp/Vaughn St @ NW 23rd Ave

												
Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations		↑↑			↓	↑↑	↑	↓	↑	↑	↓	↓
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		0.95			1.00	0.95	1.00	1.00	0.95	0.95	1.00	1.00
Frpb, ped/bikes		0.99			1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes		1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.98			1.00	1.00	0.85	1.00	0.89	0.85	1.00	0.96
Flt Protected		1.00			0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)		3430			1770	3539	1583	1770	1570	1504	1770	1746
Flt Permitted		1.00			0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (perm)		3430			1770	3539	1583	1770	1570	1504	1770	1746
Volume (vph)	0	495	85	165	305	475	155	100	65	420	120	60
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	521	89	174	321	500	163	105	68	442	126	63
RTOR Reduction (vph)	0	12	0	0	0	0	69	0	0	0	0	13
Lane Group Flow (vph)	0	598	0	0	495	500	94	105	276	234	126	76
Confl. Peds. (#/hr)	1		16		16		1	40				
Turn Type				Prot	Prot		Prot	Prot		Prot	Prot	
Protected Phases		2		1	1	6	6	3	8	8	7	4
Permitted Phases												
Actuated Green, G (s)		20.6			29.5	54.1	54.1	8.2	20.0	20.0	7.7	19.5
Effective Green, g (s)		20.6			29.5	54.1	54.1	8.2	20.0	20.0	7.7	19.5
Actuated g/C Ratio		0.22			0.31	0.58	0.58	0.09	0.21	0.21	0.08	0.21
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		753			557	2041	913	155	335	321	145	363
v/s Ratio Prot		c0.17			c0.28	0.14	0.06	0.06	c0.18	0.16	c0.07	0.04
v/s Ratio Perm												
v/c Ratio		0.79			0.89	0.24	0.10	0.68	0.82	0.73	0.87	0.21
Uniform Delay, d1		34.6			30.6	9.8	8.9	41.5	35.2	34.4	42.6	30.8
Progression Factor		1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		5.8			15.8	0.1	0.0	11.1	15.0	8.0	38.6	0.3
Delay (s)		40.4			46.4	9.8	9.0	52.7	50.3	42.4	81.2	31.0
Level of Service		D			D	A	A	D	D	D	F	C
Approach Delay (s)		40.4				25.4			47.7			60.4
Approach LOS		D				C			D			E
Intersection Summary												
HCM Average Control Delay		37.1			HCM Level of Service				D			
HCM Volume to Capacity ratio		0.80										
Actuated Cycle Length (s)		93.8			Sum of lost time (s)				12.0			
Intersection Capacity Utilization		80.0%			ICU Level of Service				D			
Analysis Period (min)		15										
c Critical Lane Group												

Movement	SBR
Lane Configurations	
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Volume (vph)	25
Peak-hour factor, PHF	0.95
Adj. Flow (vph)	26
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	40
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

2030 Off-Peak
NW Nicolai St @ Wardway & 29th Ave

													
Movement	EBL	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	NBR2	
Lane Configurations													
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0	4.0			4.0	4.0			4.0			
Lane Util. Factor	1.00	1.00	1.00			1.00	1.00			1.00			
Frt	1.00	1.00	0.85			1.00	0.99			0.88			
Flt Protected	0.95	1.00	1.00			0.95	1.00			0.99			
Satd. Flow (prot)	1770	1863	1583			1770	1846			1634			
Flt Permitted	0.47	1.00	1.00			0.95	1.00			0.96			
Satd. Flow (perm)	866	1863	1583			1770	1846			1578			
Volume (vph)	10	345	335	5	5	20	310	20	3	0	5	13	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Adj. Flow (vph)	11	375	364	5	5	22	337	22	3	0	5	14	
RTOR Reduction (vph)	0	0	1	0	0	0	2	0	0	12	0	0	
Lane Group Flow (vph)	11	375	368	0	0	27	357	0	0	10	0	0	
Turn Type	pm+pt	custom		Prot		Prot	Perm						
Protected Phases	1	3 6	6 7	5		5	2 3	4					
Permitted Phases	3 6						4						
Actuated Green, G (s)	32.9	32.4	34.2			2.0	33.9	8.6					
Effective Green, g (s)	31.4	31.4	36.0			1.0	32.9	8.8					
Actuated g/C Ratio	0.43	0.43	0.49			0.01	0.45	0.12					
Clearance Time (s)	3.0						3.0	4.2					
Vehicle Extension (s)	3.0						3.0	3.0					
Lane Grp Cap (vph)	368	793	772			24	823	188					
v/s Ratio Prot		c0.20	0.23			c0.02	0.19						
v/s Ratio Perm	0.01						0.01						
v/c Ratio	0.03	0.47	0.48			1.12	0.43	0.05					
Uniform Delay, d1	12.3	15.2	12.6			36.4	14.0	28.8					
Progression Factor	1.00	1.00	1.00			1.00	1.00	1.00					
Incremental Delay, d2	0.0	0.4	0.5			225.0	0.4	0.1					
Delay (s)	12.4	15.7	13.1			261.4	14.4	28.9					
Level of Service	B	B	B			F	B	C					
Approach Delay (s)		14.4					31.7	28.9					
Approach LOS		B					C	C					
Intersection Summary													
HCM Average Control Delay			23.4	HCM Level of Service		C							
HCM Volume to Capacity ratio			0.56										
Actuated Cycle Length (s)			73.8	Sum of lost time (s)		16.0							
Intersection Capacity Utilization			56.7%	ICU Level of Service		B							
Analysis Period (min)			15										
c Critical Lane Group													

HCM Signalized Intersection Capacity Analysis






















2030 Off-Peak
NW Nicolai St @ Wardway & 29th Ave



Movement	SBL2	SBL	SBT	SBR	NWL	NWR	NWR2
Lane Configurations			↔		↔	↔	↔
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0		4.0	4.0	4.0
Lane Util. Factor			1.00		1.00	1.00	1.00
Frt			0.98		1.00	0.85	0.85
Flt Protected			0.96		0.95	1.00	1.00
Satd. Flow (prot)			1758		1770	1583	1583
Flt Permitted			0.74		0.95	1.00	1.00
Satd. Flow (perm)			1351		1770	1583	1583
Volume (vph)	25	55	1	10	255	45	15
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	60	1	11	277	49	16
RTOR Reduction (vph)	0	0	5	0	0	0	12
Lane Group Flow (vph)	0	0	94	0	277	49	4
Turn Type	Perm	Perm				Prot	Prot
Protected Phases			4		7	7	7
Permitted Phases	4	4					
Actuated Green, G (s)			8.6		15.4	15.4	15.4
Effective Green, g (s)			8.8		16.6	16.6	16.6
Actuated g/C Ratio			0.12		0.22	0.22	0.22
Clearance Time (s)			4.2		5.2	5.2	5.2
Vehicle Extension (s)			3.0		3.0	3.0	3.0
Lane Grp Cap (vph)			161		398	356	356
v/s Ratio Prot					c0.16	0.03	0.00
v/s Ratio Perm			c0.07				
v/c Ratio			0.58		0.70	0.14	0.01
Uniform Delay, d1			30.8		26.3	22.9	22.2
Progression Factor			1.00		1.00	1.00	1.00
Incremental Delay, d2			5.3		5.2	0.2	0.0
Delay (s)			36.0		31.5	23.1	22.2
Level of Service			D		C	C	C
Approach Delay (s)			36.0		29.9		
Approach LOS			D		C		
Intersection Summary							













HCM Signalized Intersection Capacity Analysis

2030 Off Peak
NW Nicolai St / US30 & Yeon Ave

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00		0.97	0.91		1.00	0.95	1.00
Frpb, ped/bikes		1.00	1.00		0.99		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.95		0.94		1.00	0.99		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1787	1770		1698		3433	5020		1770	3539	1548
Flt Permitted		0.56	1.00		0.78		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1051	1770		1351		3433	5020		1770	3539	1548
Volume (vph)	85	15	345	70	25	70	560	1090	85	45	1270	115
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	89	16	363	74	26	74	589	1147	89	47	1337	121
RTOR Reduction (vph)	0	0	0	0	30	0	0	9	0	0	0	45
Lane Group Flow (vph)	0	105	363	0	144	0	589	1227	0	47	1337	76
Confl. Peds. (#/hr)	4						4	8		4	4	8
Turn Type	Perm	custom		Perm			Prot			Prot	custom	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		5 6 8	4								6
Actuated Green, G (s)		12.3	88.0		12.3		19.9	53.5		5.9	40.6	53.5
Effective Green, g (s)		13.9	88.0		13.9		20.0	55.5		6.6	42.1	55.5
Actuated g/C Ratio		0.16	1.00		0.16		0.23	0.63		0.08	0.48	0.63
Clearance Time (s)		5.6			5.6		4.1	6.0		4.7	5.5	6.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		166	1770		213		780	3166		133	1693	976
v/s Ratio Prot							c0.17	0.24		0.03	c0.38	
v/s Ratio Perm		0.10	0.21		c0.11							0.05
v/c Ratio		0.63	0.21		0.67		0.76	0.39		0.35	0.79	0.08
Uniform Delay, d1		34.7	0.0		34.9		31.7	7.9		38.7	19.2	6.3
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		7.6	0.1		8.2		6.7	0.4		7.2	3.8	0.2
Delay (s)		42.3	0.1		43.1		38.4	8.3		45.9	23.1	6.5
Level of Service		D	A		D		D	A		D	C	A
Approach Delay (s)		9.5			43.1			18.0			22.5	
Approach LOS		A			D			B			C	
Intersection Summary												
HCM Average Control Delay		19.8					HCM Level of Service			B		
HCM Volume to Capacity ratio		0.76										
Actuated Cycle Length (s)		88.0					Sum of lost time (s)			12.0		
Intersection Capacity Utilization		77.4%					ICU Level of Service			D		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2030 Off Peak
I-405 Ramp/Vaughn St @ NW 23rd Ave

												
Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations		↑↑			↓	↑↑	↑	↓	↑	↑	↓	↑
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		0.95			1.00	0.95	1.00	1.00	0.95	0.95	1.00	1.00
Frpb, ped/bikes		0.99			1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes		1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.98			1.00	1.00	0.85	1.00	0.88	0.85	1.00	0.96
Flt Protected		1.00			0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)		3437			1770	3539	1583	1770	1565	1504	1770	1760
Flt Permitted		1.00			0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (perm)		3437			1770	3539	1583	1770	1565	1504	1770	1760
Volume (vph)	0	555	85	180	360	510	340	100	65	455	155	75
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	584	89	189	379	537	358	105	68	479	163	79
RTOR Reduction (vph)	0	11	0	0	0	0	151	0	0	0	0	10
Lane Group Flow (vph)	0	662	0	0	568	537	207	105	296	251	163	95
Confl. Peds. (#/hr)	1		16		16		1	40				
Turn Type				Prot	Prot		Prot	Prot		Prot	Prot	
Protected Phases		2		1	1	6	6	3	8	8	7	4
Permitted Phases												
Actuated Green, G (s)		23.0			35.7	62.7	62.7	9.3	22.5	22.5	11.0	24.2
Effective Green, g (s)		23.0			35.7	62.7	62.7	9.3	22.5	22.5	11.0	24.2
Actuated g/C Ratio		0.21			0.33	0.58	0.58	0.09	0.21	0.21	0.10	0.22
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		731			584	2051	917	152	325	313	180	394
v/s Ratio Prot		c0.19			c0.32	0.15	0.13	0.06	c0.19	0.17	c0.09	0.05
v/s Ratio Perm												
v/c Ratio		0.91			0.97	0.26	0.23	0.69	0.91	0.80	0.91	0.24
Uniform Delay, d1		41.5			35.8	11.3	11.0	48.1	41.9	40.7	48.1	34.5
Progression Factor		1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		14.7			30.2	0.1	0.1	12.7	28.4	13.7	41.0	0.3
Delay (s)		56.3			66.0	11.3	11.1	60.8	70.2	54.5	89.1	34.8
Level of Service		E			E	B	B	E	E	D	F	C
Approach Delay (s)		56.3				32.5			62.6			67.8
Approach LOS		E				C			E			E
Intersection Summary												
HCM Average Control Delay		47.3			HCM Level of Service				D			
HCM Volume to Capacity ratio		0.93										
Actuated Cycle Length (s)		108.2			Sum of lost time (s)				16.0			
Intersection Capacity Utilization		88.9%			ICU Level of Service				E			
Analysis Period (min)		15										
c Critical Lane Group												

Movement	SBR
Lane Configurations	
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Volume (vph)	25
Peak-hour factor, PHF	0.95
Adj. Flow (vph)	26
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	40
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

City of Portland

Office of Transportation
1120 SW 5th Ave, Rm 800
Portland, OR 97204

Cldy 55f By: CDB/RC For: Zhou

NW NICOLAI ST @ NW YEON AVE/I405 RAMPS

File Name : 100413TOB

Site Code : 00000000

Start Date : 4/13/2010

Page No : 1

Groups Printed- VEHS PEDS

Start Time	NW YEON AVE Southbound					NW NICOLAI ST Westbound					NW YEON AVE/I405 RAMP Northbound					NW NICOLAI ST Eastbound					Exclu. Total	Inclu. Total	Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total			
11:00	8	216	17	0	241	14	7	8	0	29	46	201	12	0	259	16	7	68	0	91	0	620	620
11:15	9	230	21	0	260	17	3	9	0	29	40	225	18	0	283	7	10	68	0	85	0	657	657
11:30	5	239	35	0	279	24	12	8	0	44	39	182	15	0	236	19	9	72	1	100	1	659	660
11:45	9	264	20	0	293	17	12	6	0	35	31	250	14	0	295	15	3	76	0	94	0	717	717
Total	31	949	93	0	1073	72	34	31	0	137	156	858	59	0	1073	57	29	284	1	370	1	2653	2654
12:00	7	231	22	0	260	13	8	17	0	38	41	201	6	0	248	20	3	96	0	119	0	665	665
12:15	12	248	31	0	291	8	2	26	0	36	45	216	13	0	274	24	7	72	0	103	0	704	704
12:30	17	243	41	0	301	3	1	21	0	25	35	219	12	0	266	24	4	62	0	90	0	682	682
12:45	13	245	19	0	277	9	6	21	0	36	52	230	19	0	301	24	3	51	0	78	0	692	692
Total	49	967	113	0	1129	33	17	85	0	135	173	866	50	0	1089	92	17	281	0	390	0	2743	2743
Grand Total	80	1916	206	0	2202	105	51	116	0	272	329	1724	109	0	2162	149	46	565	1	760	1	5396	5397
Apprch %	3.6	87	9.4			38.6	18.8	42.6			15.2	79.7	5			19.6	6.1	74.3					
Total %	1.5	35.5	3.8		40.8	1.9	0.9	2.1		5	6.1	31.9	2		40.1	2.8	0.9	10.5		14.1	0	100	

NOTE: NW 29TH AVE CLOSED YEON TO NICOLAI

City of Portland

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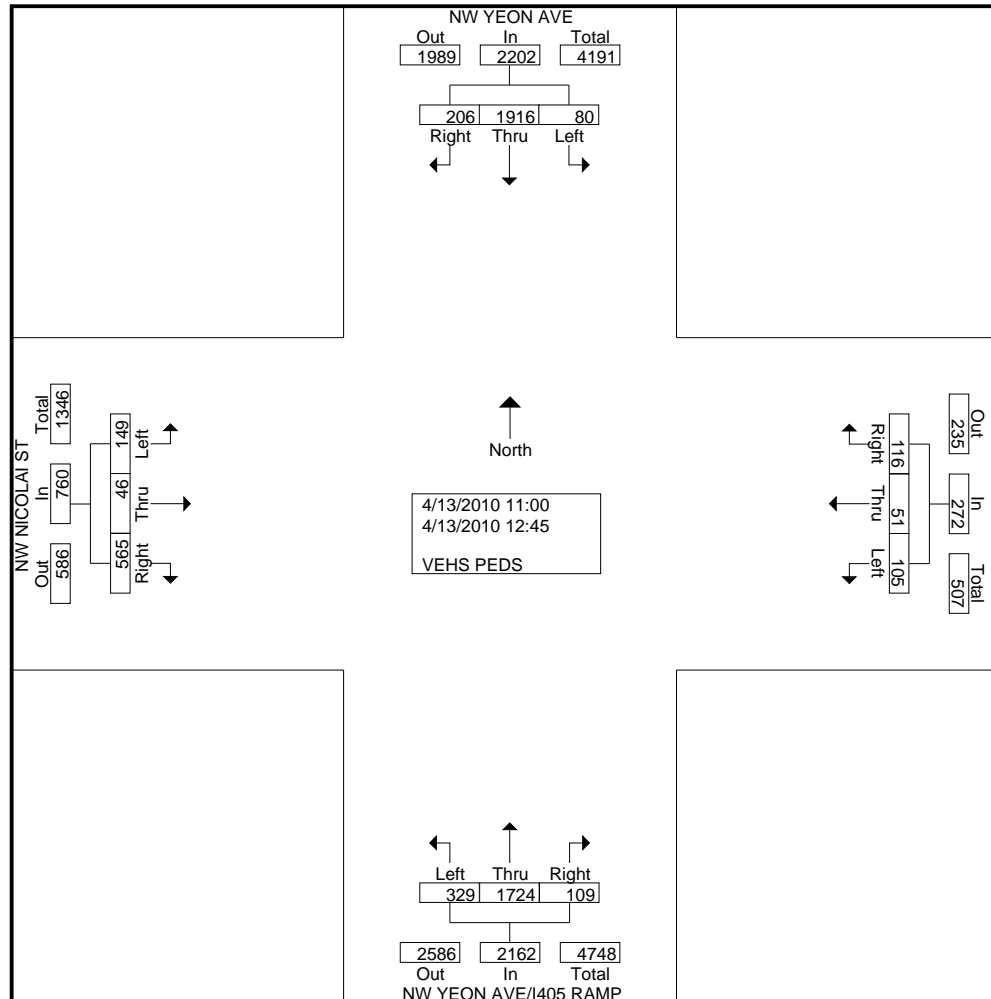
NW NICOLAI ST @ NW YEON AVE/I405 RAMPS

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NW NICOLAI ST @ NW YEON AVE/I405 RAMPS

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	NW YEON AVE Southbound				NW NICOLAI ST Westbound				NW YEON AVE/I405 RAMP Northbound				NW NICOLAI ST Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 11:00 to 12:45 - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 11:45																	
11:45	9	264	20	293	17	12	6	35	31	250	14	295	15	3	76	94	717
12:00	7	231	22	260	13	8	17	38	41	201	6	248	20	3	96	119	665
12:15	12	248	31	291	8	2	26	36	45	216	13	274	24	7	72	103	704
12:30	17	243	41	301	3	1	21	25	35	219	12	266	24	4	62	90	682
Total Volume	45	986	114	1145	41	23	70	134	152	886	45	1083	83	17	306	406	2768
% App. Total	3.9	86.1	10		30.6	17.2	52.2		14	81.8	4.2		20.4	4.2	75.4		
PHF	.662	.934	.695	.951	.603	.479	.673	.882	.844	.886	.804	.918	.865	.607	.797	.853	.965

City of Portland

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O'cast by: CDB For: Zhou

NW 23RD AVE/VAUGHN ST/I405 NB EX

File Name : 100407TOB

Site Code : 00000000

Start Date : 4/7/2010

Page No : 1

Groups Printed- VEHS PEDS

	NW 23RD AVE Southbound					I-405 NB EX Southwestbound					NW VAUGHN ST Westbound		NW 23RD AVE Northbound					NW VAUGHN ST Eastbound								
Start Time	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Exclu. Total	Inclu. Total	Int. Total
10:00	23	6	7	0	36	43	87	118	28	0	276	0	0	8	10	88	0	106	0	107	12	4	123	0	541	541
10:15	34	17	5	1	56	41	77	120	39	0	277	0	0	24	15	130	0	169	0	96	10	0	106	1	608	609
10:30	28	15	6	1	49	51	77	106	36	0	270	0	0	20	13	95	0	128	0	112	21	1	134	1	581	582
10:45	37	13	11	0	61	48	68	132	35	0	283	0	0	22	22	89	0	133	0	128	18	7	153	0	630	630
Total	122	51	29	2	202	183	309	476	138	0	1106	0	0	74	60	402	0	536	0	443	61	12	516	2	2360	2362
11:00	24	15	10	4	49	44	88	116	31	0	279	0	0	23	14	102	0	139	0	135	21	3	159	4	626	630
11:15	26	19	2	2	47	39	51	126	47	0	263	0	0	22	17	111	0	150	0	131	17	5	153	2	613	615
11:30	32	14	6	2	52	39	71	120	38	0	268	0	0	31	12	93	0	136	1	115	28	14	158	2	614	616
11:45	38	11	7	0	56	44	96	114	38	0	292	0	0	25	20	114	0	159	0	113	17	0	130	0	637	637
Total	120	59	25	8	204	166	306	476	154	0	1102	0	0	101	63	420	0	584	1	494	83	22	600	8	2490	2498
Grand Total	242	110	54	10	406	349	615	952	292	0	2208	0	0	175	123	822	0	1120	1	937	144	34	1116	10	4850	4860
Apprch %	59.6	27.1	13.3			15.8	27.9	43.1	13.2	0		0		15.6	11	73.4	0		0.1	84	12.9	3				
Total %	5	2.3	1.1		8.4	7.2	12.7	19.6	6	0	45.5	0	0	3.6	2.5	16.9	0	23.1	0	19.3	3	0.7	23	0.2	99.8	

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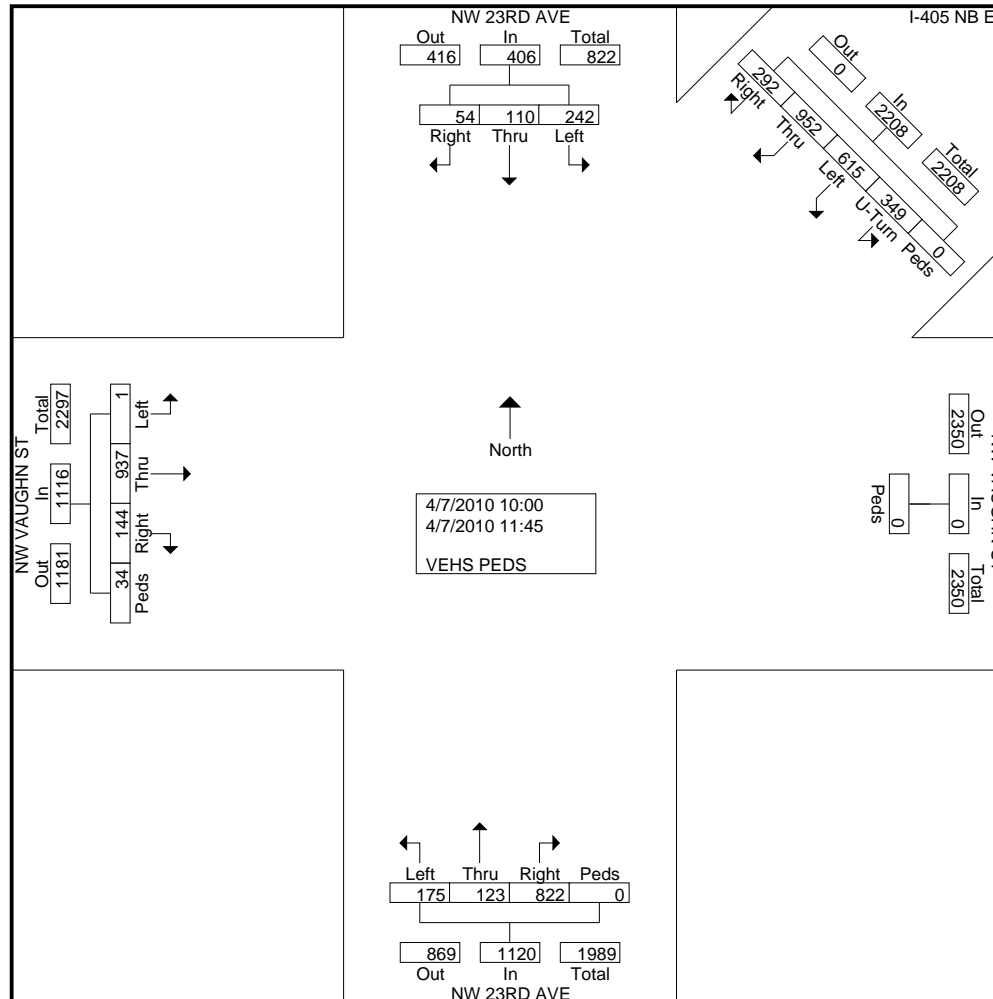
NW 23RD AVE/VAUGHN ST/I405 NB EX

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City of Portland

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NW 23RD AVE/VAUGHN ST/I405 NB EX

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	NW 23RD AVE Southbound				I-405 NB EX Southwestbound						NW VAUGHN ST Westbound		NW 23RD AVE Northbound					NW VAUGHN ST Eastbound					
Start Time	Left	Thru	Right	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 10:00 to 11:45 - Peak 1 of 1																							
Peak Hour for Entire Intersection Begins at 11:00																							
11:00	24	15	10	49	44	88	116	31	0	279	0	0	23	14	102	0	139	0	135	21	3	159	626
11:15	26	19	2	47	39	51	126	47	0	263	0	0	22	17	111	0	150	0	131	17	5	153	613
11:30	32	14	6	52	39	71	120	38	0	268	0	0	31	12	93	0	136	1	115	28	14	158	614
11:45	38	11	7	56	44	96	114	38	0	292	0	0	25	20	114	0	159	0	113	17	0	130	637
Total Volume	120	59	25	204	166	306	476	154	0	1102	0	0	101	63	420	0	584	1	494	83	22	600	2490
% App. Total	58.8	28.9	12.3		15.1	27.8	43.2	14	0		0		17.3	10.8	71.9	0		0.2	82.3	13.8	3.7		
PHF	.789	.776	.625	.911	.943	.797	.944	.819	.000	.943	.000	.000	.815	.788	.921	.000	.918	.250	.915	.741	.393	.943	.977

LOCATION

Location: NW WARDWAY ST E of 29TH AVE / NICOLAI ST

Bound: N **Channels:** 1

Date: From 4/12/2010 10:45:00 AM (MON) to 4/14/2010 12:30:00 PM (WED)

CountID: 10041221.VL1

NOTES

Excpt Type: Obstruction

Conditions:

Comment: **NW 29TH AVE CLOSED N/NICOLAI

Count Loc: NW WARD WAY S/NW NICOLAI ST

SUMMARY DATA

	AM	PM	Daily
Total Volume:	1520	2125	3645
Peak Hour Volume:	269	302	302
Peak Hour Start:	6:45	16:15	16:15
Peak Hour Factor:	0.862	0.878	

INTERVAL DATA

Hour	Min: 00-15	Min: 16-30	Min: 31-45	Min: 45-60	Total
0	4	8	5	4	21
1	2	1	6	4	13
2	5	5	7	3	20
3	4	6	2	3	15
4	6	4	10	15	35
5	16	20	27	38	101
6	40	40	51	68	199
7	55	68	78	65	266
8	52	50	62	56	220
9	54	56	55	38	203
10	55	50	48	52	205
11	45	59	58	60	222
12	58	67	73	69	267
13	84	59	68	61	272
14	67	61	64	60	252
15	61	72	80	64	277
16	68	66	66	86	286
17	84	66	64	59	273
18	46	46	38	40	170
19	41	24	16	26	107
20	19	14	17	23	73
21	16	14	14	18	62
22	15	11	15	12	53
23	10	8	8	7	33

LOCATION

Location: NW NICOLAI ST W of 29TH AVE / WARDWAY ST

Bound: E

Channels: 1

Date: From 4/12/2010 10:30:00 AM (MON) to 4/14/2010 12:30:00 PM (WED)

CountID: 10041222.VL1

NOTES

Excpt Type: Obstruction

Conditions:

Comment: **NW 29TH AVE CLOSED N/NICOLAI

Count Loc: NW NICOLAI ST W/NW WARD WAY

SUMMARY DATA

	AM	PM	Daily
Total Volume:	2745	3105	5850
Peak Hour Volume:	582	526	582
Peak Hour Start:	7:30	16:0	7:30
Peak Hour Factor:	0.887	0.854	

INTERVAL DATA

Hour	Min: 00-15	Min: 16-30	Min: 31-45	Min: 45-60	Total
0	9	9	11	10	39
1	9	5	6	7	27
2	7	6	13	10	36
3	9	23	5	9	46
4	11	12	14	16	53
5	19	32	43	47	141
6	39	58	74	108	279
7	84	109	164	152	509
8	122	144	118	101	485
9	107	83	87	94	371
10	86	67	100	79	332
11	96	102	120	109	427
12	119	98	108	123	448
13	101	107	97	111	416
14	111	85	97	87	380
15	98	99	125	89	411
16	147	120	154	105	526
17	147	96	79	67	389
18	57	54	45	45	201
19	33	38	30	17	118
20	21	25	20	15	81
21	20	8	12	12	52
22	15	14	10	12	51
23	7	11	4	10	32

LOCATION

Location: NW NICOLAI ST E of 29TH AVE / WARDWAY ST

Bound: W

Channels: 1

Date: From 4/12/2010 10:30:00 AM (MON) to 4/14/2010 12:15:00 PM (WED)

CountID: 10041227.VL1

NOTES

Excpt Type: Obstruction

Conditions:

Comment: **NW 29TH AVE CLOSED N/NICOLAI

Count Loc: NW NICOLAI ST E/NW WARD WAY

SUMMARY DATA

	AM	PM	Daily
Total Volume:	1506	1316	2822
Peak Hour Volume:	273	231	273
Peak Hour Start:	7:0	12:45	7:0
Peak Hour Factor:	0.822	0.902	

INTERVAL DATA

Hour	Min: 00-15	Min: 16-30	Min: 31-45	Min: 45-60	Total
0	7	7	3	8	25
1	6	7	12	3	28
2	9	6	4	4	23
3	10	1	7	7	25
4	5	14	12	12	43
5	10	15	21	36	82
6	33	35	60	67	195
7	56	83	56	78	273
8	53	62	54	47	216
9	50	53	52	54	209
10	44	51	47	50	192
11	56	41	57	41	195
12	67	52	41	62	222
13	43	62	64	51	220
14	50	49	52	47	198
15	40	36	54	40	170
16	45	32	38	32	147
17	52	37	34	21	144
18	19	17	9	11	56
19	8	8	11	6	33
20	5	7	12	10	34
21	10	9	9	7	35
22	8	8	8	8	32
23	9	4	7	5	25